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HISTORY OF
THE SECOND WORLD WAR

UNITED KINGDOM MEDICAL SERIES

Editor-in-Chief

SIR ARTHUR S. MACNALTY, K.C.B., M.A., M.D., F.R.C.P., F.R.C.S.

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THE ROYAL AIR FORCE MEDICAL SERVICES

EDITED BY

Squadron Leader S. C. REXFORD-WELCH

M.A., M.R.C.S., L.R.C.P., R.A.F.

VOLUME II

Commands

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FOREWORD

BY THE EDITOR-IN-CHIEF

THIS second volume of the Royal Air Force Medical Services treats of the medical work of the different Commands. All these Commands were the multiple arms of the Royal Air Force, co-ordinated and controlled by central organisation, and further developed and designed for purposes of offence and defence in the War of 1939–45. Each and all of them presented new problems of medical administration, health and disease which demanded the highest medical and scientific knowledge for their prompt solution. In the twelve chapters of this volume Squadron Leader S. C. Rexford-Welch records the details of organisation, describes how the problems arose, and how they were for the most part solved speedily and successfully.

This ceaseless and efficient work of the Medical Services, unspectacular and often not realised by those outside the Services, made a great contribution towards ultimate victory. The men and women serving in the Commands had their health preserved, their welfare maintained, their morale strengthened and their psychological difficulties considered and resolved.

In Chapter I, Bomber Command, the medical organisation and administration is described in greater detail than in the chapters dealing with the other Commands. This is because many of these features are common to all Commands. A certain amount of repetition, in the descriptive accounts, is inevitable, but care has been taken to reduce this to a minimum as far as possible.

It is of interest to note how the exigencies of war in the air propounded fresh problems for the Medical Services. This was the case with all the Commands, and in the course of the narrative there are many instances, three of which may be mentioned here. In Ferry Command, to keep open communications across Africa, the closing of the Mediterranean necessitated fresh services and there were summer and winter routes across the Atlantic. These new departures immediately brought new problems of medical administration and provision in their train. Again, the training of Parachutists in Army Co-operation Command (Chapter 6) involved fresh problems of aviation medicine and surgery. Radar demanded special attention to the vital and important question of the eyesight and conditions of work of radar operators, and called for prompt investigation by ophthalmologists.

The Second World War therefore increased the scope, potentialities and difficulties of aviation medicine. Hence this second volume is a

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further valuable contribution to knowledge of the subjects and reflects the highest credit on the Royal Air Force Medical Services.

This volume of the Official Medical History of the War has been prepared under the direction of an Editorial Board appointed by H.M. Government, but the Editor alone is responsible for the method of presentation of the facts and the opinions expressed.

ARTHUR S. MACNALTY

1954

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ABBREVIATIONS

A.A.F.	Auxiliary Air Force
a/c, A/Cft	Aircraft
A/C.	Air Commodore
A/B.	Air Bomber
A.B.S.D.	Army Blood Supply Depot
A.C.D.	Airmen's Convalescent Depot
A.C.H.	Aircrafthand
A.C.M.B.	Aviation Candidates Medical Board
A.C.M.O.	Assistant Chief Medical Officer
A.C.S.E.A.	Air Command South East Asia
A.C.W.	Aircraftwoman
A.D.G.B.	Air Defence of Great Britain
A.D.R.U.	Aircraft Dispatch and Reception Unit
A.E.A.F.	Allied Expeditionary Air Force
A.H.B.	Air Historical Branch
A.I.	Airborne Interception
A.M.E.S.	Air Ministry Experimental Station
A.M.G.O.T.	Allied Military Government of Occupied Territories
A.O.C.	Air Officer Commanding
A.O.P.	Air Observation Post
A.P.1269	Air Publication. (Medical Officers' Handbook)
A.R.P.	Air Raid Precautions
A.S.R.	Air Sea Rescue
A.T.	Atlantic Transport
A.T.A.	Air Transport Auxiliary
B.E.F.	British Expeditionary Force
B.O.A.C.	British Overseas Airways Corporation
B.P.S.O.	Base Personnel Staff Officer

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B.R.C.S.	British Red Cross Society
B.U.C.O.	Build Up Control Organisation
C	Centigrade
C.A.E.U.	Casualty Air Evacuation Unit
C.C.S.	Casualty Clearing Station
C.G.	Phosgene
C.H.	Chain Home
C.H.E.L.	Chain Home Extra Low
C.H.L.	Chain Home Low
C.I.U.	Central Interpretation Unit
CLK/G.D.	Clerk General Duties
C.M.P.	Civilian Medical Practitioner
C.R.O.	Civilian Repair Organisation. (Aircraft)
C.S.B.	Central Statistical Branch
D.C.O.	Dental Clerk Orderly
D.D.T.	Dichloro-diphenyl-trichlorethane
D.G.M.S.	Director-General of Medical Services
D.I.	Dangerously Ill
Disp.	Dispenser
D.M.S.	Director of Medical Services
D. of P.	Director of Personnel
D.P.M.O.	Deputy Principal Medical Officer
D.P.M.O.(H)	Deputy Principal Medical Officer (Hygiene)
E/A	Enemy Action
E.M.S.	Emergency Medical Services
Eng:	Engineer
E.N.T.	Ear, Nose, and Throat
E.T. Room	Early Treatment Room
F.B.	Flying Boat
F/B.	Fighter/Bomber
F.F.I.	Free From Infection
F.I.D.O.	Fog, Intensive, Dispersal of
F.P.M.O.	Flying Personnel Medical Officer
F.P.R.C.	Flying Personnel Research Committee
Ft.	Feet
F.T.S.	Flying Training School
'Gee'	Code name for an electrical navigation aid
G.C.I.	Ground Control Interception
Gnr:	Gunner

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G.O.C.	General Officer Commanding
G.R.	General Reconnaissance
G.S.	General Service
H.2.5.	Code name for Radar
H.S.L.	High Speed Launch
I.D.O.	Inspecting Dental Officer
I.P.T.M.	Institute of Pathology and Tropical Medicine
I.T.C.	Infantry Training Centre
I.T.W.	Initial Training Wing
JU.88	Junkers 88. German Dive Bomber Aircraft
J.W.O.	Joint War Organisation
L.A.C.	Leading Aircraftman
L.A.C.W.	Leading Aircraftwoman
Lab: Asst:	Laboratory Assistant
M.A.A.F.	Mediterranean Allied Air Force
M.A.P.	Ministry of Aircraft Production
M.B.T.T.	Mobile Blood Transfusion Team (R.A.F.)
M.E.	Middle East
M.E.A.F.	Middle East Air Force
M.F.H.	Mobile Field Hospital
M.I.Room.	Medical Inspection Room
M.P.C.	Ministry of Pensions Circular
M.R.C.	Medical Research Council
M.R.O.	Medical Routine Order
M.S.D.	Medical Stores Depot
M.T.E. & D.	Medical Training Establishment and Depot
M.T.	Mechanical Transport
M.U.	Maintenance Unit
M/U.	Mid upper
N.A.A.F.I.	Navy, Army and Air Force Institutes
N/Ord.	Nursing Orderly
N.C.O.	Non-Commissioned Officer
N.Y.D.N.	Not yet diagnosed (neuropsychiatric ?)
O.A.M.C.U.	Overseas Air Movements Control Unit
O.C.T.U.	Officer Cadet Training Unit
Ops.(Air)	Operations (Air)
Org.	Organisation
O.T.U.	Operational Training Unit

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P.A.C. . .	Prophylactic Ablution Centre
P.D.C. . .	Personnel Dispatch Centre
P.M.O. . .	Principal Medical Officer
P.M.R.A.F.N.S.	Princess Mary's Royal Air Force Nursing Service
P.O.L. . .	Petrol, Oil, Lubricants
P.P.I. . .	Plan Position Indicator
P.R. . .	Photographic Reconnaissance
P.T. . .	Physical Training
P.T.I. . .	Physical Training Instructor
P.T.S. . .	Parachute Training School
Q.A.I.M.N.S. .	Queen Alexandra's Imperial Military Nursing Service
R.A.A.F. . .	Royal Australian Air Force
R.A.E. . .	Royal Aircraft Establishment
R.A.M.C. .	Royal Army Medical Corps
R.A.S.C. . .	Royal Army Service Corps
R.C.A.F. . .	Royal Canadian Air Force
Rad: Asst: .	Radiological Assistant
R.D.F. . .	Radio Direction Finding
R.N. . .	Royal Navy
R.S.S. . .	Radio Servicing Stations
R/T. . .	Radio Telephony
S.A.S. . .	Special Air Service
San: Asst: .	Sanitary Assistant
S.B.A. . .	Sick Berth Attendant
S.E.A.C. . .	South East Asia Command
S.I. . . .	Seriously Ill
S.M.O. . .	Senior Medical Officer
S.P.S.O. .	Senior Personnel Staff Officer
S.S.Q. . .	Station Sick Quarters
S.T.C. . .	Special Treatment Centre
T.A.F. . .	Tactical Air Force
T.A.F.A. .	Territorial and Auxiliary Forces Associations
T/B. . .	Torpedo Bomber
T.C. . .	Transport Command
U.K. . .	United Kingdom
U.S.A.T.C. .	United States Air Transport Command
U.V.L. . .	Ultra Violet Light

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V.A.D.	Voluntary Aid Detachment
V.D.	Venereal Disease
V.I.P.	Very Important Person
V.L.R.	Very Long Range
W.A.A.F.	Women's Auxiliary Air Force
W.M.O.	Woman Medical Officer
W/Op.	Wireless Operator
W.R.N.S.	Women's Royal Naval Service
W.V.S.	Women's Voluntary Services

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PREFACE

THIS Second Volume of the Royal Air Force Medical History contains narratives of the medical effort in R.A.F. Commands and comparable formations. It is divided into twelve chapters, nine treating of the formal home-based commands, and one each devoted to the 2nd Tactical Air Force, No. 60 Group, and the Royal Air Force Regiment.

Certain medical activities were identical in the different formations and it would have been attractive to cover the common features in one narrative, leaving the individual problems neatly differentiated in the rest. But this method, strictly followed, would have resulted in narratives incomplete in themselves, lacking somewhat in interest, and demanding frequent reference for full understanding. Some compromise has been possible and the first narrative—that of Bomber Command—is in some degree the master-narrative. It contains, for example, the story of aviation medicine in its general application. For the most part, however, the risk of repetition has been accepted.

In compiling a history relatively close to the event, and based largely on reports made by men in the stress of more immediate work, there is no sure way of avoiding all error of interpretation or indeed of fact. It is perhaps too much to hope that this volume is blameless. Where possible statements have been checked by comparison with parallel information and the narratives have been tested, and some have been compiled, by officers who held responsible medical posts in various commands and formations during the war.

The volume may be of particular interest to members of the R.A.F. Medical Branch who served in the various formations mentioned. Beyond this there is indication of the variety of responsibility falling to the Medical Branch of a fighting force in war. Instances coming readily to notice are the problems of 'Lack of Moral Fibre' in the Bomber Command narrative, the organisation of blood collection in Technical Training Command, visual problems in No. 60 Group, and certain aspects of Paratroop Training in Army Co-operation Command. The general lesson of the narratives is, I think, that there can be no pre-determined boundary to medical responsibility in war and hence there must be no crippling rigidity of medical thought or organisation.

Many have helped directly and indirectly in the preparation of this volume—too many to mention all by name. Special acknowledgement is, however, due to the following members of the R.A.F. Medical Branch who have given their time and effort most generously: Group Captain O. S. M. Williams—Coastal Command narrative; Air

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Commodore L. M. Corbet—Transport Command narrative; Group Captain C. C. Barker—Ferry Command narrative; Group Captain J. B. S. Gregor—Balloon Command narrative; Group Captain C. Crowley—Maintenance Command narrative; Group Captain J. R. Cellars—Flying Training Command narrative; and Air Commodore A. F. Cook—2nd Tactical Air Force narrative.

This History has been compiled in the Medical Directorate of the Air Ministry, and the Editors were medical officers. They acknowledge with gratitude the work of Miss M. Hart and Miss J. D. Goodwin whose unflagging assistance to the Service Editors has, in so many ways, been invaluable.

The task in the final stages of the compilation of the volume has been greatly eased by the ready help and advice offered by Lieutenant-Colonel C. L. Dunn and Mr. W. Franklin Mellor, of the Editor-in-Chief's staff, whose suggestions and criticisms have been of the utmost value.

S. C. Rexford-Welch

The Medical Directorate,
Air Ministry, London.
1954

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CHAPTER 1

BOMBER COMMAND

THIS chapter is divided into three parts. The first part is mainly informative and describes briefly the creation, organisation, administration and expansion of the Command as a whole from the War of 1914–18 to 1945 to present a background against which the accomplishments of the Command during the war can be summarised. The second part, comprising the bulk of the account, is divided into a medical narrative describing the medical organisation and administration and a medical commentary describing how the system worked in practice. The third section is devoted to the Flying Personnel Medical Officer and Aviation Medicine.

The Medical History of Bomber Command must perforce be based on both administrative and operational considerations. There was the normal work of providing medical care and attention to Command personnel and supervising hygiene and sanitation in R.A.F. stations at home and abroad. But there was also the very important need for the specialist medical supervision of those engaged in operational duties of all kinds in order to ensure the highest efficiency in their performance.

The section on aviation medicine has been written in some detail. It was considered preferable to cover the subject comprehensively in this account to avoid duplication in each command narrative, and to refer, in these other narratives, only to those problems which were peculiar to the commands themselves. (*See* also the Medical Research volume in this series, Chapter 2, 'The Flying Personnel Research Committee', pp. 30–45.)

General Narrative

IT is proposed to give a brief account of the growth of Bomber Command from the end of the First World War up to the beginning of the Second World War, continuing with an account of general events of importance during the period 1939 to V.E-day in 1945. With this background the medical history of Bomber Command during the Second World War will be seen in its true perspective.

The Royal Air Force, in common with the other two Services, passed through lean years after the War of 1914–18, and expansion began only when the international situation became menacing in 1935.

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THE BACKGROUND OF BOMBER COMMAND

THE FIRST WORLD WAR

The Royal Air Force was the most powerful air arm in the world at the end of the First World War, but this position was not maintained. It is interesting to note that by October 1918 the R.A.F. took delivery of three Handley-Page four-engined bombers, the first aircraft capable of attacking Berlin from airfields in East Anglia.

From the air point of view, the War of 1914–18 was predominantly an 'Army Co-operation War'; as a result, bombing in the Royal Air Force started late and never reached maturity. Bombers working with the Army seldom penetrated more than 50 miles behind the enemy's lines; in these circumstances army co-operation bombing was a very inadequate preparation for a 'strategic air offensive'. This short-distance raiding called for no special navigational training or equipment and raised no such problems as meteorological forecasting and high-altitude flying.

So long as air policy and supply were controlled by the War Office and the Admiralty, obstacles seemed likely to remain. The Army had little zeal for bombing outside its immediate forward area. The Admiralty, though eager to bomb Germany, wished to do so chiefly in order to destroy objectives of importance to the Navy, and this limitation of outlook weakened their case against the more urgent demand for the Western Front.

The Zeppelin attacks of 1915–16, followed by the daylight raids by Gotha aircraft in June 1917, enforced a realisation of the fact that aircraft possessed a war potential exceeding the existing concepts of military strategy and tactics. Britain, despite naval supremacy, was shown to possess an Achilles heel in the vulnerability of London to air attacks from across the narrow sea. London, as a capital city, as an administrative and business centre, as a port, and as the home of one-sixth of Britain's civilian population, was of vital strategic importance. Besides, as aeroplanes of greater range were produced, the danger would spread to other ports and the industrial Midlands, upon which the British war machinery very largely depended.

It was envisaged then that a primary use of air power would be to destroy in the homeland of the enemy the industries and communications which nourished all his armed forces. The true offensive weapon of air power would be the long-range bomber, not, as on the Western Front, the short-range fighter. It was considered that bomber forces would require the creation of a separate Air Ministry and Air Staff, for only these could view the air war as a whole and properly handle this new instrument for both defence and offence.

The improvised bomber force which it was possible to organise in 1918 was never in a position to launch a large-scale offensive. This

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force—known in the beginning as the 41st Wing, then as the 8th Brigade, and later as 'The Independent Force'—deserves mention, since its operations from Oches were the best practical experience available to those who later planned the rôle of Bomber Command. The force was small in size and carried a comparatively light bomb-load. Heavy and concentrated attacks were therefore not possible, and even a sustained offensive was difficult to achieve, for machines often set out to bomb the Rhineland only to find the Rhine Valley hidden by mists or clouds, while on many days and nights the weather made it impossible to attempt any air activity at all or only allowed short-range operations.

The British view was that plans to bomb Germany from England should be undertaken with the Independent Force to be based in Norfolk. The home-based force, No. 27 Group, the direct ancestor of Bomber Command, actually began to form in September 1918. It was to be equipped with four-engined Handley-Page V.1500 night bombers, each capable of carrying 250-lb. bombs to Berlin. The machine had passed its trials early enough to make the creation of a home-based bomber striking force a practical project, but too late for theory to be translated into practice.

From the foregoing it will be clear that in the War of 1914–18 the experiment of a methodical, large-scale 'independent' air offensive was never really attempted. The experience of 1914–18 was much too limited to show how in practice bombers, and especially long-range bombers, could best make sure of locating the targets, of hitting them when they had found them, and of destroying them when they had hit them. Even the basic question of tactics was still under debate, and no one could say with certainty to what extent sustained day-raiding would be possible in the face of a determined and properly organised defence system, nor how deeply it could hope to penetrate. Night-raiding tactics were still immature.

ECONOMY AND DISARMAMENT, 1919–33

The home-based 'Independent' bomber force which had been conceived during the last months of the War of 1914–18 was re-born in 1923. During the fifteen peaceful years which followed the Armistice of 1918 comparatively slow progress was made in elucidating those more specialised problems of tactics and technique upon which the teaching of war-time experience was inconclusive, obscure or altogether silent. The slow progress was chiefly due to the policy of economy and disarmament of all the fighting services, which, as late as February 1934, still held out little hope of any early provision of bombers with really adequate range and load. The four-engined Handley-Page aircraft had no successors; instead, in March 1933, the home-defence

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night bomber squadrons were still equipped with Vickers Virginia twin-engined aircraft. It was not until January 1934 that the first Heyfords went into service, and Hendons did not arrive until November 1936.

High-altitude flying and other technical problems which might arise from any marked improvement in the range of anti-aircraft gunfire were just beginning to be faced in 1933. All the manifold physiological, engineering and navigational problems connected with flying at great altitude were still scarcely appreciated. The problem of fatigue had, however, received some attention. Something had been done to make the pilot's work less tiring and less exacting by careful design of the aircraft seats and the position of controls, by the exclusion of draughts and the provision of cockpit heating. High-altitude research proper was virtually non-existent.

THE ORIGIN OF BOMBER COMMAND

Throughout the inter-war period many proposals were made for maintaining or increasing the size of the Royal Air Force, but almost without exception they were shelved or drastically reduced by subsequent amendments made on the grounds of economy. This policy was responsible for the problems of 1935, when it was finally decided that the Royal Air Force should be doubled in size and the existing organisation divided into various functional commands. Every expansion programme proposed after that date was found to be inadequate before it was completed, and fresh proposals had to be brought forward, while those already approved were still far from completion.

German rearmament caused the revision of British defence policy. The home-based bomber striking force which had been created in 1923 was reorganised into a separate Bomber Command in 1936 and detailed plans for its employment in the event of a war with Germany began to be prepared in the summer of 1937. By 1936 reorganisation had taken place throughout the Royal Air Force and the new commands were organised as follows:

Air Ministry

Bomber Command	3 Bomber Groups 1 Auxiliary Group
Fighter Command	1 Fighter Group 1 Army Co-operation Group
Coastal Command	1 Reconnaissance Group 1 Training Group
Training Command	2 Training Groups, including R.A.F. College, Cranwell.

(Reserve Command was not formed until February 1939.)

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The Munich Crisis of September 1938 revealed defects of organisation and administration in Bomber Command. Of these the most striking was the bad effect of over-centralisation of control in Command Headquarters. As a result the delegation of wide powers of operational and administrative control to Group Headquarters was quickly introduced. The Medical Branch shared in the process with the appointment of a Senior Medical Officer to each Group. The value of the step in practice may be judged by its general adoption throughout the R.A.F. shortly before the outbreak of war. Its value might have been even more dramatically demonstrated had not the 'phoney war' period of 1939–40 given time for stabilisation of the general reorganisation.

Other defects revealed and not so easily remedied were shortage of aircrew, especially reserves, and the need for advanced training. The latter led to the institution of the Group Pools, the forerunners of the Operational Training Units, as an intermediate training unit between Flying Training Schools and the operational squadrons.

It can be seen that expansion had begun so late that it had to take place in a great hurry, and that ordered methods proved by time could not be employed. In such circumstances it was inevitable that, until all the necessary armaments, airfields and buildings were provided, conditions would not be of the best. This factor presented the Medical Branch with wide problems of preventive medicine in maintaining the health of the large numbers of men and women who found themselves in the Service and in unaccustomed conditions. Apart from this, preparations had to be made to deal with the many casualties expected from bombing. It was fortunate indeed that a period of inactivity in which to hasten and complete the work, occurred between the declaration of war and the Battles of France and Britain.

BOMBER COMMAND IN THE WAR OVER EUROPE

On the outbreak of war the Royal Air Force possessed no bomber force strong enough to inflict material damage in enemy territory. In theory, the Luftwaffe was to be discouraged from attacking the United Kingdom, not only by those defences which showed their worth in the Battle of Britain, but by the threat of retaliation from our metropolitan striking force. The Royal Air Force, however, had no heavy bombers in the present understanding of the term.

The offensive sorties of the Command were at this time restricted to attacks on elements of the German Fleet. Orders were given for the attack on the German Fleet on the second day of the war; the greatest care was to be taken not to injure the civilian population. Apart from a raid on Sylt, the only targets for the first seven months of the war were the highly defended naval units. Aircraft operating beyond the area of fighter protection, slow and without self-sealing

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petrol tanks, were an easy prey for fighters of the German Air Force. Lessons were quickly learned from these casualties. In the war against Bomber Command's other enemy—the weather—night sorties to drop leaflets over enemy territory brought home parallel lessons in regard to navigation, icing and meteorological difficulties, comfort and welfare. In 1939 and 1940 thirty to eighty bombers on a raid represented a big night force. Meteorological reports were poor and the aircraft flew in the clouds for hours at a time, while the operational height of bombers in the early days did not allow them to break clouds to obtain a star fix. They flew largely by dead reckoning, as few navigational aids were available, and their bases in England were hard to make on the way home. Later, meteorological forecasting improved and forecasts in latitude, longitude and height were given. Losses were heavy in 1940, 1941, 1942 and the beginning of 1943 owing to flak, searchlights and enemy fighters.

While the land war in Western Europe lasted, Bomber Command did its best to harass the enemy; first in Norway*, where there were no suitable airfields, so that every sortie from this country carried maximum petrol but few bombs; then the six weeks' campaign in France and the Low Countries, when the targets for the small number of aircraft available were troop concentrations, transport and oil-storage sites. A typical example is given in Plate I, which shows the concentration of barges in Boulogne Harbour.

The surface raiders *Scharnhorst* and *Gneisenau*, after one victorious sweep of our shipping lines, were immobilised in Brest Harbour from March 1941 to February 1942, and made their spectacular escape up Channel, only to be damaged by mines laid by Coastal Command. The *Gneisenau* spent the rest of the war in dock, but the *Scharnhorst* carried out further sorties until sunk in the North Sea in December 1943. The *Bismarck*, one of the large units of the German Navy, was sunk in 1941, causing further embarrassment to the German Naval Authorities.

On August 25–26, 1940, the first attack was made on Berlin. Lesser towns, mainly in the Ruhr and Rhineland, were visited from time to time by small forces which had no greater effect than to harass the population. In January 1941 the strategic campaign against German synthetic oil plants was chosen as the most profitable programme for the following months, but two factors put an early stop to this far-sighted intention. Experience showed that without scientific aids to navigation, small targets like oil plants were almost impossible to bomb successfully by night, and day bombing had been discarded as too costly. Even targets in populous areas could be missed when

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* *See* Volume III, Chapter 2, Norway 1940.

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darkness or haze baffled aircrews. The other deterrent factor was the intensification of the war at sea, which made necessary a diversion of effort against U-boat bases and centres of Focke-Wulf aircraft activity as a means of relieving our menaced shipping.

The autumn of 1941 proved to be a critical time. The weather was most unfavourable, and there was little bombing until the winter was well advanced. The Germans had begun to counter our night bombers with night fighters, aided by radar-controlled searchlights. Our casualties, both from enemy action and from weather troubles at base, were mounting, and orders had to be given to conserve the force until the spring.

From February 1942 the Command progressed steadily in equipment. Of the new aids, 'Gee'* was the first to be put into use, and gave the navigator a sure means of determining his position at ranges from this country as far distant as the Rhineland. For making deeper penetration, he was thrown on his own resources but had the advantage of accurate position finding on the first and last stages of his flight. Other aids by which targets could be bombed accurately were being developed. As yet the bomber force was not large enough to make an appreciable impact on the enemy, but on May 30, 1942, Bomber Command, by drawing on the resources of its training units, was able to stage a raid of a thousand bombers and destroyed nearly one-third of Cologne in a night with 1,500 tons of bombs. It was an unmistakable demonstration of what could be done, but only at that time by interfering to some extent with training.

Big difficulties persisted. The supply of aircrews never failed, but dilution and operational casualties kept the Command short of experienced crews and, with the development of incendiary bombing, misplaced bombs outside the target area were apt to throw astray the effort of the whole force. The aim now was to swamp the enemy with incendiary bombs and start fires such as had been caused at Lübeck in March. In August 1942 the Pathfinder Force came into being to develop the technique of target-finding and so to lead the main force. In December 1942 another radar aid—'Oboe'*—enabled pathfinders for the first time to overcome the industrial haze which had prevented the accurate bombing of the Ruhr targets, and the following month brought the first use of the navigational aid H.2.S.†

The force was still not big enough. On January 1, 1943, it contained eight squadrons of light bombers for day attacks and for its night bombing two squadrons of Mosquitoes, sixteen squadrons of medium bombers and thirty-six heavy squadrons. The Eighth United States Army Air Force first joined in this offensive against German soil on

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* *See* No. 60 Group, Chapter 11.

† *See* Flying Personnel Medical Officer Section of this Chapter.

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January 27, and it became possible in time to develop an attack which presented complementary phases—the Royal Air Force bombing by night and the United States Army Air Force, with the more powerfully armed bombers and the long-range fighters, by day.

For Bomber Command there began a series of battles in which the industrial targets in Germany were hammered systematically. First came the Battle of the Ruhr, which began at Essen on March 5–6, 1943. The spectacular bombing of the Möhne and Eder Dams by Lancasters of No. 5 Group on May 17 was a vital complement of this struggle. Hamburg was crippled in four nights at the end of July, and after many other main cities had felt the weight of the offensive, the Battle of Berlin was waged in November 1943 and the following months. Many attacks had been made on industrial centres in the last nine months of the year, though it was calculated that the industrial targets were ten times greater than in the preceding three and a half years of the war. Plates II and III illustrate this phase of the operations.

Germany was being forced more and more on to the defensive. Already her air force had lost all semblance of balance between offensive and defensive power. Large numbers of Ju. 88s which could have been used to attack shipping were given a fighter rôle against our night bombers. Anti-aircraft guns and searchlights and the radar equipment to control them were needed in greater numbers. About two million Germans, men and women, were mobilised as members of the armed forces in a purely defensive rôle, or in civil defence. These defences were becoming more powerfully organised, but the initiative always lay with Bomber Command, and every night of operations contained not only battles over enemy territory but battles of wits between Bomber Command Air Staff and the Luftwaffe commanders and controllers. Radar aids and radio counter-measures became an important feature of all operations, and there can be no doubt that they materially reduced the number of casualties sustained by our bomber forces, thereby ensuring continuity of effort in the bomber squadrons.

Early in 1944 preparation for the invasion of Europe began. Bomber Command was employed in attacking some eight important railway centres in Western Germany, Belgium and France. Between March 6, 1944, and the end of June, eighty-one attacks were made by Bomber Command on rail centres, and twenty-one attacks on tunnels and junctions. The standard of accuracy achieved was very high and in two cases a whole railway junction was annihilated in a single attack. There is strong evidence that this dislocation of transport defeated the plans of the enemy to repel the Allied forces by the deployment of his best divisions as reinforcements.

During the campaign in Normandy hundreds of heavy bombers using similar pathfinder technique to that for the attack on targets at

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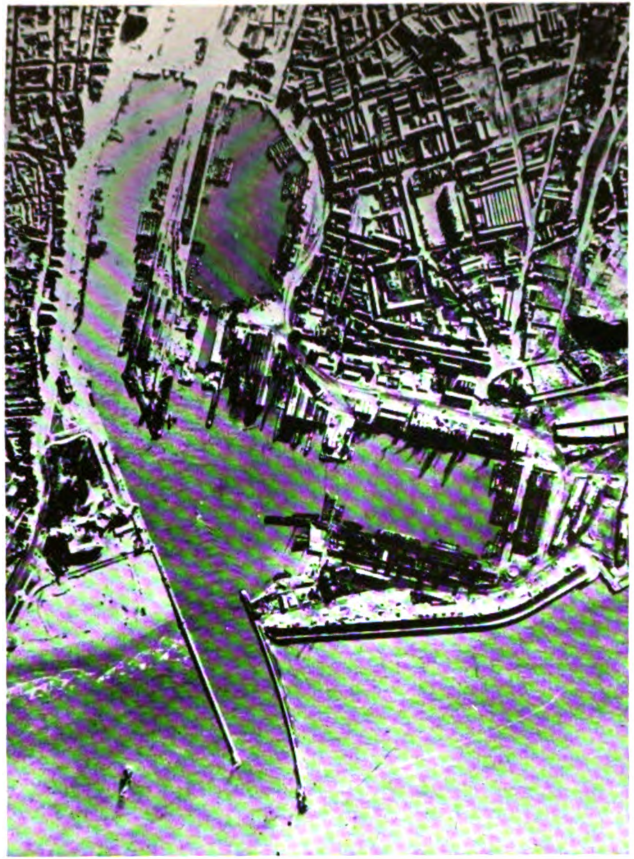

Plate I: A Concentration of German Invasion Barges in Boulogne Harbour, September, 1940

Plate II: Devastation following Heavy Raids by Bomber Command. Frankfurt

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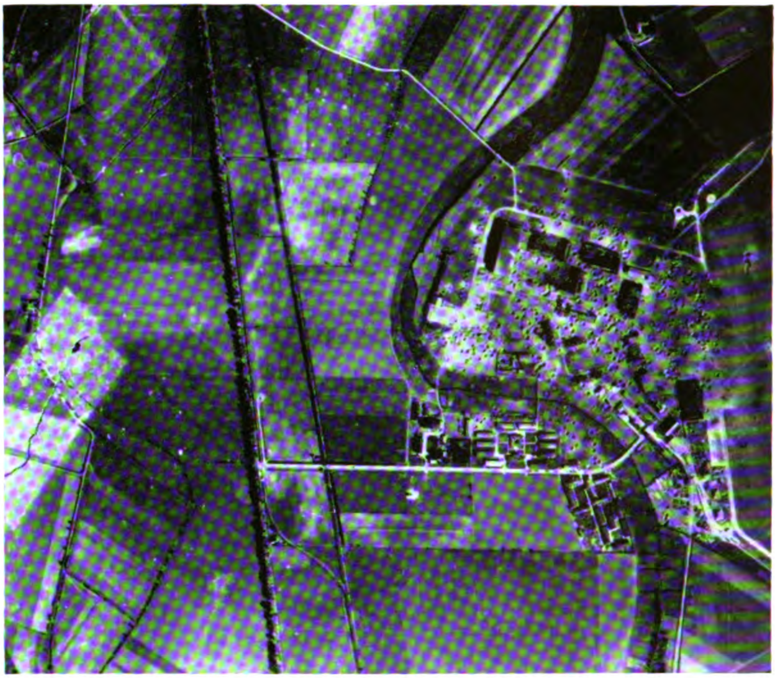

PLATE III: An Example of Precision Bombing on a Small but Vital Target in which the Principle of Target Marking was employed

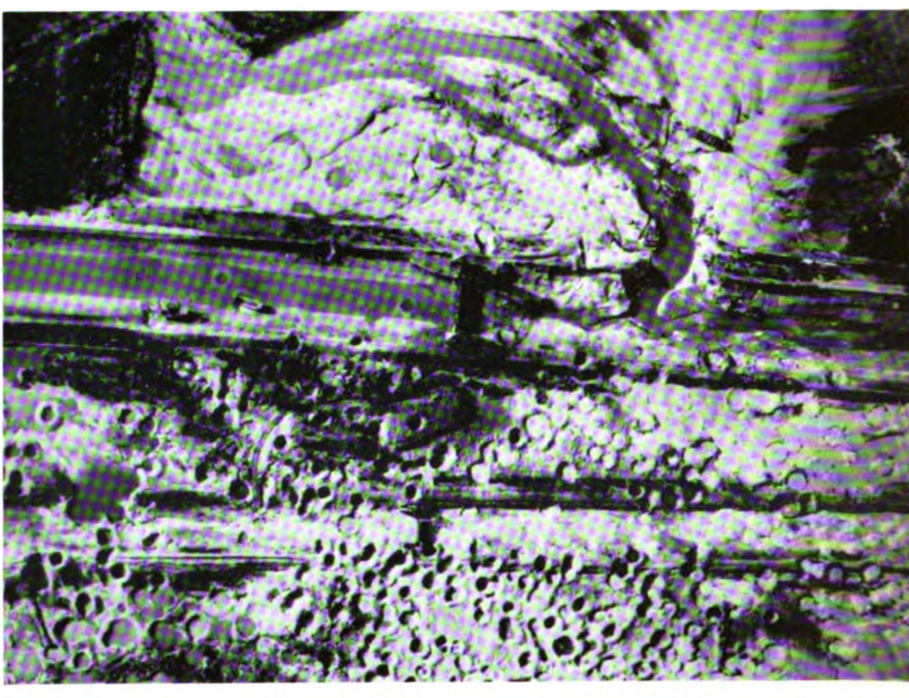

PLATE IV: Breaching the Dortmund–Ems Canal in November 1944. The broken Canal Bank and a Stranded Vessel can be clearly seen

facing p. 9]

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night, gave close support to the troops in the field—at Villers Bochee, round Caen and Bretteville—where the attack was concentrated in a circle of 700 yards radius and wherever the need was felt to open the way for the advance of our armies. In six attacks of this kind 16,000 tons of bombs were dropped. But these Army tasks were comparatively rare, and for a while the bomber force returned to the strategic offensive and, with all the necessary aircraft and equipment, set out to drain Germany of her oil. All through the winter of 1944–5 there was a huge battle between the Allied bomber force on the one hand, and the weather and the superhuman efforts of the Germans to repair their plants and restore their industry on the other. Bomber Command made sixty-three attacks on oil plants, with nearly 100,000 tons of bombs. The result of the combined offensive was that the Germans' output of motor and aviation petrol—some 300,000 tons a month when industry was at its peak—fell to below 60,000 tons by September 1944, and by March 1945 became a mere trickle.

It now fell to the Command to apply the process of destruction to the German transport system—first by dislocating communications during the enemy's Christmas offensive in the Ardennes, then by denying him the freedom to cross the Rhine, and finally by isolating the Ruhr. In the last phase the most important single contribution was the breaching of the Dortmund-Ems Canal, of which the enemy had the use for a few days only between September 24, 1944, and the end of the war. (*See* Plate IV.)

There remained the new threat from the German Navy, both in the pre-fabricated submarine and in the units of the surface fleet that still remained. Bomber Command turned once again to the attack of U-boat construction bases and of naval ports. A specialist force of Lancasters from No. 5 Group sank the battleship *Tirpitz* while still in the refuge of Norwegian waters. The pocket battleships *Lützow* and *Admiral von Scheer* were sunk, and the cruiser *Hipper* damaged.

In the last two months of war, during which the Western and Eastern Fronts were rapidly converging, virtually no industrial areas remained for Bomber Command to attack, the task having been satisfactorily accomplished. Even before hostilities ended, the Command was able to spare many aircraft for the repatriation of Allied prisoners-of-war, liberated by our advance guards. Lancasters brought home nearly 75,000. The same heavy bombers were used to drop more than 6,500 tons of food to relieve the sufferings of the Dutch.

It has not been possible in this short review to write of the expansion of the Command, the huge increase in operational airfields, the supply and equipment of the aircraft, the steady and continuous effort without which its power would have come to an end, the great performance of maintenance tasks, the manning of the chain of command and control,

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nor, most noteworthy of all, the supreme courage of the crews in the air. These are reflected in the figures which sum up the total effort—336,000 operational sorties, in which 955,044 tons of bombs were dropped on the enemy, and 57,424 casualties, killed and missing, were suffered.

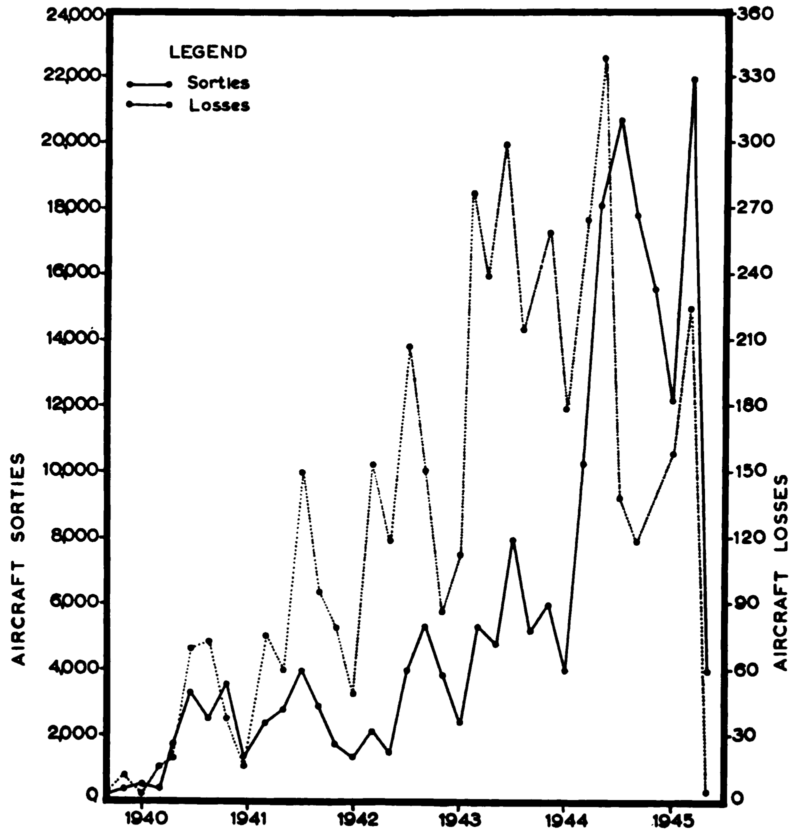

FIG. 1. Graph showing Aircraft Sorties and Aircraft Losses. Period 1940–5.

Fig. 1 shows the monthly figures for aircraft sorties and losses throughout the war. It will be seen that the peak number of sorties—about 21,000—was not reached until near the end of the war in 1945, but that the peak number of losses—about 345—came earlier in 1944.

At Appendices A and B will be found further information concerning the tonnage of bombs dropped and personnel strengths.

BOMBER COMMAND MEDICAL ORGANISATION BEFORE THE WAR

The war-time medical organisation and administration of Bomber Command had been planned mainly during the period between the

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Munich crisis and the outbreak of war. It is convenient to consider the plans in detail under four headings:

(*a*) The expansion and reorganisation during the pre-Munich stage.

(*b*) Mobilisation and its lessons during the Munich phase.

(*c*) Expansion, re-arming and preparation for war during the post-Munich stage.

(*d*) Test of preparedness and the new problems arising during the immediate war stage.

(*a*) THE EXPANSION AND REORGANISATION DURING THE PRE-MUNICH STAGE

During this stage, ground problems of the first expansion scheme to meet the re-arming programme predominated and were constantly changing as succeeding schemes became more ambitious. For these reasons no medical plan to meet an immediate threat of war, or actual war, was in existence and neither a medical organisation nor a medical administrative scheme had been evolved to meet such an eventuality. During this stage and the stages of Munich and post-Munich the medical administration of the Command and the staff medical officers for that purpose were centralised at Command Headquarters; staff visits to stations were shared and had not been allocated on any particular group or geographical basis.

From a study of the war and mobilisation plans by the medical staff in the spring of 1938, and from the experience gained later at station defence exercises, a medical administrative instruction was drawn up dealing with the station passive defence in an emergency. This instruction was issued to all Bomber Command stations, was slightly modified after Munich and, in the years to come, remained more or less the basis of station medical organisation and administration in emergency.

The following precautions were taken:

(i) Improvised gas measures were provided at station sick quarters for handling gas-contaminated wounded, pending completion of the permanent annexes.

(ii) Medical mobilisation instructions were drawn up for immediate issue, in an emergency, to Bomber Command stations, and mobilisation pools were formed at this time under Bomber Command control.

(iii) Shortly before Munich, intensive inoculation measures were taken to ensure that all mobilising squadrons, and as many ground personnel as possible, would be protected in the event of war.

(iv) The policy of providing priority dental treatment for the air-crew of mobilising squadrons was instituted.

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The ground problems in this stage were chiefly those of accommodation and sanitation, imposed by ever-increasing expansion schemes. There was a time of discomfort due to mud, temporary accommodation and other disadvantages which were unavoidable in circumstances where the building programme was always behind the man-power expansion. Nevertheless, conditions were usually borne cheerfully by all concerned without any measurable ill effects upon health and morale.

The flying problems in this stage were due to the introduction of Wellington, Whitley, Hampden and Blenheim aircraft and the air and administrative staffs were tackling the initial troubles of these new machines and the wider problems which their range and speed opened up. The re-equipment raised many important medical matters, mainly because of the differences between the new types and the aircraft then in use, namely Harrows and Battles. The new types required a complete mental adjustment to envisage even some of the new factors involved.

From a medical point of view the practical implication of such things as cold and height, the suitability of physiological aids provided to resist cold and oxygen-lack and the effects of long operational trips (up to eleven hours in the air), were almost unknown. The efficient functioning of the human element in these aircraft had still to be tested, while the fortitude and endurance of which bomber crews were capable had yet to be disclosed.

(*b*) MOBILISATION AND ITS LESSONS DURING THE MUNICH PHASE

At this stage the medical organisation of the Command and the establishment on the Bomber Command stations was on a peace-time footing. New sick quarters and gas annexes, where commenced, were nowhere completed. Where provided, the improvised gas annexes were crude and offered little or no protection against blast or proper facilities for the care of gas-contaminated injured. The station establishment was one medical officer to each station. The number of ambulances in the Command, on a basis of two per station, was about 30 per cent. below establishment. In these circumstances the outlook would have been grave in the event of a major attack combined with gas. When the warning was given that mobilisation was about to commence, the mobilisation instructions referred to above were issued and a check of mobilisation pools was made by a member of the medical staff of Bomber Command.

At this time, the Command Headquarters medical staff was one medical officer below establishment, and of the five officers on the strength, one was absent sick, one awaiting posting abroad, and one,

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the Deputy Principal Medical Officer, who was on war appointment, had no relief nominated.

When mobilisation was ordered the Deputy Principal Medical Officer proceeded to his war station and a temporary relief was not provided until some five days later; only a skeleton staff of three medical officers at Bomber Command was thus left at the beginning of this critical period.

The efficiency of the medical organisation on operational stations suffered from the system which removed medical officers to war appointments, usually outside the Command. Reliefs, who in some cases were due to be found from officers called up on the Reserve, were slow in arrival or did not appear at all. Stations were without medical officers for days and it was necessary to authorise employment of local civilian medical practitioners. The reliefs, where available, had no knowledge of the station or the squadrons. The bad effect on the morale of personnel and the efficiency of the station at a critical and dangerous period can be imagined.

During this period telephone contacts between stations and Command could be made, but contact in the reverse direction was difficult and on a priority basis, thus adding to administrative difficulties.

Many lessons were learned from the Munich phase. To remedy the defects in medical organisation and administration that the Munich crisis had disclosed, a letter was sent to Air Ministry signed by the Air Officer Commanding-in-Chief. The main points of policy in the letter were:

(i) Centralised Bomber Command medical administration was unworkable in war and hence decentralisation to Groups was necessary and might be made the basic organisation during peace-time in preparation for war.

(ii) Operational Commands ought to be kept up to authorised medical establishments, and medical personnel should mobilise with their stations and squadrons and not be moved away during the early phase of the war.

(c) EXPANSION, RE-ARMING AND PREPARATION FOR WAR DURING THE POST-MUNICH STAGE

This stage was characterised by the increasing ground expansion and the equipment of existing squadrons and squadrons in course of formation, with the new aircraft referred to previously, and by the intensified training and preparation for war both in the air and on the ground.

The medical organisation went hand-in-hand with this expansion. In the summer of 1938 a general scheme to decentralise the staffs of all the administrative services of Bomber Command to Groups had

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been submitted by Bomber Command to Air Ministry and had been approved for most of the technical services, but not, so far, for the medical services.

It was decided at Bomber Command to anticipate this approval. As a beginning, members of Bomber Command medical staff were given individual visiting and inspection duties to the stations already formed or being formed in groups on a basis of geographical proximity, with a view to acquainting each senior medical officer with the general administration of a group and with the local needs of his particular group, should decentralisation of the medical services of the Command become necessary.

In the spring of 1939 the Air Officer Commanding-in-Chief decided that in the event of an emergency the Command medical staff should be decentralised to the fullest extent permitted by the peace-time establishments. This decision was incorporated in Command War Orders and implemented by an Administrative Staff Order appointing, by name, Senior Medical Officers-designate, of named Groups. The text of this Administrative Staff Instruction is given in Appendix C. It was framed in the spring of 1939 as the basis of a group medical organisation and remained so when, in accordance with Bomber Command War Orders, decentralisation took place on August 24, 1939.

(*d*) TEST OF PREPAREDNESS AND THE NEW PROBLEMS ARISING DURING THE IMMEDIATE WAR STAGE

During this time the medical requirements of stations continued to be kept under the constant review required by the expansion of personnel, buildings, re-arming and the preparation for war. New sick quarters and a few new sick annexes were being completed. Defects in and suggestions for improving these were being investigated and reported on, and their best use and the required equipment were kept under consideration. Through station passive defence exercises, opportunity was afforded for practical tests of these new buildings and of the station organisation required in an emergency. By such means it was possible during this period to build up a station medical organisation based on Command Administrative Instructions for Stations, referred to above, that would be adequate, within the limits of the available resources, to meet not only the emergency which arose on September 3, 1939, but also the expansion programmes on the stations.

The keenness and ingenuity of the station medical officers during this period was remarkable, and many of their sound ideas were adopted and utilised to the benefit of the common interest and aim. A few examples are quoted. The Pemberton Billing wheel stretcher carrier officially issued to stations was, until modified later, unsuitable, and accordingly wheel stretchers of a more suitable type of some five

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different patterns were made locally throughout the Command's operational stations. The General Service stretchers were thought unsuitable for use in concentrated gas attacks because of the difficulty of decontaminating them. The excellent type of A.R.P. metal stretcher did not fit the Service ambulance stretcher racks, and to meet this need large numbers of simple metal stretchers of different types were made under local initiative.

The practical experience gained on station exercises showed that the scale of barrack equipment for sick annexes laid down was inadequate for the increase in station personnel and for the greater flow of casualties with which these annexes might have to deal. Emergency reserves of expendable medical stores were issued to all sick quarters on a scale submitted to, and approved by, the Air Ministry. Approval was also obtained for an initial issue of morphine solution to station sick quarters to supplement morphine tablets, as the latter were inconvenient for emergency use*. Emergency accommodation was earmarked on all stations and partially equipped and used as a dispersal store for reserves of sick quarters' equipment. In 1940, following an enemy bombing attack on the Royal Air Force bomber station at Driffield, the suggestion was made by that station through the Senior Medical Officer of No. 4 Group that 'electric headlamps' should be issued for the use of surgical staff attending wounded in the sick annexes. The issue of two of these to sick quarters was approved by the Air Ministry and this issue, together with other items to increase barrack equipment, subsequently became general to all stations in the United Kingdom.

First-aid parties throughout the Command were trained in the collection and decontamination of wounded, and lectures and instructions were given to flying personnel in the use of the first-aid equipment provided in aircraft.

The re-arming programme gave rise to flying problems, and this demanded from medical officers an ever-increasing interest in flying personnel and a study of the strain to which they were likely to be exposed. To gain interest and experience it was necessary for medical officers to seek and be given every facility. The co-operation of group commanders was enlisted and eventually Group Orders were issued which brought the station medical officers directly into touch with the training and operational problems of squadrons and ensured that they were given every opportunity for obtaining experience of flying conditions, and practical experience of personnel both on the ground and in the air. A personal letter on the subject was addressed to all medical officers on stations and to newly recruited medical officers on posting. This letter is reproduced in Appendix D.

* The tubunic morphine ampoule syringe was not at this period a standard issue.

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It is not unreasonable to suggest that this co-operation between flying personnel and medical officers was largely responsible for the status a medical officer enjoyed in Bomber Command from then onwards, and this was reflected in an increasing degree during the war period by the desire of group and station commanders to retain suitable medical officers, and by their insistence on replacement of the few inevitable misfits.

Much study was given to the treatment of casualties in, and their removal from, aircraft, and methods were under constant trial. The results of these investigations were consolidated in a Command Medical Memorandum (Appendix E) issued to all stations, and finally circulated to other Commands in December 1939. It should be recorded that the hoist method for the removal of casualties advocated in the Memorandum was first made generally practicable at R.A.F. Station, Wyton, where a simple attachment was designed and made for connecting the flying harness of a casualty in an aircraft to the hook of a mobile crane or of a hangar gantling, and was first used there for removing casualties from Blenheim aircraft. This principle was extended and used at R.A.F. Station, Scampton, on Hampden aircraft where the harness attachment was simplified and used in conjunction with a light, collapsible crane also locally designed and made, which was permanently housed on the roof of the ambulance. Reports of these methods and photographs of them in use were forwarded to the Air Ministry, who in 1940 authorised the manufacture of twenty-five of these ambulance cranes, sufficient to equip one ambulance on each station where there were aircraft on which this crane could be used.*

The feeding of crews on long operational flights was another important matter investigated. The opinions of executive officers with great experience of long-distance flying were sought. A suitable dietary sufficiently flexible and varied to cater for different tastes was designed and submitted to the Air Ministry for approval. Authority for a special monetary allowance to purchase items not included in the messing rations issued in kind was asked for, and an allowance of 1s. per crew member was at last approved in 1940, to be later raised to 1s. 6d. At this time the effect on food of the intense cold later experienced by crews was not appreciated. It was found in practice that perishable articles like sandwiches, oranges and bananas, included in the choice of flying rations, became uneatable on exposure to such cold. Hot drinks of tea, coffee or Bovril, etc., biscuits, sweets and chocolate, and dried or preserved fruits, became, later on, the established choice for consumption on long flights. An additional issue of tea and sugar to supplement the

* It should be recorded that the top hamper so caused affected the handling of ambulances considerably and that this method was only suitable for heavy ambulances such as the Albion.

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normal rations was authorised in 1940 for use by crews, when the Service ration of tea was rightly reduced to that allotted to civilians.

Oxygen was another important problem during this period. The Air Officer Commanding-in-Chief was continually emphasising the importance of the use of oxygen by aircrews and issued a Command Medical Memorandum to all stations, instructing that oxygen was always to be used at altitudes of and above 15,000 ft. and in certain circumstances at 10,000 ft. There existed a lack of appreciation of oxygen among flying personnel, either due to the fact that the majority of pilots in the War of 1914–18 had little experience of its use and little appreciation of the disastrous effects of oxygen lack, or because the inter-war generation had little or no experience of such matters, for the reason that the older type of bomber aircraft could not operate at heights where the use of oxygen was essential.

With the newer types of aircraft the position was completely changed. It was essential for bomber crews to be made oxygen-conscious, by practising the handling and wearing of oxygen apparatus, and these matters had to be made an integral part of operational training. In this connexion the medical officer at Upwood personally carried out a series of practical tests of short duration on Harrow aircraft at the then maximum obtainable height of 18,000 ft. His work was helpful and stimulating to aircrew interest in this subject but only proved what was already known and published.

The Air Ministry Flying Personnel Research Committee was formed in 1939 and Bomber Command was asked by the Director-General of Medical Services for a list of problems within the terms of reference of the Committee for research and investigation. This list was supplied.

The foregoing narrative outlines the history of Bomber Command from 1918 onwards and traces the development of mass strategic bombing to its peak in the later war years; it also gives a brief account of the medical organisation of the Command from 1938 to the outbreak of war. Without this survey the conditions described in the following sections would not be seen in their true perspective.

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APPENDIX A

Bomber Command Sorties—Tonnage of Bombs Dropped—Mines Laid and Aircraft Missing—Yearly from the Start of the War.

	All operations				Over Germany only		
Year	Aircraft despatched	Aircraft missing	Tons dropped	Mines laid	Aircraft despatched	Aircraft missing	Tons dropped
1939 .	591	38	31	—	—	—	6
1940 .	22,473	475	13,033	762	11,071	215	7,022
1941 .	32,012	923	31,704	1,055	20,897	662	22,996
1942 .	35,358	1,450	45,561	9,574	22,922	1,121	37,197
1943 .	65,068	2,391	157,457	13,834	48,312	2,086	136,433
1944 .	166,844	2,770	525,518	17,500	78,083	1,831	275,559
1945 .	67,483	608	181,740	4,582	54,034	525	178,461
Aggregate	389,829	8,655	955,044	47,307	235,319	6,440	657,674

APPENDIX B

Bomber Command—Personnel Strengths for 1939–45

	R.A.F.		W.A.A.F.		Dominion		
Date	Officers	Airmen	Officers	Air-women	Officers	Airmen	Totals
Sept. 3, 1939	1,100*	13,000*	30*	150*	(not available)		14,280*
Jan. 1, 1940 .	1,811	18,918	45*	700*	,,	,,	21,474*
July 1, 1940 .	2,204	34,502	99	1,195	,,	,,	38,000
Jan. 1, 1941 .	3,472	54,929	192	2,434	,,	,,	61,027
July 1, 1941 .	4,174	77,578	255	4,643	277	1,481	88,408
Jan. 1, 1942 .	5,467	109,054	566	11,082	766	3,707	130,642
July 1, 1942 .	6,264	109,530	740	17,279	921	4,911	139,645
Jan. 1, 1943 .	7,596	122,047	900	22,166	1,368	7,409	161,486
July 1, 1943 .	9,781	132,371	978	31,856	3,083	14,425	192,494
Jan. 1, 1944 .	13,091	137,161	1,082	33,633	5,257	18,863	209,087
July 1, 1944 .	15,859	143,505	1,069	35,321	7,699	22,841	226,294
Jan. 1, 1945 .	16,342	136,919	1,063	37,255	8,442	20,703	220,724
July 1, 1945 .	17,809	123,260	1,006	33,431	8,503	18,567	202,576

* Approximate figures.

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APPENDIX C

REORGANISATION OF THE ADMINISTRATIVE STAFF AND SERVICES

BOMBER COMMAND MEDICAL STAFF INSTRUCTION, SERIAL NO. 1

In accordance with Bomber Command Headquarters letter BC/S.22058/ Org. dated July 7, 1939, paragraphs 3 and 4, and letter of same reference dated July 21, 1939, paragraph 3, the duties of the medical services at Group Headquarters are laid down as follows:

2. The Medical Officer designate will organise, in peace, the medical resources within the Group to a state of war preparedness, and implement and anticipate in every way possible the intentions and purpose of Bomber Command War Orders Part VIII, Administration, paragraphs 17 and 18.

3. He will be directly responsible for the following duties:

(*a*) The correct interpretation and application of Command Medical Instructions, and of general medical policy within the Group.

(*b*) Supervision of the training of medical personnel in the medical organisation of stations and in those duties required in an emergency.

(*c*) The organisation of all medical resources within the Group for the purpose of mutual assistance between stations in the vicinity.

(*d*) Supervision of the maintenance and serviceability of war medical equipment and stores.

(*e*) Liaison with local civil hospital institutions and local civil Medical War Organisations, and co-ordination of the medical service with that of the Civil Emergency Medical Services of the locality.

(*f*) A knowledge of the medical war establishments and scales of medical equipment of the stations, squadrons and other formations in the Group e.g., satellite and rearward aerodromes.

4. His ultimate duty and aim is to organise from the resources at his disposal an effective medical service adapted to local conditions in war, and to keep such records as may be necessary to ensure that the local medical organisation, for the administration of which he becomes responsible on mobilisation, is immediately operative in an emergency, or on change of appointment at any time.

APPENDIX D

MEDICAL SUPERVISION OF FLYING PERSONNEL

LETTER FROM PRINCIPAL MEDICAL OFFICER, BOMBER COMMAND

I have made this letter to you and all Station Medical Officers in Bomber Command a personal one rather than deal with the subject in the form of a general memorandum of instruction. My reason for doing so is that the subject is one which intimately concerns the personal relationship between you as a Station Medical Officer and flying personnel, and I only wish to try and emphasise certain practical hints on matters which are, as you know, admirably dealt with in Chapter IV of Air Publication 1269 and elsewhere.

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Neither you nor squadron flying personnel have any actual experience of war and I can believe that station Medical Officers may not realise that the effects of physical and psychological stresses of flying and operational training are very similar to and vary only in degree with the effects of the stresses of war; I think it is most important that this should be realised and accepted as a guiding principle, and I have two main reasons for thinking so—*Firstly*. If this point is not realised, Medical Officers may not look for the symptoms and effects of those everyday fatigues and stresses which occur in peace and which, because they seldom become cumulatively disabling, are therefore likely to pass unnoticed or undetected. *Secondly*. In war the effects of these same stresses are cumulative, and when they reach a certain degree they become disabling. The last war proved that nearly every case which was allowed to continue at duty until physiologically and psychologically disabled required many months *curative rest* before efficiency was restored; and it proved that early detection of the symptoms of commencing inefficiency followed by a short period of *preventive rest* restored the normal level of efficiency.

For these reasons an unobtrusive study of the fatigue and stress of flying personnel in peace is all-important, for without this fundamental knowledge and experience of flying personnel a Medical Officer cannot, in war, carry out his primary duty of keeping the officers and men under his care fit for maximum duty by preventive measures and advice.

To a very great extent this knowledge of flying personnel can only be gained by personal experience, and I think it is a Station Medical Officer's first duty to gain that experience in peace by interests in, and contacts with, flying personnel both on the ground and in the air. Medical examinations, as such, will not assist you much in a study of flying stress, because, in peace, very few who have been accepted by Central Medical Establishment for flying duty fall below the standard efficiency tests compared with the numbers found to do so in war: you will therefore have little opportunity of proving for yourself in peace the value of efficiency tests which were proved so valuable in war in detecting and confirming those suspected of approaching inefficiency.

The knowledge of flying personnel which we can gain in peace has another and equally important aspect, and that is the study of those factors in the environment which tend to accelerate the onset of flying stress and fatigue (such things as physical discomfort, cold, carbon monoxide poisoning, oxygen want and noise). The physiological effect of such things may not always be immediately obvious and it is in this field of observation that the advice of a Station Medical Officer can be of value—not only in the detection but in the prevention of the stresses and discomforts they cause. A knowledge of the physiological aspects of Oxygen and of Mechanical Forces given at paragraphs 576 and 577, Air Publication 1269 is essential to understanding some of these problems, but it is chiefly by experiencing variations of these conditions in flight and their effect on oneself that a Medical Officer can really learn to appreciate the part they play in the production of fatigue and stress in aircrews. Only by personal experience can he judge the effects of noise and discomfort and distinguish between natural tiredness and accelerated fatigue.

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The comradeships of war are formed in an atmosphere of discomfort and hardship. I believe it is part of the duty of a Medical Officer to share and experience, in peace, some of the discomfort and stress of flying personnel so that he may increase both his understanding of flying conditions and the confidence of personnel who at some time may require his aid and advice. There is little new in these views to Medical Officers who have qualified as pilots (there are five in the Command) but it is hoped that they may be helpful to the more junior officers who may not yet have had the experience or opportunity to realise their importance.

APPENDIX E

HANDLING OF CASUALTIES IN FLIGHT AND THEIR REMOVAL FROM AIRCRAFT ON THE GROUND

1. ATTENTION TO WOUNDED IN THE AIR

Cold conditions, flying clothing and harness and limited fuselage space render the giving of any effective first aid to wounded during flight a matter of extreme difficulty.

The less, in general, a wounded man is disturbed, until skilled assistance can be given, the better it will be for the wounded man. When, however, it is necessary to replace or move a casualty he should be placed, if possible, in a position which will permit him to assume instinctively the attitude he finds to be most comfortable, after which he should be disturbed as little as possible.

In cold conditions and if the height necessitates, he should be given oxygen which will, in any case, help to maintain body warmth; additional warmth can be provided in the form of blankets and hot bags, if available.

Morphia should be given if pain is great.

The dressing of wounds is best restricted to exposed parts of the body; wounds received in the air will be relatively clean compared to those sustained in ground action, and more general harm than any particular good may be done by attempting to undress a casualty in order to expose and dress a wound; flying clothing and flying boots in addition to providing warmth will act as a general cushion and will help to support and prevent movements of fracture of the extremities should these have occurred.

Unless the casualty is known to have been wounded in the abdominal region, he may be given small quantities of fluids to relieve thirst.

2. REMOVAL OF CASUALTIES FROM AIRCRAFT

The aim should always be to avoid any movement which would increase the severity of an existing injury or condition, and to avoid inflicting avoidable suffering. There are three methods available:

(*a*) Man-handling
(*b*) Neil-Robertson Stretcher
(*c*) Hoist.

The choice of these methods must, whenever possible, depend on the two principles stated above.

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(*a*) *Man-handling*. This should only be resorted to if the type of aircraft and the position of the casualty in the aircraft justifies excluding either of the other two methods.

(*b*) *Neil-Robertson Stretcher*. The use of this stretcher although invaluable in certain selected cases, is limited; as it is necessary to man-handle a casualty inside the aircraft when using this type of stretcher, the relative superiority of this appliance must be weighed against the method of hoist whenever this alternative is possible.

(*c*) *Hoist*. This is undoubtedly the method of choice whenever the position of the casualty and the provision of suitable hatches in the aircraft permit. This method reduces man-handling to a minimum. It minimises unnecessary infliction of pain and the risks of causing further injury: it has the advantage also that it is more generally applicable with existing types of aircraft than either of the two previous methods. It is the least distressing to the patient; calls for no effort on his part, is comfortable and safe and instils confidence; it has definite advantages over the use of the Neil-Robertson stretcher as it avoids the man-handling which is always necessary to get a casualty into that type of stretcher.

Medical Organisation during the War

GENERAL DESCRIPTION OF BOMBER COMMAND STATIONS

PRE-WAR PERMANENT STATIONS

The strength of a pre-war permanent bomber station was approximately 600 at the outbreak of war. By the end of 1939 this had increased to about 1,700 personnel until in 1941 the average station strength was 2,000 to 2,500, and this was maintained during the remaining years of the war.

These pre-war stations built or in course of construction at the beginning of the war presented few problems of a hygienic nature. They were compactly built and of solid brick design and possessed the amenities and equipment of a model village. Provision was made for a water carriage system with everything to a satisfactory scale, and sewage plants were adequate and modern. Drainage and sewage could safely be regarded as capable of dealing with a 30–50 per cent. increase, subject to proper maintenance and supervision. The removal of refuse was on orthodox lines, similar to those of any civilian community, and extensions to these services were possible.

Accommodation consisted of well-built brick buildings, officers' mess and living quarters, sergeants' mess and barrack blocks, airmen's barrack blocks, officers' married quarters, N.C.Os'. married quarters and airmen's married quarters. The messes and barrack blocks were centrally heated while all types of married quarters were heated by modern kitchen boilers and coal fires. The messes were large, airy

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well-ventilated buildings, fitted with modern labour-saving cooking apparatus and adequate drainage systems. All ancillary mess rooms for food storage and the preparation of vegetables were adequate, and combined modern hygienic trends in respect of cleaning and drainage, fly-proofing and healthy staff working conditions.

The working conditions for personnel were similar to those obtaining in the best factories. The hangars for the repair of aircraft were large well-built modern buildings with adequate washing and latrine facilities and fully equipped with appropriate safety devices. The navigational, mechanical transport, engineering, equipment, armament, signals, photographic, operations and headquarters sections were accommodated in modern buildings with adequate space for comfortable and efficient working.

The airfields consisted generally of three runways of different lengths, approximately 1,400 yds., 1,500 yds. and 2,000 yds., intersecting in the form of a triangle. The ends of the runways were connected by a broad, well-made perimeter track, off which there were ten to fifteen dispersal points, where aircraft were dispersed and in suitable weather minor repairs not requiring a hangar could be carried out. At each dispersal one or two huts were placed for the convenience of guards and personnel working there. Each hangar, on the side facing the airfield, had a series of rooms extending along its length. Here squadron headquarters and aircrew rest and instructional rooms were placed. Here also were the lockers, and drying and dressing rooms for aircrew. The hangars were centrally heated.

The medical facilities on these stations consisted of a single- or double-storied sick quarters, which was centrally heated. Bed accommodation was as follows:

	R.A.F.	W.A.A.F.
Stations with 2 storey permanent construction	25	Nil
Stations with 1 storey permanent construction	10	Nil

These buildings were divided into large and airy wards and offices, and were provided with every facility. There was a well-built kitchen with cupboards, larder, cooking equipment and adequate fly-proofing arrangements. There were two well-fitted dental surgeries, two consulting rooms and a well-stocked dispensary. The isolation wards were comfortable and suitable for the isolation or observation of infectious cases, while the crash theatre was fully equipped for attending to the severest surgical emergencies arising from crashes. Leading off from the sick quarters was the decontamination centre to deal with gas casualties. This was so fitted that it contained another crash theatre. The centre was air-conditioned, had air locks, and was, in most cases, completely protected from blast by earth mounds.

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Accommodation for recreation and sport had been incorporated in the station design and was built as a part of the station. Rugger, soccer and hockey pitches were laid out. The officers, N.C.Os. and airmen had their own all-weather tennis courts, while facilities were provided for squash and badminton. Depending on the situation of the station, other local amenities were available. At Wyton, for example, swimming at a nearby pool and boating with the Huntingdon Boat Club was possible. Many stations had gymnasia which further increased sport facilities. The N.A.A.F.I. Institute had social and recreational facilities, and every station managed to have its own cinema and stage, where shows were given frequently, either concerts, films or variety entertainments.

The hangars, workshops, technical buildings, administrative buildings, barrack blocks, messes, recreation rooms, N.A.A.F.I. Institute and station sick quarters were placed near one another on one side of the airfield and were all within easy walking distance of each other along good roads lined with trees. Grass plots between and around buildings were well laid out with flowers and shrubs.

WAR-TIME STATIONS

(*a*) *Non-dispersed.* A few war-time stations had little or no dispersal, but the majority were built on the dispersed plan. The war-time non-dispersed station was in essential a replica of the peace-time bomber station, except that the various buildings were of cheaper material and poorer design to meet the expansion of the Command. Accommodation consisted of separate groups of hutments for officers, N.C.Os. and airmen. The respective messes were situated near the sleeping huts and no sleeping accommodation was provided in the messes. There were no married quarters for officers, N.C.Os. or airmen. The messes were built one brick thick and concreted on the outside, and heating was provided by slow combustion coke stoves. These messes were adequate, but all the fittings were of war-time quality, and drainage and ancillary equipment were often inadequate. Ablution facilities were centralised in a few buildings on each living area.

The working conditions for personnel were not so good as in peace-time stations. The hangars were large and built of one brick thickness and corrugated iron, with adequate washing and latrine facilities. The various technical sections previously mentioned were accommodated in hutted or one-brick-thick single-storey buildings. They were all stove-heated.

The airfield consisted of the three runways and perimeter track, arranged as previously described. The squadron headquarters, aircrew rest and instructional rooms were not part of the hangar but were placed near it in their own area.

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The sick quarters on these stations consisted of buildings one brick thick, concreted outside, with the same facilities as the peace-time stations described, but the fittings and finish were of poorer quality. On this type of war-time station there was central heating in the main buildings. The Gas Decontamination Centre was not always connected with the sick quarters, and although blast-proof was not so stout in construction as in the peace-time station.

Facilities for recreation and sport had not been incorporated in the station design to the same extent. Usually there was a squash court and gymnasium, but field sports depended on local enthusiasm, and hiring or utilising neighbouring fields for rugger, soccer and hockey. There was no sports pavilion as on peace-time stations. There were no tennis courts, unless the station laid out its own or arranged for the use of local courts if available. The N.A.A.F.I. Institute was not so elaborate as those previously described, but the stations managed from their own resources to have a cinema and stage for concerts, films and variety shows.

The various buildings and living sites were not quite so compactly placed as on a peace-time station. There was a dearth of roads, and muddy paths took the place of the many good roads of the peace-time station. The presence of trees, shrubs and flowers depended on the enthusiasm of the section and more often than not none were planted.

(*b*) *Dispersed.* The policy of dispersal was decided upon in 1940, and its chief purpose was to protect life and material against enemy attacks from the air. This policy affected the layout of war-time stations, the intention being that a dispersed station should consist of a number of separate sites so situated that an attack on one of them would not endanger another.

The communal site was at some distance from the technical site and airfield, and consisted of the airmen's cookhouse, the N.A.A.F.I. Institute, concert hall, gymnasium and church, ablutions, and in some cases the officers' and sergeants' messes. The technical site was in convenient proximity to the airfield and consisted of headquarters buildings, squadron and flight offices, workshops, mechanical transport yard, hangars and ancillary buildings. The dormitory site was away from both technical and communal sites, and the huts providing sleeping accommodation were themselves apart from one another.

Two features modified the degree of dispersal on any station: first, the presence of existing buildings, or buildings under construction, and second, the likelihood of enemy air attack on that particular station. The Royal Air Force Bomber Command peace-time stations, such as Watton, Wyton, Scampton and Coningsby, to mention only a few, were hardly affected at all. Royal Air Force Station, Pershore, a war-time operational training unit in No. 91 Group, was likewise not

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built to the full dispersed plans, because plans for the station were completed and most station buildings were being used before the full development of the policy of dispersal. There were other stations where building had been in progress for some time, and at such stations it was only possible to modify the plans, having regard to local conditions and construction already completed.

The fully dispersed type of station came into use from 1942 onwards. The main effects of dispersal on the layout of a bomber station were that, firstly, the distances between the sites were great, in some cases up to three or four miles; secondly, water could not be supplied to all sites because of the distances between them; thirdly, nearly all the ordinary requirements of life, other than a place to sleep, had to be provided at the central communal site; fourthly, inspection and movement of materials required transport and the areas administered by stations were greatly increased.

When materials were plentiful the buildings on the communal and technical sites consisted of buildings one brick thick concreted outside and heated by coke stoves. The dormitory sites comprised prefabricated huts such as the Thorne, Nissen and Laing and were heated by stoves. The ablutions were centralised in the communal site at first until such facilities on the sites were authorised. The sites were not initially on main drainage and were occupied in that state with the result that bucket latrines had to be set up; later in 1942 these sites, wherever possible, were put on main drainage. When material became in short supply, stations coming into use in 1943 and onwards were composed of buildings in all sites made up of prefabricated huts. The prefabricated huts and buildings were easily erected and adapted or altered to suit changing circumstances, and this was of advantage* to designers and contractors in meeting the large expansion programme of Bomber Command.

The earlier sick quarters were built of one brick construction, and like the rest of the station were dispersed. The layout was the same as previously described, and it had central heating. With the change-over to Nissen construction the sick quarters of the dispersed all-Nissen type and containing all the facilities mentioned were combined for airmen and airwomen. Apart from the crash theatre and the two dental surgeries, which were electrically heated, the building, including kitchen, consulting room, offices, wards and isolation wards was usually heated by slow-combustion stoves.

Although the layout, within limits, was essentially the same in all three types of station, there was considerable dissimilarity in the final

* It was noted, however, that huts when re-erected after dismantling showed signs of damage and moves increased their deterioration rate.

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quality of buildings and facilities. Peace-time stations consisted of substantial buildings of brick situated near one another and built when there had been time and material for refinements, which could not be afforded in war-time owing to the ever-increasing expansion of the Command. All amenities on the dispersed stations were inferior to those enjoyed on peace-time stations. For example, the concrete paths and roads were too narrow and were made of inferior concrete, with the result that they were constantly being repaired and were always muddy, owing to vehicles taking to the grass at the sides of the road to pass each other. The ground between the concrete paths on the dispersed sites became a sea of mud in wet weather, and this mud was carried into all the buildings in the camp. The consequences of dispersal were far-reaching in as much as they affected either directly or indirectly every aspect of life on the camps.

ACCOMMODATION

At the outbreak of war, stations were rapidly filled to overflowing with new recruits. As an instance, at R.A.F. Station, Watton, the population rose from about 600 peace-time personnel to about 1,700 by the end of 1939, and the figures continued to increase until in 1941 the average station strength was about 2,500. At Wyton, owing to the influx of large numbers of officers, airmen and soldiers, all available new buildings, as well as the old hutted camp, were occupied. The old hutted camp had to be used until further new buildings were ready in the spring of 1940. Nearly all the facilities at stations were overtaxed, and there was in particular a lack of accommodation, which meant that squadrons did not enjoy the amenities of a complete station, while station personnel were also overcrowded. At peace-time stations officers were accommodated in the brick-built centrally-heated officers' mess and in the vacated married officers' quarters heated by coal fires. At Wyton, the huts which were occupied were heated by stoves. Airmen in these stations were accommodated in the new brick-built barrack blocks and in the airmen's married quarters. Even using all available accommodation, a small number of men had to be accommodated in tents for some weeks at most of the stations pending the completion of new buildings.

Personnel were accommodated therefore in the following main types of building: permanent R.A.F. construction, requisitioned premises, private billets and tents. W.A.A.F. on stations were usually accommodated in vacated airmen's married quarters. Requisitioned premises were administered by the R.A.F. and became temporarily part of the station, no matter what distance the requisitioned building might be from it. Private billets, on the other hand, served merely as domestic accommodation, and when enough of a good standard could be found

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they were satisfactory. All domestic, messing, and hygienic problems were overcome in good billets because the men were looked after as members of the household, but there were some disadvantages. The billeting system created an unplanned dispersal, which did not necessarily provide any shelter from bombing, nor any basis for organising transport. In a military sense, this close contact with civilian life was not good for the solidarity of the station, while if billets were bad, the schemes were usually failures because all the benefits of private accommodation, home-cooking and domestic hygiene were lost.

The chief medical concern in 1939, after the most pressing difficulties had been solved, was the provision of adequate semi-permanent accommodation in all the groups before the onset of winter. Generally the problem was solved by the construction of various types of buildings and the requisitioning of neighbouring buildings, so that all personnel were in some kind of semi-permanent accommodation by the winter, when the problems of blackout and ventilation had begun.

Accommodation at peace-time stations was generally satisfactory, despite some overcrowding, and it was naturally accepted that during the war married quarters had to be used for other purposes. As the war progressed, groups became larger and new war-time stations were opened up, but there was not a comparable increase in building. The problems at the various stations were mainly the large ones of finding accommodation and securing adequate messing facilities and making hygienic arrangements. The situation on stations where accommodation and sanitation were insufficient, required both improvisation and ready initiative. All sections of the station were affected, and the medical officer was consulted by all kinds of people, chiefly about accommodation, grease-traps, drains, provision of men for sanitary duties, disposal of refuse by civilian contractors and a host of other hygienic matters of daily life. Medical officers who had no previous Service experience were at a disadvantage in these circumstances, but the ability to improvise outweighed even previous experience.

As already stated, the permanent stations, such as Coningsby and Hemswell, presented a favourable picture. Accommodation had been planned upon a more generous scale and other facilities were also available on a peace-time basis. These stations had acquired in the course of time extra buildings of one sort or another, notably blocks of married quarters, which could be used as barrack accommodation. Additionally, almost all ancillary buildings were available and the standard of comfort offered was superior to that at war-time stations, where there was much new and hurried construction or where tents and temporary buildings had to be used. There was some overcrowding and disorganisation at the permanent stations, but in no case did the difficulties approach those at more recently constructed stations.

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New construction of accommodation gradually improved matters, but there was considerable delay in the completion of buildings, and medical officers during the war had often to accept temporarily a certain degree of overcrowding beyond the limits laid down. But conditions were worse in satellites because of the rapid expansion which took place there. At the outbreak of war, satellites were regarded merely as emergency landing grounds and there was no intention of using them as living sites. Accommodation had therefore to be provided, and construction always lagged behind the demand, because the scope of satellites expanded until they became sub-stations and full stations with strengths of 1,000 to 2,000 personnel.

Double-tiered beds were used on some stations, and while it was true that barrack rooms had more floor space available for dressing under this arrangement, the temptation to executive authorities to add more beds so that each man had less than 45 sq. ft. was often irresistible. Accommodation, where double-tiered beds were used, was investigated periodically by the Command Medical Staff. It was evident in 1942 that the regulation standard or more was maintained except in a few instances where the strength had soared beyond available accommodation. There was still a considerable amount of double-tiered bedding accommodation and this appeared the rational solution where strengths considerably exceeded the capacity. It was foreseen at this time that, unless the provision of accommodation was accelerated, some difficulty would arise in maintaining this minimum floor space. An appreciable amount of new construction was ready by 1941, but the increase in numbers of personnel generally remained above the rate of construction and requisitioned premises and billets had still to be occupied in some groups. Newly constructed buildings were occupied at the earliest possible moment throughout the period of the war years. Each group had some peace-time constructed stations, but as the war progressed the majority of stations were made up of war-time buildings.

By 1942 the percentage of men accommodated in barrack blocks of permanent stations had become small compared with those in huts, billets or requisitioned buildings of the war-time stations. It was disappointing for the authorities that, despite all the new construction, use had to be made of billets and requisitioned premises. On the other hand, airmen were not altogether displeased, although living in billets and requisitioned premises involved some inconvenience, for new buildings were even more dispersed in most cases and no cooking and only field sanitary facilities were provided on the sites.

Overcrowding, officially recognised by authority by the reduction of floor space to the region of 32 sq. ft. per person, had fortunately been counteracted by the favourable weather conditions during the winter of 1942–3 and the apparent non-virulence of the usual winter diseases.

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These conditions obtained to some extent throughout the war and, as late as the spring of 1944, the Command was pressing for a big effort during the spring and summer months in works construction and repair so as to ensure the best possible conditions for the following autumn and winter. By the summer of 1944 and onwards there was considerable improvement in accommodation and other hygienic matters and further steady progress was anticipated.

BLACKOUT AND VENTILATION

At the beginning of the war the early measures taken to secure complete blackout were usually incompatible with those necessary to provide adequate ventilation. The usual difficulties of providing a free flow of air with efficient blackout were experienced and many attempts were made on stations to solve the problem, which was a major one.

To understand the nature of the problem it is necessary to realise that it consisted of a large number of smaller problems, that is to say, each type of building and each type of window required a different kind of blackout. The variety of windows, doors and other apertures, all of which had to be screened, was almost endless. Apart from this the use to which buildings were put had to be considered. Elaborate measures were unnecessary in buildings seldom used at night, but a foolproof and efficient method of blackout was particularly important in all buildings in constant use, such as messes, cookhouses, and other domestic buildings. In tents the problem did not arise, because no method could be devised of blacking out the ordinary tent, and therefore, no light could be permitted during the hours of darkness.

Command authorities did not issue any specific instructions with regard to the method of blackout because clear-cut instructions would not have solved the problem and, in recognising this, Command Headquarters advised station and unit authorities that they must use methods best suited to their individual needs. One method, however, was singled out for recommendation. Materials used were plaster or beaver board, cut to the same size as the aperture which it was designed to black out, and strengthened at the edges by battens. In it were cut one or more oblong spaces and these were protected by pieces of similar material which were considerably larger than the spaces themselves, and were set away from the main sheet by small blocks of wood. Air could thus pass in or out through the spaces but light was prevented from showing. Though there were many variations of this method, all conformed to the same principle. Another method was to use faint blue lights inside buildings during the hours of darkness, so that windows could be opened or shut as desired and no blackout was provided on the windows

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themselves. There were two disadvantages, namely, that the main lights might be switched on by mistake, and that the blue light hardly provided enough illumination for moving safely from one part of the room to another. In any case the method could not be used except in corridors or in buildings on dormitory sites. It was, however, preferable to the close-fitting curtains or boards of plastic materials which allowed practically no ventilation, particularly in sleeping quarters where each man often had only the minimum permitted amount of floor space. When blackout material became more plentiful, the method of choice was the provision of adequate light-proof curtains for windows so that entering air did not cause light spaces to form in the curtains. The curtain rings at the top of the window and the upper parts of the curtains were covered by an adequate wooden pelmet. The curtains were made long enough to extend beyond the foot of the window, again preventing light from showing.

LIGHTING AND HEATING

All stations were equipped eventually with electric light, and the interval between the occupation of stations and the functioning of the electric system was usually brief. In partly constructed stations electrical breakdowns and the falling of the electric supply behind building schedule led to the use of emergency lighting on occasions. Most problems of lighting arose in connexion with the blackout, and this has already been mentioned in the previous section as far as the main buildings were concerned. It was in another connexion, however, that the main difficulties arose. The buildings which presented the worst problems were the ablution blocks which were situated near sleeping sites. These were often excluded as far as blackout was concerned on account of the shortage of material, and, apart from this, it was very difficult to maintain an efficient blackout for both doors and windows in a small building where ventilation was so important. Some of these ablution blocks contained water closets as well as ablution benches and showers, and their use increased the importance of adequate ventilation. Sometimes the problem was shelved and no lighting at all was provided, so that the ablution blocks could only be used during the hours of daylight if they were to be kept clean; at other units lights were provided and all the windows were painted with dark blue or black paint, so that the lights had to be kept burning by day and night when the ablution blocks were in use. Personnel had an unfortunate habit of removing the globes from these buildings, which did not help matters. Medical officers could only draw attention to the necessity for providing a proper system of blackout and ventilation with adequate lighting in these buildings.

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The permanent stations, such as Hemswell, Marham and Bassingbourne, were well equipped with central heating systems or slow-combustion stoves, the former method of heating being the more satisfactory. Radiators placed under windows which had been blacked out by the means already mentioned were satisfactory. The hot air rising from the radiator drew in a current of fresh air through the upper aperture so that the air within the room remained at a comfortable temperature without draughts throughout the period of blackout.

Makeshift arrangements had necessarily to be improvised at non-permanent type stations which sprang up from 1940 onwards. Various forms of open or slow combustion stoves were in general use; neither type was very efficient largely owing to deficiencies in the buildings which they were intended to heat. Oil stoves were used in many improvised quarters on account of the difficulty of replenishing the solid fuel-burning stoves during the night. These oil stoves did not provide enough heat and, furthermore, were in short supply. Great efforts were made to improve standards of heating during the war years and practically all methods were tried according to local requirements.

DRYING ROOMS

Drying rooms had been provided on the domestic sites at most stations by 1942, but little use was made of them. The chief reason was the impossibility of preventing petty thefts, unless someone was in charge of each drying room. Access to the buildings had to be unrestricted, otherwise the object of providing them was defeated; airmen and airwomen, particularly the latter, were consequently disinclined to leave any of their clothing in them. Another reason for their infrequent use was the shortage of solid fuel and the difficulty, to which reference has been made elsewhere, of finding personnel to attend to the necessary boilers and fires. Many of the smaller drying rooms were heated by a stove and the problem of getting the stove lit when required for drying was usually beyond organisation.

MESSING AND CATERING

Separate messes for officers, sergeants and airmen were maintained in the Command in accordance with usual Royal Air Force practice. The types of station in the Command influenced the siting and construction of the messes. Thus the airmen's mess on a peace-time station was of substantial construction, close to the other station buildings. These buildings were satisfactory and seldom gave rise to any difficulties. On war-time stations having operational training unit personnel or operational squadrons, the messes were either brick or prefabricated huts and their siting was dictated by local conditions. On the dispersed stations proper, which came into use in the latter part of 1942 onwards,

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the messes were built as far as possible to a standard pattern, usually completely prefabricated, and formed part of the communal site.

The typical combined airmen's mess and cookhouse was built of brick and plaster which had a light roof supported on metal frames. One or more wings adjoined a centrally placed kitchen. These wings were furnished with tables and benches and were used as dining halls. A passage led off from the kitchen and communicated with the necessary rooms for the preparation and storage of food. The meat storage was usually in a separate small building on the same site and it was fly-proof and generally provided with adequate drainage. Rations were obtained from the R.A.S.C., N.A.A.F.I., local producers and local shops. The quality of food was good and there was little cause for complaint except when local and temporary conditions caused shortages. Cooking was not always above reproach, although it was considered that the general standard of the food ready for consumption was higher than that enjoyed by the civilian population. Messing tended to vary not only between stations but on the same station at different times. This variation in the messing and catering standard appeared to be chiefly due to numerous changes in personnel, reallocation of stations to new groups, variations of strength and shortage of kitchen staff.

Operational meals in officers' and sergeants' messes were continually receiving attention, and by the efforts of the station catering officer most difficulties could be overcome. Shortage of accommodation was one of the main difficulties, and at Middleton St. George, for example, in March 1943, the sergeants' mess was overcrowded; cooking equipment and messing accommodation were designed for 120 men, while about 450 were being fed and three sittings were necessary. This situation improved when a new site was opened up later, but at the time constant medical supervision was necessary to avoid chaotic and unhygienic conditions.

Command, group and station catering officers were appointed by mid-1941. The duties of the Command and group catering officers were the supervision of catering generally and of the station catering officers, the improvement of the mess and kitchen equipment and the welfare of all catering personnel. The station or unit catering officer was responsible for station messes, local improvement of kitchen equipment, the cleanliness of cooking sites and of cooking personnel, the collection and disposal of salvage and swill, and to some extent the selection of cooks and butchers; he was also allowed to act as adviser to the officers' mess. Generally speaking, the standard of messes improved after the appointment of catering officers.

These officers were recruited in the main from civilians who had been employed, sometimes for years, in the catering trade, and they replaced the non-commissioned officers who had previously been in charge.

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Later the supply of trained catering officers from civil life was exhausted, and officers without previous experience were selected for an intensive training course; the majority of these officers proved satisfactory. The chief problems of the catering officer were to prevent overwork among catering personnel, to ensure cleanliness, to meet local criticisms of diet and to prevent waste of food, salvage and swill.

At stations the catering officer with energy and drive could make great improvements in the messes and feeding arrangements.

HYGIENE IN COOKHOUSES

Following the circulation of letters from the Director of Hygiene pointing out the necessity for strict personal cleanliness among cooks and kitchen staffs, there were several requests from stations for permission to construct cloakrooms and ablutions adjoining airmen's cookhouses on new war-time stations. It was felt that efforts to improve the personal hygiene of the kitchen staff, the general cleanliness and sanitary arrangements in cookhouses, were somewhat negatived by the omission of the necessary facilities from the standard design on which all such premises were constructed. For example, defects in messing arrangements pointed to an inadequacy of preparation rooms and cooks' restrooms in prefabricated messes. The maintenance of a proper state of cleanliness among cooks was difficult for many reasons, the chief of which were that 'cleaning work', usually carried out by aircrafthands, had to be done by cooks and that there was a shortage of soap, the supply obtained, manufactured for scrubbing, being unsuitable for personal use. Blue and white overalls were issued, the former for personnel preparing vegetables and the latter for those handling food. In the summer of 1943, following Air Ministry advice regarding *Sonné* dysentery, bowls containing Dettol, scrubbing brushes, soap and water were placed in the kitchens for the use of cooks. Fly-proofing of larders and food stores in the messes, particularly in war-time stations, had in many cases not been carried out, and the deficiency was repeatedly stressed by medical officers in the hope that fly-proofing would be done at an early date*.

Great interest was taken, shortly after the appointment of catering officers, in the local growing of foodstuffs on stations, and energetic catering officers succeeded in maintaining interest indefinitely. Production teams were organised on many stations and during the succeeding years thousands of pounds' worth of home-produced foodstuffs were grown. The teams produced all kinds of vegetables and tomatoes, and some stations kept pigs and poultry. The money raised by the stations

* Fly-proof gauze was very scarce throughout the war period and priority was naturally given to overseas demands.

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went into public funds. These schemes for station production were of great value, not only because station personnel were able to remedy any possible deficiencies in their diet by their own efforts, but also because a substantial contribution was made towards the saving of imported foodstuffs.

Strict discipline had to be maintained in order to prevent waste. Many medical officers were surprised that the quantities of swill, particularly in the early days before the appointment of catering officers, could mount to such enormous proportions, showing clearly that either too much food had been prepared or that what had been prepared had been rejected by the airmen. Many schemes for the proper disposal of swill, salvage and rubbish were introduced, but the principles involved were invariably the same and the difficulties encountered similar.

SANITATION AND CONSERVANCY

WATER SUPPLIES

Wherever possible at Bomber Command stations, existing water supplies from local authorities were used. These supplies were almost without exception pure and adequate, but testing was carried out periodically as a matter of routine. The many stations which were not served in this way were supplied by pumps, mains and tanks of Royal Air Force construction; the source in these instances was from rivers, lakes, and boreholes. Supplies were generally adequate, though there were occasions when the deep wells dried up and emergency supplies had to be used until a new borehole was made or the stations connected to some public supply. Occasionally, recourse had to be made to water-carts. Constant supervision by medical officers was necessary to ensure a potable water supply. Where necessary, water was sterilised by chlorination, by portable water sterilisers, or, in emergency, by boiling. At some stations, particularly those originally built as satellites and later becoming full stations, supplies became inadequate for the increased number of personnel and the problem was usually solved by increasing the existing supplies by another borehole, or finding local public sources to increase the water supply.

As the Command expanded greatly in 1942 and the following years, more stations were being built in localities where no local main supply was available, or where it was too far away to be piped. The sources at these stations were mostly deep wells, tested and chlorinated and softened if necessary, though water-softening plant was in short supply from 1942 onwards.

There was considerable variation in the availability of water on the various sites on stations. All new sites constructed on the permanent stations which had had a main water supply for a long period were

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served, but this was made possible by the proximity of buildings one to another. On dispersed stations proper such as Chipping Warden, Oulton, Hardwick and Hethel, shortage of time, labour and materials made it impossible to pipe water to all sites, and it was the policy to supply the communal site and the technical site. The main problem is illustrated by Oulton, the satellite of Swanton Morley, where the distance of the communal site from the technical site, approximately four miles, was an example of dispersal carried to an extreme.

The lack of water supply at the dispersed dormitory sites caused some inconvenience. Few airmen wished to rise in the morning, particularly in winter time, dress, walk half a mile or more to the communal site, undress, wash, have breakfast, and walk back to their sleeping sites with washing kit and then finally return to walk a mile or more to the aerodrome to start their duties. Later in the war the issue of bicycles improved the position considerably. However, permission was given in 1942 for the extension of water pipes to other sites and buildings, including sleeping sites, wherever there were labour and materials to spare, and where it was known that sufficient drainage would be provided. Again, sleeping sites were sometimes so situated that it was impossible to connect them with existing drainage systems and therefore to the water supply.

During the war years water samples from stations were sent to the R.A.F. Institute of Pathology and Tropical Medicine at Halton for analysis. For example, 150 samples were sent in 1944, and of these, 11 were unsatisfactory. Copies of all reports were passed to the Chief Engineer of Bomber Command for his action where necessary.

SEWERAGE

At all peace-time stations provision had been made for a water carriage system to adequate scale, and drainage and sewerage systems could safely be regarded as capable of dealing with a 30–50 per cent. increase, subject to proper maintenance and supervision. Percolating filter sewage disposal systems were in use at most stations. Disposal of sewage from billets and requisitioned houses was often into cess pits, emptied at regular intervals by the local council. While a station was being built and where the sewerage plant was incomplete, or when dormitory sites were not connected to main drainage, bucket latrines and 'Elsan' closets were used. The contents of the bucket latrines were emptied into Otway pits or into a man-hole on a mains system.

Dispersal associated with expansion was very soon found to create difficulties, which were increased by an uncertainty as to the limit of the population to be located on the station at any future date.

Although every endeavour was made to provide a planned system of sewerage and drainage, either by linking up with the local authorities

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scheme or by providing a separate station installation, it was found necessary to introduce at most stations, as part of the arrangements, some form of field or camp sanitation, more often at new stations with widely dispersed living sites, than at the old and more compactly built stations. Numbers of these schemes not infrequently resulted in difficulty; for example, sewerage plants became overloaded because too many additional drains were connected to them. Field appliances were constructed as needed, some by the Works Department, others by the station, and frequently insufficient personnel were provided on the station establishment to deal with them.

The station sewerage plants were all capable, when working efficiently and not overloaded, of producing an effluent satisfying public health regulations. In this connexion reference is made to the promptitude with which sewage analyses were carried out by the R.A.F. Institute of Pathology and Tropical Medicine, Halton; for example, during 1942, 104 such analyses from Bomber Command were carried out, 19 of which had to be repeated, although it was not always possible to have defects remedied immediately and entirely when unsatisfactory reports were received. The Works Department at stations, which had many difficulties to contend with, usually managed to improve matters.

In 1941 and the succeeding years the increase in strength, particularly at certain stations, and the consequent overloading of sewerage plants caused a great increase in the quantity of suspended solids in the effluent. The problem was dealt with by careful supervision of the existing sewerage plants and the provision of small local extensions where necessary. These measures were at best temporary, and it was continually urged that new construction should begin as soon as possible.

The information provided in the monthly sanitary reports from stations indicated a fairly good standard of sanitation throughout the Command and it was considered in 1942 that R.A.F. personnel on the whole had little cause for complaint. Constant attention was paid to defects as and when noted. In 1942 the Principal Medical Officer amended the *pro forma* used for monthly sanitary reports from stations to bring out more clearly 'defects noted but not remedied'. In connexion with sanitary matters he indicated that the group sanitary assistant must visit stations and remain on them for a few days, showing how improvements could be made and seeing that his recommendations were carried out. It was considered that this procedure was likely to be more effective than inspection followed by copious reports.

In some instances surface water was admitted into the sewerage system. That such water could seriously affect the sewage action was not always appreciated by stations, and local enthusiasm to effect a magical disappearance of surface water by these means required to be

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tempered. Absence of grease traps at messes or inefficient grease traps often clogged up drain pipes and interfered with the sewerage plant. Use of chemicals for disinfection at bucket draining sites, or in 'Elsans' and pails subsequently tipped into sewage drains, on occasions resulted in defective action at the sewerage plant. Man-hole tipping or emptying latrine buckets into the sewerage pipes at various points had its drawbacks in practice as well as its advantages. Any arrangements for 'man-hole tipping' had to be most carefully considered by the Works Department before it was permitted, having regard particularly to the capacity of the plant and its type. If properly considered and supervised the practice was sound and there were instances where the arrangements, including the washing facilities for pails, were excellent.

The excess sullage, which tended to overload sewerage systems, was satisfactorily dealt with by directing its flow into soakaway pits and herring-bone systems; it was also directed into water courses and ditches after solids had been trapped.

Overloading of sewerage plants continued throughout the war, and where it became a sanitary nuisance, a new or additional sewerage plant had to be installed. Improvements, such as extra filter beds and the replacement of filter media, had to be made at several stations; however, it was not always possible to build or improve upon the scale which had been requested and it was remarkable how careful supervision of the existing systems could prevent a serious breakdown in plant which according to peace-time standards was grossly overloaded.

GROUP SANITARY ASSISTANTS AND SANITARY SQUADS

The problem of maintaining the sanitary personnel at their established strength was a continual source of anxiety at stations. The work was of a semi-skilled kind for which controlled organised squads of workers were necessary, and when organised, work proceeded with the smoothness of a well-run factory. Unorganised and with too frequent changes of personnel, the conservancy arrangements could become chaotic. The personal supervision of the sanitary squad by medical officers and group sanitary assistants was a big factor in keeping up good sanitary conditions in Bomber Command.

The chief duty of a Group Sanitary Assistant was to visit stations to effect remedies personally or advise on measures to be taken, and to demonstrate practical means of overcoming the difficulties. The length of a visit to any one station varied to a very considerable extent according to circumstances. There were certain difficulties in connexion with the N.C.O. sanitary assistants' visits to stations. Success depended on the ability of the individual to impress the station administrators with his knowledge, experience, ability and drive. There was a certain amount of disappointment among the sanitary

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assistants in that their status in the Royal Air Force did not seem to be as good as it was in their civilian appointments as sanitary inspectors. Under Public Health Regulations and Bye-laws they had statutory powers in civil life, of which they were, quite rightly, very conscious, but in the Service as sergeants some of them found difficulty in offering to the administrative staff at stations advice which at times was of necessity critical. Generally this problem was overcome with a fair degree of success, but the difficulty of enlisting the support of local works services to effect sanitary remedies was always commented upon by these assistants.

The sanitary squad consisted of a sergeant or corporal and a number of airmen, all in the trade of aircrafthand, general duties. Each station had an establishment for such a squad, under the control of the commanding officer, but in practice attached to the station medical officer, who correlated the work with medical requirements. The work of the sanitary squad included the supervision and cleaning of ablutions, latrines, soakaways and sites in the neighbourhood; the setting up of latrines and the emptying of buckets when this was not done by the civilian contractor; the maintenance of grease traps and the cleansing of cookhouse sites. The members of the squad were best instructed in their duties by the medical officer and the group sanitary assistant. The medical officer was usually accompanied by the N.C.O. in charge of the sanitary squad when making sanitary rounds of the station.

A survey of the sewage effluent analyses taken during the war period and representative of all months of the year shows that approximately one-third proved unsatisfactory. Generally, the unsatisfactory samples were found, with few exceptions, to be dated during the late winter and early spring period. The chief disadvantages in connexion with Service sewage treatment plants were stated by group sanitary assistants to be the absence of flow recorders and the lack of exact knowledge concerning peak flows, which differed so much from those experienced at municipal plants. While this was realised, it had to be appreciated by group sanitary assistants that with the difficulties in providing for war installations, many of the niceties of peace-time provision were impossible.

BUCKET LATRINES, URINALS AND FIELD SANITATION

Dispersal associated with expansion began to affect methods of sewage disposal from 1941 onwards. It was often impossible, owing to the nature of the ground, to extend the sewerage system so that it might drain the dispersed sites without pumps; apart from this the expense and labour involved made such extensions out of the question. All the usual methods of disposal of faeces and urine in the field were used according to the suitability of the ground. The majority of dispersed

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sites were supplied with bucket latrines or chemical closets. Deep trenches for faeces and urine, and soakaways, were not so generally used. The bucket latrines were emptied by local contractors or by the sanitary squads (it became increasingly common to employ local contractors because of the difficulty of maintaining a sanitary squad up to establishment); the faeces were then disposed of through a man-hole into the camp water-borne system or buried in pits. Chemical closets were widely used but were not regarded as satisfactory because their construction was too flimsy to withstand reasonably hard wear; the seats were easily broken and they were difficult to maintain in a clean condition; furthermore, sufficient time for the proper chemical action could not be given when they were in frequent use. The chemical closet in these circumstances became no more than an unsatisfactory bucket latrine.

The use of station lorries for the removal of buckets presented problems, the lorry supplied usually having a body platform some five feet from the ground. The difficulty of lifting almost full latrine buckets to this height, without splashing some of the contents over the side and upon the sanitary personnel, can well be imagined, while to transport a lorryload of latrine buckets without splashing the contents over the road to the danger of passers-by, was a difficult operation even when the road-way was good and almost impossible when the roads on stations were bad. The disposal and cleaning of buckets on permanent and war-time stations varied from excellent bucket-washing platforms to no provision at all. The contractor emptied the buckets into large containers, which were then removed from the station.

The use of chemicals for disinfection purposes at bucket-draining sites or in closets, subsequently tipped into the sewerage system, on occasion resulted in defective action at the sewerage farm.* 'Man-hole tipping', or emptying the latrine buckets into the sewerage system at various points, had its drawbacks in practice as well as its advantages. The problem caused by admitting a sudden heavy load of excreta too close to the sewerage plant was that there was insufficient time for its dilution and frequently material unsuitable for sewage disposal found too ready an entrance. A special pail-washing and flushing arrangement at the 'man-hole tipping' site, known as 'Furber's Folly' after the medical officer who designed it, proved very efficient and was used by the Works Department as a basis for a permanent design. By using this device facilities were available for washing out the buckets quickly by water under pressure, and at the same time avoiding the soakage of workers, the waste water being drained away immediately.

Urinals of the trough type, draining into the soakaways, generally proved satisfactory provided that the troughs were at a good height,

* Due to the inhibiting powers of disinfectants on the zooglœa of the filter media.

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had sufficient fall, large enough soakaways were constructed and the ground around the urinal was well prepared by concreting or a good layer of cinders. Where urinal buckets were used it was advisable that they should be raised some 6 in. from the ground and inclined forward. The difficulties associated with all latrines, whether on the main sewer or not, would have been avoided to a great extent by proper care and attention, neither of which was easily obtainable. Care was lacking because individuals using them were often completely unmindful of other users, and supervision was difficult because of the lack of labour and frequent changes of personnel. In this respect the very poor lighting and permanent blackout conditions in latrines created further problems.

The final disposal of excreta, by means other than the sewage farm, usually presented difficulties in the early stages of the stations, but was overcome where satisfactory Otway pits could be constructed; when well constructed in sufficient numbers these pits could be used indefinitely. At most stations where dissatisfaction with them was experienced, the difficulties were related to the geological conditions, the high level of the surface water or to the admission of storm water into the pits. Where the ground and other circumstances allowed, deep trench latrines were preferable to any bucket system, as they saved labour and avoided the handling of filth. There were, however, many factors in siting, layout and construction of a station which prevented the more general use of such latrines.

Sanitary Arrangements for W.A.A.F. Personnel. Certain arrangements applicable to W.A.A.F. personnel on stations became necessary. With the advent of W.A.A.F. in Bomber Command, a new feature of camp sanitation arose in respect of the collection and disposal of sanitary towels. Contrary to many aspects of station sanitation, this problem was not solved but aggravated by the availability of a water carriage system, and blocked drains and disorganised sewerage plants became a common feature of station life. The problem of disposal of sanitary towels with which airwomen working in dispersed war-time stations were confronted was a very real one, especially in summertime. It was a sound hygienic and economical investment to make disposal of these articles as easy as possible for airwomen. No scheme functioned smoothly without the intelligent co-operation of every airwoman on the station, and concise and simply worded instructions regarding the local facilities for disposal were given or shown to each airwoman on her arrival at a station. Sanitary buckets were provided in all lavatory and ablution blocks and a conveniently placed incinerator was usually provided on every communal W.A.A.F. site. On technical and office sites medical officers recommended that each lavatory block should have a sanitary bucket, which was emptied into the station

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incinerator by an airwoman at convenient times. Too much reliance could not be placed on boiler house and open fires in sleeping quarters as overloading of these furnaces would cause the fires to go out, with consequent waste of fuel and complaints from the R.A.F. stokers when they had to remove the refuse and relight the fires.

DISINFECTION, DISINFESTATION AND SCAVENGING

Arrangements for disinfection in the Command were very satisfactory. Generally speaking, disinfection was provided in three main ways:

(*a*) On permanent stations a large capacity disinfecting plant was installed and was able to meet all requirements.

(*b*) War-time stations were supplied with a field portable disinfector, able to deal with a small number of blankets and personal kit. Larger quantities were dealt with by neighbouring stations or the local authority.

(*c*) At the few stations where no disinfecting apparatus was held, all articles were sent to a neighbouring station or the local authority as the need arose.

Throughout the war years disinfestation was generally satisfactory and there were no major infestations, although rats and cockroaches caused trouble periodically at stations. In rat infestation, recourse was usually had to the Local War Agricultural Executive Committee, or contracts were placed with firms specialising in pest destruction. The training of airmen in rat destruction did not prove a success owing to the posting of such personnel away from stations, or, as they were mostly aircrafthands (general duties), their re-mustering to a trade. Infestation by cockroaches was controlled fairly easily in brick-built hutments, but in wooden and prefabricated huts, particularly cookhouses, no really satisfactory method of dealing with the pest was devised. Anti-louse powder was commonly used and an advance was made in the latter years of the war when D.D.T. powder became available.

STATION AND SQUADRON MEDICAL OFFICERS

The care of the sick and wounded was exclusively the responsibility of medical officers. Although station and unit hygiene and sanitation were the responsibility of the commanding officer of the station, part of the duty of the medical officer was to advise and assist the commanding officer regarding these matters. The distinction between responsibility and duty regarding hygiene and sanitation was not always understood by commanding officers and caused friction with the medical officer on occasions. Nor was this distinction always clearly understood by medical officers new to the Service because the main

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work of the station medical officer was the practice of preventive medicine and the constant supervision of all local conditions which might affect it. This change-over from civil to military life was not easy for some medical officers because it took time for them to grasp the fact that the health of their individual patients was no longer their only important responsibility and it was necessary to direct their attention to all factors which could influence the well-being of their units as a whole. Added to this there was much to learn of Service administration and organisation. The peace-time R.A.F. medical officer was taught these matters at a course at the Medical Training Establishment and Depot during the first three months of his Service career,* and he had the advice and assistance of senior officers with plenty of Service experience. In war-time the length of the course had to be cut down, on occasions to as little as seven days, and personal contact with senior officers of the medical service was greatly reduced by the preponderance of newcomers.

The outbreak of war and the resulting expansion of Bomber Command caused a withdrawal of the more experienced officers from stations in Bomber Command to fill senior administrative posts. At the same time problems of hygiene and sanitation were multiplying as a result of the rapid growth of stations and the introduction of the policy of dispersal. Very few stations in the early days had an establishment for a squadron leader medical officer, and the duties of station medical officer were carried out by comparatively junior medical officers. However, by 1942 most station establishments had been upgraded to squadron leader and by that time there was a large number of medical officers in Bomber Command with considerable war-time experience. The progressive development in the size of all stations and the occupation of partially completed stations due to the rapid expansion of the Command, threw great responsibility on the medical officers and was an ideal background for training in sanitation and hygiene. On these partially completed stations the essential accommodation was habitable but often interior equipment was lacking or incomplete and the building of ablution blocks, latrines, cookhouses, paths and roads was far behind schedule. Keenness and initiative on the part of the medical officer during the transient stages so as to provide as soon as possible a reasonable standard of hygiene, sanitation and welfare was well repaid.

DESCRIPTION OF DUTIES

The medical duties on a bomber station could be roughly divided into those at station sick quarters, R.A.F. and W.A.A.F., and those on

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* *See* Volume I. Chapter 1.

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the station and airfield. Sick parades, medical treatment, medical boards, re-mustering examinations, 'free from infection' inspections, inoculations and vaccinations and medical administration were carried out by both the station and squadron medical officers in sick quarters. Lectures were given to the sick quarters staff on sick quarters routine, medical administration, crash and treatment room procedure, and assistance was given to enable medical orderlies to pass their tests for promotion. The squadron medical officers maintained contact with the flying members of the squadrons, in particular the non-commissioned ranks, by informal visits to flight offices, crew rooms and dispersal huts. Contact with the officers in the squadron was assured by daily association in the mess. In addition to informal talks and discussions the squadron medical officer was responsible for lectures on the practical aspects of aviation medicine. This included lectures on oxygen, high-altitude flying, the prevention of otitic barotrauma, frostbite, proper care and use of flying clothing, 'bends', night vision, physical fitness, first aid in the air, hygiene and venereal disease. By giving these lectures to small groups of flying personnel at a time, individual attention and practical demonstration could be given.

Lectures on venereal disease were given to all male personnel on the station, but the greater part of the time was devoted to the training of stretcher-bearers and to teaching the principles of first aid. From time to time lectures were given on many other subjects such as general hygiene, and, on stations where there were one or more squadrons of the R.A.F. Regiment, lectures were required on the care of the feet and kindred subjects.

Routine sanitary rounds of the station were a never-ending task. Every section, every building, messes, ablution blocks, latrines, grease traps and sewage farm had to be inspected, and outlying and signals sections had also to be visited. On a dispersed type station this sanitary round required two to three days for completion and the light ambulance or a light van was used to convey the medical officer and usually the N.C.O. in charge of the sanitary squad from place to place. Any matters requiring attention were noted and entered up more fully in the medical officer's section of the station sanitary diary. The diary was then passed to the Commanding Officer for his remarks and decisions, and the remarks and suggestions of other section officers were included.

Matters of sanitation and hygiene worthy of the medical officer's attention on sanitary rounds were many and varied. Even on the permanent type station this was true, although good building, absence of dispersal and the provision of sanitary services on the scale of a model village, all tended to diminish medical problems. Dispersal associated with rapid expansion presented the most difficult problems to the medical officer, who had to deal with newly constructed dispersed stations

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consisting partly of new prefabricated or requisitioned buildings. The problems of accommodation, messing, water and sewage were all interwoven to such an extent that changes in one had repercussions upon one or more of the others. A move to an incomplete station depended for its success upon the keenness and initiative of all concerned and particularly on that of the medical officer.

Many, if not most, of the problems were created by the necessity for bringing stations up to full capacity in a space of time during which it was impossible to complete accommodation and sanitary arrangements. The position had to be appreciated and accepted and it was repeatedly emphasised by the Principal Medical Officer of Bomber Command, that medical officers at these stations had considerable sanitary duties imposed upon them as a result of this lack of accommodation and other facilities.

STATION SICK QUARTERS

DESCRIPTION OF VARIOUS TYPES

The provision of adequate sick quarters accommodation on stations, sub-stations and satellites was a big problem throughout the war years. The possession of a sick quarters built in peace-time was another of the advantages enjoyed by personnel serving at stations on the permanent list. There were 25 such stations with two-storey accommodation and 10 stations with one-storey permanent construction. These buildings were divided into large and airy wards and offices and had every facility. The disadvantages were that for their size they had insufficient bed accommodation, a two-storey permanent building having, for example, accommodation for only eleven beds.* Furthermore, they were built for male personnel only, and with the advent of airwomen on stations alternative accommodation was necessary. This was met on these stations by converting officers' married quarters into the W.A.A.F. sick quarters or using one of the main wards in the two-storey building for airwomen and building a Nissen or other type hut in communication with the main building to house the airmen.

Originally, as in all commands, stations were permitted sick quarters of types agreed upon by the Air Ministry Works Directorate, the Director of Hygiene and the Director of Organisation. Beds were provided on a fixed basis of 1 per cent. R.A.F. and 2 per cent. W.A.A.F. strength with a minimum of four beds. No provision was made for sick quarters at satellites and this omission was overcome to some extent by rearrangement, requisitioning and improvisation, so as to ensure that the routine work of the units and emergencies could be catered for;

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* This was the official figure which was invariably exceeded on the grounds of expediency.

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stations which were in the process of building were provided with either a new building of R.A.F. construction, or in some instances with a requisitioned house. The provision of medical inspection huts on satellites relieved the situation slightly. However, by the beginning of 1943 certain buildings suitably situated were becoming available which, at small expenditure, could be converted into good sick quarters and which, although small, tided over the period until priority permitted the building of type sick quarters. This applied particularly to Operational Training Unit satellites, because satellites by this time were being provisioned more and more on a station basis. By mid-summer of 1943 the position was as follows:

Official Medical Accommodation.	R.A.F. beds	W.A.A.F. beds
Stations with 2-storey permanent construction	25	nil
Stations with 1-storey permanent construction	10	nil
Stations with temporary brick construction .	22	21
Stations with requisitioned houses . . .	4	6
Stations with married quarters . . .	nil	18
Satellites with medical inspection huts only .	37	nil
Nil accommodation	nil	47
Totals	98	92

The total number of R.A.F. beds available at this time was approximately 1,050, and W.A.A.F. 380. These fell short of the 1 per cent. and 2 per cent. allocation of beds for R.A.F. and W.A.A.F., but the distribution was such that requirements were met fairly satisfactorily.

PROBLEMS OF DISPERSAL

The policy of dispersal affected the siting of sick quarters, which themselves became dispersed in the same way as dormitory sites. This dispersal had advantages not only because it provided greater safety in case of air attack, but also because the sick could be cared for on a specially chosen quiet site, away from the normal business of the airfield. There were two chief disadvantages. First, the distance between sick quarters and the airfield increased the use of mechanical transport and the time taken to bring patients into sick quarters; second, a medical inspection room on the station or near the airfield became a necessity with requisitioned sick quarters. These were, of course, already provided on those stations which had a permanent sick quarters and to which a dispersed sick quarters was added. The permanent sick quarters contained the medical inspection room. Shortage of labour and materials delayed the construction at new stations. For a 'Medical Inspection Room' it was desirable that a building with sufficient accommodation for sick parades and for the

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resuscitation of injured should be constructed. Much could be and was done in a very small space, but at least three rooms were needed to form a satisfactory medical inspection block. Requisitioned dispersed sick quarters required some modification and much ingenuity was shown by medical officers and nursing staff in bringing about a conversion into a well-equipped sick quarters. The initiative of medical officers was responsible for the speed with which the conversion was made and for the provision of numerous extra items of equipment. Many forms of improvisation were employed to supplement equipment obtained by indenting and many gifts were utilised.

MESSING FOR PATIENTS

Keeping food warm for in-patients was a problem as food had often to be fetched from the mess up to a mile away and the stove in the sick quarters was very small. The only solution would have been to provide a cook at sick quarters and a suitable kitchen range, but the issue of hay boxes and other types of insulated containers effected considerable improvement.

AMENITIES

Pending the completion and opening up of combined sick quarters on many stations in 1944, stations were doing their best to provide accommodation for sick airwomen. The prefabricated hutted combined sick quarters were generally satisfactory providing adequate accommodation for airmen and airwomen in one building. The main deficiency was lack of central heating, a boiler being supplied in most instances for baths and hot water only. The wards and offices were heated by slow combustion stoves, with all the disadvantages associated with them, chiefly the difficulty of lighting and keeping them going, and above all the large quantities of soot which they invariably produced. The drawbacks will be appreciated when it is realised that these buildings contained up to thirty-five stoves, the maintenance of which, with shortage of medical personnel, was no mean task. The crash room and dental rooms were heated usually by electrical resistance pipes.

Initiative and keenness on the part of personnel could nevertheless make these buildings very pleasant. Curtains at the windows and colourful rugs added much to the comfort and appearance. Many had flower gardens and vegetable gardens, thanks to the activities of the staff. The medical authorities at Command and groups gave every encouragement to medical officers and staff, who by improvisation were trying to develop the best conditions during the transitory stage.*

* The majority of the comforts were supplied by the British Red Cross Society and Order of St. John of Jerusalem.

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STAFF DIFFICULTIES

By the spring of 1944 shortage of nursing orderlies at satellite stations, as station sick quarters were opening up, was fairly acute and there was no likelihood of an increase because of a general shortage of both airmen and airwomen nursing orderlies. This shortage was viewed with some apprehension by group and station medical officers. Re-allocation of duties of the nursing orderlies, airmen and airwomen, was necessary to make the optimum use of an ever-dwindling staff. There was also a tendency to use officers' and observation wards and side rooms for staff living quarters. In most instances this was inevitable, owing to living accommodation being too far distant, and with staff shortages orderlies were sometimes required to be on duty or call for twenty-four hours. By the summer of 1944 nursing orderly strengths were usually well below establishments and the availability of R.A.F. nursing orderlies for airfield duties was generally insufficient to meet all requirements. To tide over this period of shortage W.A.A.F. personnel were used to a limited extent, selection being made from those who volunteered and were regarded as suitable by the medical officer. An Air Ministry directive was issued that orderlies need not stand by on the airfield so long as they were instantly available at sick quarters where they could perform useful duties pending a call to an emergency.*

By October 1944 the majority of Operational Training Unit satellite stations had their permanent sick quarters. Satellite sick quarters at Oakley, Edgehill, Turweston and Little Horwood were brought into use during October, but it was not possible to make use of these buildings owing to the acute shortage of nursing orderlies. As it was not anticipated that there would be any improvement in the near future all units were advised by the Group S.M.O. to make the best use of available staff and so maintain the expected high standards, especially during the coming winter months.

STANDING ORDERS

The successful running of station sick quarters depended on every member of the staff knowing his or her own job and co-operating with the other members of the staff. To this end standing orders were most useful, and although they varied in minor details from station to station, the underlying principles were the same. The orders covered the day-to-day work in sick quarters and made provision for all emergencies likely to arise.

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* The crash ambulance in these instances was always located at S.S.Q. and was invariably under way with its full complement in under sixty seconds from the time of the alarm being given.

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(*a*) *Allocation of duties.* The first necessity was the allocation of duties. For example, by the Saturday of each week or any other convenient day the N.C.O. in charge of sick quarters drew up a weekly duty roster showing duties and hours of work for all personnel of the section, including such non-medical personnel as normally worked there, the work beginning and ending at 0800 hours on Sunday. Provision was made on the roster for the staffing of the following:

(i) Wards at Main Sick Quarters (twenty-four hours).
(ii) Medical Inspection Room at Main Sick Quarters (day only).
(iii) W.A.A.F. wards and Medical Inspection Room (twenty-four hours).
(iv) Duty N.C.O. and orderly for each day.
(v) Office (day only).
(vi) Ambulances (crash orderly and driver) (twenty-four hours).

(*b*) *Duties of medical officer and N.C.Os.* The duty medical officer was nominated in Daily Routine Orders and did not leave the station during his tour of duty unless detailed to do so and then only after having secured the presence of the duty medical officer-in-waiting, who then became the duty medical officer. His tour of duty was from 0800 hours one day to 0800 hours the next. He saw all cases arriving for admission or for out-patient treatment throughout his tour of duty and was responsible for arranging their disposal and treatment with the least possible delay. He visited the wards at 1800 hours to ensure that treatments had been carried out properly and that arrangements were made for such treatments as might be necessary during the night. It was his responsibility to keep the sick quarters informed as to his whereabouts on the station throughout his tour of duty.

The N.C.O. in charge of sick quarters was responsible to the senior medical officer of the station, for the efficient administration and supervision of all departments in sick quarters, including the office, wards, medical inspection rooms, stores, ambulances and staff discipline. He ensured that junior N.C.Os. left in charge in his absence were competent to take over these duties. He also ensured that a suitable understudy was trained in each essential post as directed by the senior medical officer and that such understudies were not on leave at the same time as the person whose job they were understudying.

(*c*) *Crash procedure.* In the event of a crash being notified to sick quarters the following procedure was generally carried out. The duty N.C.O. and crash orderly proceeded immediately in the heavy ambulance to the scene of the crash, as indicated on the crash map by Flying Control. If immediately available, the duty medical officer accompanied them, but otherwise he was informed and proceeded to the crash in the light ambulance. In all crashes and emergency calls the senior medical officer was informed as quickly as possible regarding the occurrence and all the action that was being taken. Meanwhile the

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medical inspection room and theatre were prepared by the duty orderly for the reception of casualties, viz.:

(i) Hot water bottles and blankets were prepared.
(ii) Steriliser was turned on and instruments prepared.
(iii) The shock cradle was prepared.
(iv) The theatre heating and steriliser were turned on.
(v) Hot drinks were prepared.

These preparations were continued until stand-down was ordered by the medical officer or the N.C.O. in charge.

A N.C.O. and orderly for crash duties were nominated on a weekly duty roster, each period of duty commencing at 0800 hours and lasting twenty-four hours. They did not leave sick quarters except as duty required, and carried out their ordinary duties during normal station working hours. In the event of a crash they manned the heavy ambulance and carried out the crash procedure mentioned above. Usually they were allowed to rest at night in station sick quarters, but were ready to stand-to at a moment's notice. If their tour of duty entailed much work they were allowed to rest until 1230 hours next day at the discretion of the medical officer. The duty N.C.O. made a written report of any incidents during his tour of duty and signed it. The report included any data regarding crashes and was used for the Operations Record Book (Form 540), which was compiled from these reports at the end of each month. The duty N.C.O. and duty orderly were responsible for the initial documentation of all patients arriving for admission or treatment during their tour of duty and were responsible for summoning the duty medical officer to such cases or to any ward cases developing urgent symptoms.

(*d*) *Daily sick parades*. Daily sick parades were usually held at station sick quarters at the following times:

Officers	1000 hours
W.A.A.F. Officers . . .	1030 ,,
N.C.Os. and Airmen . .	0830 ,,
Airwomen	0930 ,,
Special sick parade for aircrews who had been resting in the morning after night flying . . .	1400 ,,

It was very difficult to get officers to attend at the stated times and they, like aircrew, had a tendency to come along when it suited them. Personnel (other than officers and aircrew) who wanted to report sick, handed in their names to the station orderly N.C.O. at 0745 hours and these were entered on Form 624, which was brought to the sick quarters before 0830 hours. After the sick parade Forms 624 were collected by the orderly N.C.O. and delivered to the station orderly

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room. In cases of emergency personnel were seen at any time, and in these cases special sick reports (Form 624) were raised in sick quarters. Arrival and clearance examinations were carried out at definite times during the day and the senior orderly detailed for duty in the medical inspection room at these times was responsible for seeing that all such arrivals and clearances were properly recorded in the Register, which also contained the man's full particulars and details of inoculations, vaccinations and medical grade. All other medical examinations, such as re-musterings, fitness for commission, fitness for overseas and fitness for aircrew, required previous appointments with station sick quarters, and upon completion were entered in the appropriate daily sick book, as were all other attendances at sick quarters.

(*e*) *Duties of M.I. room and ward orderlies.* Medical inspection orderlies, as detailed on the weekly roster, carried out all medical inspection room work and treatment and the orderly giving the treatment was responsible for recording the details. Treatments were given at stated times, for example, 0830 hours, 1330 hours and 1830 hours. No treatments were given without either a 'treatment chit' or verbal orders from a medical officer and no orderly gave treatment about which he was in doubt, or with which he was unfamiliar, without prior reference to the medical officer or the N.C.O. in charge of sick quarters, for instruction and guidance. Records of treatment given were kept in a book and a note made of any defaulters, who were reported by the duty N.C.O. of sick quarters to the N.C.O. in charge of their flight or section. The senior orderly was responsible for all medical equipment in use in the medical inspection room. Attention of orderlies was drawn to the relevant Air Ministry letters prohibiting aural treatment* and injections by orderlies. The senior orderly was responsible for the safe custody and recording of the issue of any dangerous drugs used in the medical inspection room.

Ward orderlies, as detailed in the weekly duty roster, were responsible for all ward and theatre work and the senior orderly on duty was responsible for ensuring that these duties were carried out. In the absence of the duty N.C.O. the senior orderly on duty was responsible for the maintenance of ward discipline and for all equipment in use in wards and theatre during his tour of duty.

(*f*) *Ambulance drivers.* Ambulance drivers were detailed for duty on the weekly duty roster. They did not leave sick quarters during their tour, except as duty might require, and were to be immediately available at any time of the night or day, when on duty. Each day they had to inspect their vehicles and check the oil, petrol and water in the radiator, lights and horn, supply of hot-water bottles, medical equipment, water

* With particular reference to ear syringing by any method.

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bottles, electric torches and local 1-in. ordnance map. Any defect in their vehicle was reported to the N.C.O. in charge of station sick quarters, and the cleanliness and tidiness of the interior and exterior of the vehicles had to be maintained. Drivers were to memorise the crash procedure and local geography within a ten-mile radius and be conversant with the giving and interpretation of pin-point map references. They were held responsible for the medical equipment in their charge and were not allowed to proceed on any ambulance run, except as might be necessary for maintenance, without authorisation from the medical officer or the N.C.O. in charge. They were available for such other duties as might be directed by the N.C.O. in charge of sick quarters.

(*g*) *Ultra-violet light therapy*. The ultra-violet light apparatus was in the charge of the nursing orderly on duty and no unauthorised persons were allowed to interfere with the apparatus. The orderly was instructed to allow the lamp five minutes to warm up and reach maximum output, and personnel were not allowed to enter the lamp room until this had been done. Bathing trunks or similar garments were to be worn so as to give maximum exposure, and also special dark goggles to avoid damage to the naked eye.

Names of persons attending and times of exposures were to be recorded, in a book kept for the purpose, by the orderly on duty. The orderly had also to record at the back of the book the time in hours and minutes for which the lamp had been in use for the day. The mercury vapour tubes were to be wiped clean with spirit at least once a week and the necessary heating in the sun-ray room was to be maintained during the winter months.

(*h*) *Leave and off-duty arrangements*. Subject to the exigencies of the Service, leave and off-duty arrangements, as laid down by Air Ministry Orders, applied to all personnel in the medical section and were to be strictly enforced. Fourteen days were to be taken in each six-monthly leave period, preferably in two periods of seven days, with or without forty-eight hours added, and applied for at least ten days before the leave was required. Two forty-eight hour leave passes were to be taken during each six-monthly leave period, either added to the seven days leave or taken separately as desired, and applied for at least five days before it was required. Twenty-four hours per week were allowed off, taken either as two twelve-hour periods or as one whole day. All leave passes were to be initialled by the N.C.O. in charge before submission to the medical officer for signature. The N.C.O. in charge was to keep an up-to-date and accurate chart record of all leave applied for and taken, and this chart was also to show all other absences of personnel whether through attachments, courses or sickness.

The senior medical officer inspected sick quarters departments, offices, kitchens, wards and staff quarters on the main station and at

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the satellites or sub-stations frequently, to ensure a good standard of maintenance.

(*i*) *Air-raid precautions.* Procedure was laid down for Air Raid Precautions and Gas Alerts. In air-raid precautions two types of air-raid warning were employed, the purple warning and the red warning. On receipt of a purple warning at sick quarters the duty N.C.O. was to be informed; he then checked the blackout of the sick quarters site to ensure that it was satisfactory and he remained up until the warning was cancelled or confirmed. On receipt of a red warning the duty N.C.O. informed the duty medical officer, roused all patients and conducted them to the sick annexe, saw that all other personnel not on duty took cover in the shelter, and that duty personnel, including drivers, proceeded to the sick annexe. Patients too ill to be moved were kept in the ward under the care of nursing orderlies as necessary. The heavy and light ambulances were suitably dispersed. On receipt of a gas alert by gas rattle signal, all personnel, patients and staff were to proceed to the sick annexe, all outer doors were to be locked and a guard supplied by station headquarters was to be posted to the main entrance, which was to remain unlocked. The air-conditioning plant was to be turned on in the sick annexe, which communicated with or adjoined the sick quarters, and both air-locks were to be manned. One orderly was to proceed in anti-gas kit to the station decontamination centre for duty there, and the N.C.O. in charge or the duty N.C.O. was to check that the above had been carried out and that the emergency ambulance, usually a lorry equipped with Flint stretcher gear, had arrived from the mechanical transport section. Fortunately the enemy did not use gas and the above measures were never put into effect except for periodic station exercises.

The above orders were typed in numerical order and copies were kept at sick quarters to be seen and read by all sick quarters personnel, including medical officers, ambulance drivers, cooks and aircrafthands. All personnel signed on an attached sheet, that they had read and understood the orders.

MEDICAL STORES

Station sick quarters were equipped to Scale A.1 of A.P.132,* supplemented by those items of medical stores which were authorised from time to time by Command Headquarters for general use. Demands for these medical stores within the prescribed scales were submitted to the Medical Stores Depot, Hartlebury, every six months on the dates which were allotted to stations for the purpose. These dates were arranged so as to ensure that demands on the Medical Stores Depot were spread evenly over the six-monthly period.

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* *See* Volume I, Chapter 8.

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To facilitate the work of dealing with medical demands at the Medical Stores Depot, instructions were issued for the guidance of medical officers when submitting their demands. The aim was to reduce supplementary demands to the occasions of real necessity. Experience showed, however, that the main reason for supplementary indents was failure to check stocks before half-yearly demands were made out. Neglect of this kind not only lowered the general efficiency of the particular sick quarters concerned but placed a very heavy burden upon the Medical Stores Depot. Supplementary demands within authorised scales were made direct to the Medical Stores Depot as being the simplest and most economical procedure, but it required the loyal co-operation of all concerned.

Demands for medical stores outside authorised scales were submitted to Command Headquarters through Group Headquarters and even then only demands for items which were necessary or useful in all station sick quarters were considered. Demands based upon individual preference were invariably rejected except where they were in respect of drugs prescribed by specialists for the treatment of particular cases.

Demands for calf lymph were sent to the Director, Government Lymph Establishment, and vaccines and sera were obtained from the Medical Stores Depot if listed in their vocabulary. Any vaccines or sera not included in the vocabulary were demanded through Command Headquarters.

The procedure for the receipt of stores was contained in A.P.1269 (Medical Officers' Handbook).

The quantity of dangerous drugs to be held at sick quarters was laid down, with regulations on how to keep the dangerous drug register at station and satellite sick quarters.

Periodic inspection of all equipment issued on loan was carried out and all vouchers in respect of loans were passed to Command Headquarters for annotation. A 100 per cent. stocktaking was required before the submission of the six-monthly demand or upon change of medical officer in charge of the station. Repairs, supply of artificial limbs, eyes, surgical appliances and boots, spectacles, elastic hosiery, abdominal belts and trusses were all covered by instructions.

To prevent stocks of drugs accumulating at sick quarters beyond all reasonable requirements, medical officers were reminded that the necessary scales were based upon the maximum quantities which were considered adequate for a total strength of 1,000 men for a period of three months. Attention was drawn to the Medical Research War Memorandum 'Economy in the Use of Drugs in War-time', and reference was made to this when submitting six-monthly demands.

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New stations were equipped at the outset to Scale Z.1, the items being forwarded to the parent station for issue. Such additional drugs and dressings as were required by the new station were supplied by the parent station, which assisted the new unit in every way connected with medical stores.

When the new station sick quarters were ready to receive the initial equipment for a new station in Bomber Command, the Group Headquarters informed Command Headquarters accordingly and the new station received the initial equipment without any further demands. When this was received, checked and taken on charge, the scale Z.1 originally issued was checked and suitable action was taken to bring it back to scale if necessary.

Satellite medical inspection huts were equipped to the scale laid down. These items were issued on loan from the parent station. The medical officer in charge of the satellite was responsible to the medical officer in charge of the parent station for the medical equipment held at the former and he made periodic checks of the equipment. The satellite ambulance was equipped with Scale B.1 of A.P.132 extracted from the Scale Z.1. Class 'B' and 'C' stores as required were issued to the satellite by the parent station, whose six-monthly demands were to include satellite requirements.

The scale for separate W.A.A.F. sick quarters was laid down and all permanent W.A.A.F. sick quarters were equipped to this scale from stocks held in station sick quarters.

Command Headquarters dealt with the issue of, and accounting for, medical stores and arranged for occasional checks of medical stores at stations. It was not possible to maintain adequate supervision of medical equipment at stations by this means. Senior Medical Officers of groups, therefore, supervised the medical equipment at stations and reported to Command Headquarters any defects observed which they were unable to deal with themselves.

Emergency reserve medical equipment was stored in some building away from sick quarters in suitable packing cases. This equipment was for emergency use only and was not unpacked except for turnover of stock when supplies were available or for checking purposes. A list of the contents was included in the packing cases and it was held on charge as a composite item under Section VIII of A.P.132. Medical officers ensured that this equipment was kept to scale for the strength of the station.

TRANSPORT

The light Morris and the heavy Albion were the two chief types of ambulance used as transport by station sick quarters. It was the practice to supply all stations, except satellites, with one or two heavy

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ambulances and one light ambulance. A certain amount of choice was given to medical officers in the opening of new stations and two light ambulances and one heavy were sometimes supplied, where local conditions demanded. The light ambulance, which was faster and consumed less petrol, was adequate for transferring slightly injured persons to hospital, or seriously injured persons for short distances. For longer distances the heavy ambulance was preferred for seriously injured cases. It was slower, could be completely closed and heated if necessary; it was more comfortable and it was roomy enough to hold medical personnel and their apparatus to deal with the patient on the way to sick quarters or hospital. The heavy ambulance was preferred for the conveyance of injured members of aircrew from crashed aircraft to hospital. These crashes invariably occurred in rough country, commons or fields, and the heavy ambulance with its high body clearance was most useful for such surfaces.

A heavy-type ambulance fully equipped with driver and one or two nursing orderlies normally stood ready at station sick quarters; but during operational sorties, night or day, the ambulance was situated near the Watch Tower or Control Tower as was best indicated locally. On most stations a heavy M.T. crane was available, but it was generally found that it did not arrive soon enough when wanted at crashes off the airfield. To overcome this, many heavy ambulances were fitted locally with light cranes on the roof, but the general opinion among medical officers was that the ambulance was better without such a fitting, as it seriously interfered with the stability of the vehicle at any speeds over 20 miles per hour. A reserve ambulance of a light or heavy type was usually available to take the place of one sent to a crash, and in addition there were available lorries, fitted with Flint stretcher gear, ready to proceed to the crash if necessary. The ambulance sent off first had to be of the heavy type, as transport over rough ground was only possible by its use. The primary purpose of the ambulance was to remove casualties as quickly and comfortably as possible, while providing first-aid treatment before and during transit. For efficiency the ambulance was fitted with enough but not too much equipment. The equipment consisted of Scale B.1 (A.P.132) and was frequently and thoroughly checked over. Items such as Wellington boots, heavy type axe, old clothes and heavy wire or bolt cutters served useful purposes not only in permitting the ambulance personnel to do something towards rescue but in allowing the ambulance to make its way through difficult country.

Radio direction and intercommunication apparatus, where fitted, was on many occasions a boon, but as it was not an official issue its installation in the ambulance depended on local co-operation on the stations which was invariably freely given.

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It was important that any patients who required transport to hospital by ambulance should be conveyed as early in the day as possible, particularly on stations where flying was in progress, and where one ambulance was stationed at or near the airfield. Where hospital facilities were some distance away, the ambulance might be the best part of a day away from the airfield and therefore not available in an emergency on the station. Many of the stations were close to civilian hospitals and local arrangements were made at these hospitals for the reception of all classes of patients. Where R.A.F. hospitals were in the area, they were preferred. Similar arrangements were made for out-patient appointments but local train and bus services were used where possible for the transport of these cases.

CIVIL HOSPITALS

It is unnecessary to include here a list of Emergency Medical Services (E.M.S.) hospitals serving Bomber Command stations. Each station was fully acquainted with its own neighbouring E.M.S. hospitals, knowing the mileage from the stations, the bed accommodation available and whether or not particular cases could be treated there. A list of E.M.S. hospitals was available on stations in the form of E.M.S. I.364, which was kept amended as required. Needless to say it was important that Command Headquarters notified units of any changes in respect of E.M.S. hospitals as early as possible.

The number of cases sent to these hospitals naturally depended on the proximity of R.A.F. hospitals, but all R.A.F. stations in Bomber Command required to use them for all personnel. The patient, accompanied by clinical notes to date, was sent at a time mutually arranged. The documents sent with the patient were a Form 624 (Sick Report) and a Form 41 (Hospital Record) completed as far as possible, and in a number of cases, a covering note on relevant points, particularly in respect of the disposal of documents on discharge of the patient. Evidence showed that this final instruction was desirable to ensure correct and prompt disposal. In this connexion the general opinion was that the wording on the footnote to M.P.C.47* might have been more explicit and on the lines of Air Ministry Pamphlet 108, clause 12 (V). Every assistance was given by the Civil Hospital Authorities. The following is a verbatim synopsis of the procedure for admission of Service personnel to an E.M.S. hospital by the medical officer at R.A.F. Station, Waterbeach, in No. 3 Group:

> *Admission.* Patients other than aircrew, except in special circumstances, are admitted to Emergency Medical Services Hospitals if accommodation in a Service hospital is impracticable; urgency or distance being the

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See Emergency Medical Services History, Vol. I, Chapter 3.

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main factors. The medical officer of the unit arranges admission by telephone with the hospital concerned. Thereafter the procedure is as follows. Two copies of Form 41 and four copies of Form 624 are raised. One Form 41 and one Form 624 are enclosed in a sealed envelope marked 'Confidential' and forwarded with the patient to the hospital concerned. The remaining forms are disposed of as below:

(*a*) To Medical Statistical Office, Ruislip: F.624(1) in a postagram envelope endorsed either 'flying' or 'non-flying personnel'.

(*b*) To Commanding Officer of Unit: F.624 (1) notification of airman's admission.

(*c*) Remaining F.624 to file.

(*d*) Form 39, flimsy (copy from F.41) inserted in Form 48 and retained in Station Sick Quarters.

(*e*) Form 39, card to Group Headquarters with Form 38 returns at end of month.

Following Admission. Unit medical officers follow patient's progress either:

By weekly *pro forma* requesting essential details and prognosis.

By telephone if distance makes it necessary or patient's condition requires.

On Discharge. The hospital is requested:

(*a*) To instruct patient to report to his unit medical officer.

(*b*) To forward M.P.C.47* with him under sealed cover.

On the arrival of the patient the unit medical officer peruses M.P.C.47, abstracts notes on to F.41, to be copied on F.39 (card and flimsy), rendered as from Emergency Medical Services Hospital. Sick leave, if indicated, is granted by the unit medical officer up to 21 days.

In exceptional circumstances sick leave may be granted direct from a civil hospital by a military registrar, who includes a report in M.P.C.47 and forwards it through the post to the unit. Thereafter the disposal of forms is as follows:

(*a*) To Medical Statistical Office, Ruislip: M.P.C.47 and card copy F.39.

(*b*) To unit commanding officer: F.624, notifying discharge.

(*c*) Enclosed in F.48 : flimsy F.39.

(*d*) To file in station sick quarters: F.41 raised by unit medical officer.

Aircrew Personnel. Full instructions on the admission and transfer procedure of aircrew personnel to and from Emergency Medical Services hospitals as soon as possible are contained in Air Ministry letter A.120567/40/M.A.2., dated 5.4.42. The essential principles are:

(*a*) No routine admission of aircrew to Emergency Medical Services hospitals should ever be made.

(*b*) Emergency admissions of aircrew are notified at once by signal or telephone to Central Medical Establishment so that:

(i) Service Consultant can visit patient at first opportunity.

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* *See* Emergency Medical Services History, Vol. I, Chapter 3.

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(ii) Transfer to a R.A.F. hospital can be arranged immediately the patient is fit to be moved.

It is emphasised that the above procedure relates only to Emergency Medical Services Hospitals and differs essentially from that adopted for Civil Hospitals not in the Emergency Medical Services Scheme.

Friendly liaison with the medical staff at E.M.S. hospitals was maintained to ensure that full medical reports were made out and despatched promptly. Such liaison helped to obviate statistical difficulties, to effect necessary transfers, and to obtain early notification of transfers to or from the seriously ill (S.I.) and dangerously ill (D.I.) lists, as well as to obtain information for relatives. Visits by the appropriate medical officers to patients in these hospitals were an important part of the liaison. The frequency of such visits was governed by Service requirements, which varied greatly, and by the number of medical officers on the station, which indeed was usually under establishment.

Patients could be admitted to E.M.S. hospitals from a parent unit; from a unit other than the parent unit, while on leave; or from a Service hospital direct, but in all cases the parent unit was the one most interested, both as regards the patient's welfare and the collection and disposal of records. In each case the Medical Statistical Office required to be supplied with a Form 624, at the earliest possible moment, and there was ample evidence that medical officers realised that this was most important from the 'follow-up' and 'check' aspects.

For admission direct to E.M.S. hospitals, the case was first seen by the station medical officer—on sick parade, in living quarters, or in station sick quarters—and full particulars were entered in the daily sick book. Form 41 was completed in duplicate and Form 624 prepared in quadruplicate, for disposal as indicated above. The preparation and forwarding of a Form 41 was regarded as essential if case notes were to be maintained by the hospital authorities. Full details of previous history and the condition of the case up to the time of admission into hospital, if given, created a good precedent for the hospital to follow. A case might have been seen previously as an out-patient by one of the specialists at the hospital, who had advised admission, but the procedure for admission was similar in all respects to that described above. Emergency admissions were generally effected by direct contact with the hospital by telephone. For the admission of aircrew personnel, the Form 624, sent to the Medical Statistical Office, was clearly marked 'Air Crew', while in the case of aircrew casualties the requirement of notifying the Central Medical Establishment was strictly complied with, so that arrangements could be made for the case to be dealt with by a R.A.F. specialist or consultant.

The patient was discharged from hospital to his parent unit or to a unit other than the parent unit, transferred to a Service hospital

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or recommended for sick leave. In the event of a medical board being required, suitable arrangements were made, through the senior medical officer of the group and the Medical Statistical Office, if the latter was involved. On discharge from hospital, the receipt of Form M.P.C.47 was expected, and when received, Form 39 (card and flimsy) was prepared, recording the principal clinical features and findings. Delay in receipt of M.P.C.47 was of frequent occurrence holding up the disposal of its contents—clinical notes, temperature charts, X-ray films and special reports—and leading to considerable correspondence. The general opinion of medical officers was that a covering letter to E.M.S. hospitals regarding the correct disposal of this form on discharge was necessary in each case.

Difficulties were met in obtaining admission of infectious cases. These difficulties were, of course, not new ones in the experience of either Service or civil doctors. To surmount them the best procedure was for the station medical officers and the local medical officers of health to maintain close liaison in all matters affecting the mutual safeguarding of the health of Service personnel and civilians.

Admission of officers to private wards was not always possible but generally there was no lack of appreciation on the part of the hospital authorities of the need to provide suitable accommodation. Throughout the war years Command Headquarters supplied medical officers with revised lists of E.M.S. hospitals in England and Wales issued by the Ministry of Health, where suitable accommodation was available for officer patients (male and female).

STATION DEFENCE SCHEMES

After the fall of France in 1940 station defence schemes became of increasing importance. Medical responsibility in these plans was limited to the treatment of the wounded and planning for the collection, treatment and evacuation of casualties. Some medical officers were not entirely clear about the purpose of the plans, which were to assist in maintaining effective resistance against any form of attack, whether from the ground or from the air—for example, a heavy bombing attack by night or by day.

The medical arrangements for dealing with ground casualties during and after an attack formed an essential part of the defence of all stations, and generally the main procedure carried out at each was similar. No one plan could be laid down and strictly adhered to for all stations. Each station had to meet its own particular needs and problems. Material factors were nearness or otherwise to an urban community with well-organised A.R.P. arrangements (rural isolation requiring greater unit independence), the degree of dispersal of aircraft and the plan of distribution of sites, living, communal or technical. Also

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important were the availability of a sick quarters with gas annexe and the proximity of stations to hospitals. All the arrangements to combat a maximum attack by air required to be in readiness to function immediately on the warning being given, bearing in mind that the dropping of parachute troops and the use of gas were always possibilities. Some stations had opportunities to test out their organisations both in practice and reality and the majority so attacked built up and improved the detail of their previous arrangements.

The scheme in operation required the collection of casualties to be a unit responsibility and this was best in the charge of a central directing staff. Stretcher-bearers required to be stationed at the most vulnerable and populated sites and casualties required to be brought or sent to collection points. Medical personnel were best employed confining themselves to skilled treatment and preparation of casualties for final evacuation at the place or places most suitable for such work. Feeding facilities had to be planned; the possible failure of the water supply and the need of the full anti-gas organisation could not be overlooked.

GENERAL PROCEDURE

During the actual attack, the prevention of casualties by insistence upon all personnel 'taking cover' while remaining on the alert, was universally adopted.* Collection of casualties during the raid was contra-indicated, unless the raid was prolonged. First aid to the casualties on the spot and removal to the nearest cover was accepted policy.

First-aid Provision, Stretcher-Bearers and their Training. The medical officer and nursing orderly establishment available on any station was inadequate where many casualties were likely to be involved simultaneously. They could not possibly deal with casualties at all stages and these trained personnel were best located at the most central point—or not more than two points—where their skilled services would be of most value. Medical plans centred on the station sick quarters, the medical inspection room or block, the gas annexe and a number of first-aid posts on the airfield and technical sites.

Additional personnel were trained to administer immediate first aid. The arrangements for instruction in elementary first aid and procedure to all personnel was a priority in the arrangements to be made by medical officers and instructions were issued from Command Headquarters to all unit commanders to co-operate with medical officers in this matter. In addition to this instruction to all, selected personnel were earmarked for first-aid parties and stretcher-bearer duties and to these fairly advanced lectures, instructions and demonstrations required

* The success of this simple procedure is alluded to in many Campaign narratives (*See* Volume III).

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to be given. Command provided medical officers with a very comprehensive syllabus covering the requirements of this subject. Frequent postings and the demands of normal duties constantly interfered with the best training arrangements.

First-Aid Collecting Points and Collection in General. Collecting points in suitable available buildings were earmarked and, if necessary, minor constructional adjustments were made to facilitate the prompt entrance and exit of casualties and their treatment. These places were suitably sign-posted. To each of these points were allotted a number of persons skilled in first aid. Each point had ample supplies of stretchers, blankets, cotton wool, bandages, shell dressings, field dressings and materials with which to improvise splints. Provision for hot drinks was necessary at all points.

Transport. One ambulance was stationed at the sick quarters and the others were suitably dispersed. Vehicles fitted with Flint stretcher gear remained on the technical site, usually in the mechanical transport yard.

RÔLE OF SICK QUARTERS AND SICK ANNEXE

The station sick quarters and its annexe, where provided, was much more than a dressing station. It approached more closely a well equipped casualty clearing station capable of dealing with the most severe casualties by giving resuscitation and surgical treatment. If it escaped the attack there was normally available a staff and equipment which could go far to provide treatment of first class quality. The arrival of a surgical team from other Service sources* or from an A.R.P. organisation permitted its facilities to be used to the fullest extent. In this respect the policy of the Royal Air Force provided something which had no equal and should a patient not be fit enough to be removed to hospital, the facilities available were such that he could be retained with confidence in sick quarters.

The satellite airfields were not so happily placed for there the medical aid post more closely resembled a field dressing station and prompt evacuation to hospital was arranged after minimum but careful treatment had been given. But here too the arrival of a surgical team could be awaited without anxiety, since better facilities were available for it than would normally be found in the field.

Most stations earmarked an auxiliary sick quarters for use in the event of sick quarters beng destroyed and made available equipment and other provisions to permit treatment pending removal to hospital.

* R.A.F. General and many station hospitals had a mobile surgical team earmarked for such emergencies.

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GAS CASUALTIES

It was realised that in the event of a combined gas and bomb attack the complications arising might be considerable. Each station, when established, had a gas cleansing centre for unwounded cases and a decontamination gas section at sick quarters. This provision was far-sighted and might have proved valuable, but fortunately no poisonous gases were used.

The handling of gas casualties at Bomber Command stations was prepared for on similar lines everywhere and a scheme to control contamination, on the transference of gas contaminated stretcher cases through the outer room and air-lock of a Bomber Command station annexe into the inner cleansing room and theatre, was more or less stereotyped on every station.

The scheme was simple and had many advantages over other more elaborate routines. It ensured that:

(*a*) no contaminated stretchers ever entered the inner room and no clean stretchers entered the outer room;
(*b*) no passage through the air-lock from one room into the other was made by anyone except the patient;
(*c*) the patient was transferred from a relatively contaminated to a relatively clean stretcher in one simple safe lifting movement in the air-lock with both doors closed;
(*d*) the use of electric bells, buzzers or signal lights to control the air-lock, always a possible source of unreliability, was avoided.

GENERAL REMARKS

The majority of medical personnel remained at posts in station sick quarters. On stations with two medical officers, one medical officer with orderly or orderlies proceeded to the medical inspection block or the station sick quarters decontamination centre. In the rare event of there being three medical officers, the procedure was that the third should either go to a first-aid post or remain in sick quarters as anaesthetist.

The telephone operators and runners undertook the reporting of casualties to the medical staff, and the gas officer and his staff went to their posts and maintained contact with the station sick quarters.

The routine of evacuation of casualties was first to the station sick quarters and thence to the neighbouring Royal Air Force, Army or civilian hospitals which normally served the station. Liaison for help and loan of ambulances was made with local hospitals and local A.R.P. organisations.

ENEMY ATTACKS ON BOMBER STATIONS

Though all stations were prepared for enemy attacks both with high explosives and gas, it was fortunate that few developed and in those

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which occurred gas was never employed. The following is a brief indication of incidents which occurred at certain stations in Bomber Command:

On July 4, 1940, R.A.F. Station, Driffield, in No. 4 Group, was bombed by a single enemy aircraft at 2230 hours. One stick of four bombs was dropped and damaged two barrack blocks, demolished two married quarters and seriously damaged many other buildings. As no air-raid alarm had been given there was a large number of men in each block and in many of the married quarters. In spite of this there were only 26 casualties, and the majority of the men injured were cut by flying glass. On August 15, 1940, the same station was again attacked, this time with more serious results to personnel. Five airmen were slightly injured, 17 casualties were transferred to Driffield Base Hospital, where 2 subsequently died, and 11 were killed outright.

At approximately 1750 hours on August 16, 1940, enemy aircraft raided and bombed R.A.F. Station, Harwell causing 2 fatal injuries, while 4 persons sustained bomb splinter wounds and machine-gun bullet wounds. On August 17, R.A.F. Station, Honington was attacked and there were a number of seriously ill, dangerously ill and fatal casualties. This station was again attacked on October 28, 1940, with 3 dead, 1 seriously injured and 6 minor injuries. To the end of the year Mildenhall, Newmarket, Dishforth, Eastchurch, Lindholme, West Raynham, Lossiemouth, Wattisham, Stradishall, Driffield, Waterbeach and Abingdon were attacked, some of them more than once. At approximately 1745 hours on October 27, 1940, R.A.F. Station, Lindholme, in No. 5 Group, was attacked by a single enemy bomber which obtained direct hits on the station sick quarters and a barrack block. There were no casualties among airmen in the barrack block but one aircrafthand employed at station sick quarters was killed while another was seriously injured and four nursing orderlies suffered minor abrasions. Driffield was repeatedly attacked but managed to carry on, the morale of the station remaining high.

During 1941, R.A.F. Stations Watton, Honington, Wattisham, Mildenhall, Waterbeach, Newmarket, Grantham, Benson, Stradishall, Mount Farm, Abingdon, Leeming, Marham, Newton, Scampton, Linton-on-Ouse, Waddington, Oakington, Elsham Wolds, Bassingbourne, Feltwell and Holme-on-Spalding-Moor were attacked, many of them several times. The largest number of casualties was suffered at Linton-on-Ouse, which was attacked at 0230 hours on May 12, 1941. The Station Commander and 11 other ranks were killed, 19 were transferred to hospital and 21 were treated at sick quarters.

In 1942 and onwards attacks were chiefly sporadic, no serious damage was done to stations, and personnel showed no lowering of morale.

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HEALTH OF THE COMMAND

The rapid expansion of the Royal Air Force after 1939 is the chief fact to bear in mind when considering the health of Bomber Command during the war years. The increase in strength consequent upon this expansion affected such questions as accommodation, messing arrangements and working conditions and all of these had some influence on the health of personnel; nevertheless, although in many instances a real danger was constituted by overcrowding and other equally undesirable conditions, no major epidemics occurred and it is a remarkable fact that there was actually a decline in the overall sickness rates for the Command between 1939 and 1945.

LIVING CONDITIONS

As already mentioned, the main difficulty to be contended with was overcrowding. New stations were being occupied before they were ready and reconstruction work was being carried out continually, while changes in the status of stations and their organisation called for accommodation and amenities for many more personnel than had been originally intended. Later, accommodation problems arose not so much from lack of space as from defects in construction. War-time buildings, and huts in particular, were often damp and draughty and although extra issues of fuel were sometimes made to counteract the dampness, these conditions, together with the prevalence of dust, largely accounted for the high incidence of upper respiratory tract infections throughout the war years; the number of cases of pneumonia which occurred was also considered to be partly due to these factors, while the reduction of floor space per person may well have been responsible for the higher incidence of pulmonary tuberculosis evidenced in 1943, not so much in its communicable aspect as in providing suitable conditions for its onset in those predisposed to the disease.

Unhygienic conditions in cookhouses and messes were in some instances further contributory factors and although an outbreak of illness might draw attention to some defect and lead to remedial action being taken, the necessity for stricter preventive measures was not sufficiently appreciated.

WORKING CONDITIONS

In 1941 the trades in which working conditions caused the most concern were those of telephonist and cook among W.A.A.F. personnel. In the former trade, hours of duty were often long and operators worked in telephone exchanges which were usually blacked out, with no natural lighting and poor ventilation; such conditions were far from ideal and were not conducive to good health. Cooks, too, worked long hours with very little free time, although the position improved later as the number

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of personnel in the trade increased. At the beginning of the war opportunities for recreation were limited owing to petrol restrictions and the blackout. Few stations had organised P.T. until more instructors were established and there were not, at first, sufficient gymnasia or recreational facilities, no provision having been made for the large influx of war-time personnel.

W.A.A.F. HEALTH AND HYGIENE

Considerable attention was paid to the health of the W.A.A.F. and as to how it was affected by the change from civilian to Service life; foot affections, caused by the unaccustomed heavier and stiffer Service shoes, were the most common complaint.

Lectures on personal and social hygiene were given by the Command Woman Medical Officer and members of the P.M.R.A.F.N.S., although it was a formidable task to cover all stations with the limited number of suitable lecturers available. However, a growing appreciation over the years of the value of such lectures and also of the necessity for 'Free From Infection' parades resulted in a reduction of head infestations and improvement in personal hygiene.

The reduction in 1943 of floor space per person was felt to be particularly harmful as applied to W.A.A.F. sleeping accommodation, where strict compliance with the scale denied reasonable comfort, especially in the disposal of clothing, and reacted adversely on the well-being of the airwomen, notably that of watch-keepers.

Provision of rest room and cloakroom accommodation for M.T. drivers, cooks, kitchen staff and other personnel whose duties involved irregular hours or short meal breaks was a problem at most stations and although steps were taken to improve matters, much more needed to be done. The question of suitable shifts and watches* was tackled persistently but very strict discipline was necessary to enforce any system compatible with health.

INCIDENCE OF DISEASE

Minor ailments tended to be more readily reported among members of aircrew and the W.A.A.F. than among other personnel; in 1943, for instance, the sickness rate for aircrew was about equal to that for W.A.A.F. personnel but approximately double that for other members of the R.A.F. Among all personnel there was a seasonal increase of disease each winter and spring but rarely any localisation, cases being spread, for the most part, over a large number of stations. The incidence of disease in Bomber Command for 1939 to 1945 is indicated in Fig. 2. This shows only the conditions requiring more than forty-eight hours

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* *See* No. 60 Group narrative, Chapter 11.

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absence from duty, but a considerable number of man-hours were lost through minor illnesses of short duration and reference to the latter will therefore be included in the brief comments which follow.

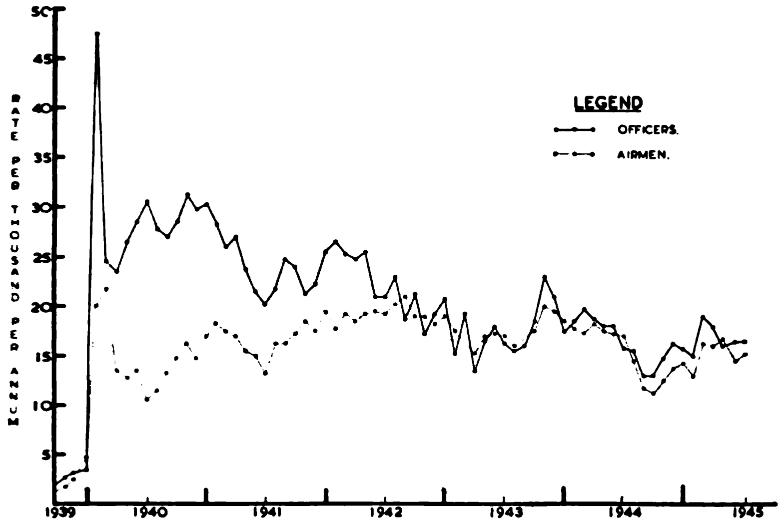

FIG. 2. Graph showing incidence of sickness in Bomber Command, 1939–45 (Excluding W.A.A.F.).

There was more sickness in the first winter of the war than in any succeeding winter, a wet October in 1939 and severe cold at the end of the year ushering in an epidemic of upper respiratory infections in November and December. In the winter of 1943, the incidence of sickness was above that for 1942 owing to the high seasonal peak of influenza cases in November and December (reflecting the position throughout the country) and again, in January 1945 a general rise in the disability rate, most marked in the respiratory class of disease, was caused by a period of severe frost. In each instance, outbreaks of minor respiratory disease were countered by gargling, staggering of beds and, wherever possible, increased ventilation in sleeping quarters.

There was a high incidence of infective hepatitis throughout the war years and particularly in 1943, when the disease was responsible for one-third of the cases of notifiable disease among R.A.F. and Dominion personnel and one-fifth of the W.A.A.F. cases. From the data available it has not been possible to make any deductions as to the origin or cause of the disease, except that it seemed prone to occur in conditions of community life as encountered in the Services. In January 1943 of 79 cases of infective hepatitis, 22 occurred at one station among aircrew personnel who, in preparation for proceeding overseas, had been inoculated against yellow fever in October 1942.

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Only a few scattered cases of food poisoning were reported and none of these could be traced to any specific cause. There were, however, a number of outbreaks of diarrhoea and gastro-enteritis, particularly in the summer months. In 1943, for instance, gastro-enteritis and other digestive disorders averaged a weekly total of 70 cases, but these again were generally distributed over a wide area and only occasionally did the number of cases occurring simultaneously at any one place give cause for anxiety concerning items of diet. Similarly, in 1944 a number of stations reported cases of gastro-enteritis during the summer and autumn but the local civilian population were also affected and it was not usually possible to pin down the source of infection. An exception to this was in November of that year, when 24 W.A.A.F. personnel, mainly teleprinter operators, were affected by a sharp outbreak of diarrhoea with colicky abdominal pain, all recovering within 48 hours; on this occasion the W.A.A.F. kitchen was stated to be satisfactory but some sausages, the only article of diet common to all those affected, were found on investigation to give heavy growths of B. *subtilis*, non-pathogenic staphyloccoci and B. *coli fæcalis*.

After a number of outbreaks of diarrhoea in 1942, instructions were issued to Groups that a special report was to be rendered to the Principal Medical Officer whenever there occurred at any one station a number of co-incidental cases of any disease which might be of an infectious nature or which might have a common origin. It was pointed out that there had been a tendency to delay in providing Command Headquarters with information as to the occurrence of such cases, numbers involved, investigations made and local action taken to bring the outbreak under control; such delay made it impossible for the P.M.O. to take effective action.

In May 1944, a series of 47 cases of enteritis, typical clinically and bacteriologically of *Sonné* type dysentery, occurred at R.A.F. Station, Chicksands Priory and by the end of the month 43 members of the W.A.A.F. and 4 airmen were affected, a further 7 W.A.A.F. and 13 R.A.F. personnel being involved by the middle of June. The station medical officer dealt with the outbreak on orthodox lines.

In July 1944, at Church Green, 20 airwomen and 5 airmen were involved in a sudden attack of *Sonné* dysentery; the cause was found to be a carrier among the cooks in the combined cookhouse and the outbreak declined after the person concerned had been removed.

Seventy-nine cases of recurrent malaria were recorded in 1942, mostly in the latter part of the year, and 107 cases in 1943, both these figures being of interest in their relation to the numbers of personnel returning from the Tropics; the figures for 1944 and the first five months of 1945 were 122 and 78 respectively. The first cases of recurrent malaria in airwomen were reported in 1944, the 19 cases from June to October including 8 Polish airwomen returning from Iran.

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A diphtheria outbreak occurred in April 1943 at R.A.F. Station, Bottesford and involved 20 personnel, including 14 W.A.A.F. The outbreak appeared to have originated from a W.A.A.F. cook in the W.A.A.F. mess, who went on leave on April 3, 1943; she was seen by a civilian practitioner and admitted to Leeds City Isolation Hospital, where she died of the disease on April 5. The first patient seen at Bottesford had shared the same hut as this airwoman. From the observations of the station medical officer the incubation period appeared to be from three to four days in most instances and the organism was, without exception, of the intermediate type; 2,000 Schick tests were carried out and 250 non-immune personnel were immunised with A.P.T.

In December 1942, 28 cases of gingivitis occurred at one station, all being traced to a N.A.A.F.I. van using unwashed cups; the outbreak soon subsided after arrangements had been made for all cups to be washed in future in water containing disinfectant.

To sum up, the incidence of disease in the Command was relatively low throughout the war years, considering the conditions under which, by force of circumstance, personnel were living; it should be remembered, however, that the majority of members of the R.A.F. and W.A.A.F. were of high physical standard.

Problems of Aviation Medicine

Station and Squadron Medical Officers: Medical Supervision of Aircrew

Many of the medical problems which arose at Operational Training Units and during operational flying were peculiar to aircrew personnel and required special handling by the medical officers concerned; one of the most important tasks for the latter was to prevent the adverse effects on aircrew which were likely to be produced by the very nature of their duties. Members of aircrew had to maintain a very high level of operational efficiency which was directly influenced by the welfare of the individual and strict supervision was necessary to ensure that they did not break down through overstepping the limits of their endurance. Medical officers were usually only too well aware of their own ignorance of flying conditions and there was little information available to assist them, apart from Air Publication 1269, in which were laid down the principles of the medical care of flying personnel. Some of the ways in which they tackled the many problems which arose during the war years are described in the following paragraphs.

OPERATIONAL SQUADRONS

On being posted to a squadron a medical officer's first step was to

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acquaint himself with all details concerning the type of aircraft in use. This was best achieved by visiting the squadron commander and other flying personnel, from whom he could obtain such information as the endurance, range and ceiling of the aircraft, the number and duties of the crew complement, seating, type of heating (if any) and oxygen supply. Not only the knowledge gained, but also the link with aircrew created by his evident interest, proved a great help to the medical officer in his work.

Personal contact with flying personnel in their own environment, that is, dispersal points, hangars, flight office, mess and off-duty haunts, was essential and was relatively easy to secure in the case of officer aircrew; there were difficulties about mixing freely with non-commissioned officers but these could be overcome, particularly as the station commander usually realised the value of such contact and did all in his power to promote friendly relationships, within the bounds of station discipline, between medical officer and non-commissioned aircrew.

The medical officer quickly developed an aptitude for 'summing-up' all flying personnel with whom he came in contact. He would endeavour to assess the temperament and constitution of each individual, often keeping a private notebook in which he could jot down details from log-books, flying experience, notes of reaction in crises and relevant personal details about the crew member concerned; he was also aware of the length of tour and the stage reached by each individual.

Close co-operation with commanding officer, squadron and flight commanders, gunnery and bombing leaders and engineer officers was acknowledged by every medical officer to be of great value in gaining an insight into the reactions of aircrew to operations. Such knowledge, supplementing his own observations, enabled him to judge whether personnel showing signs of strain were fit to carry out the remaining sorties of their tour and put him in a strong position to recommend a rest period or posting to other duties in cases where he felt this to be necessary.

The uncertainty and strain caused by the cancellation of sorties and prolonged standing-by led to crews becoming fatigued; this fatigue was often aggravated by a sense of grievance which arose simply from ignorance of the reasons for their enforced inactivity. The attitude of ground crews was also important, as any sense of dissatisfaction among them quickly communicated itself to the flying personnel, with undesirable consequences. In circumstances such as these, the medical officer could exert a steadying influence and use that influence to restore a sense of well-being among air and ground crews alike. The day to day duties of the medical officer were, in fact, closely linked with the maintenance of morale, which constituted one of the major problems among aircrew personnel.

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It was undoubtedly good policy to keep medical officers in the Command as long as possible. Whenever circumstances permitted, a period of three months was spent at an operational training unit before posting to an operational station or squadron; this provided an excellent introduction to the Command and gave an opportunity for gaining considerable experience. Inevitably there were misfits, but the good medical officer made it his concern to seek a solution to every aircrew problem he came upon and also kept in close touch with the work being done at the Royal Air Force Physiological Laboratory at Farnborough. He checked, personally, that every member of the squadron had the latest type oxygen mask of the correct size and accompanied every crew to the stores when they arrived on the squadron, satisfying himself that each man was correctly clothed and fully conversant with the use of all his equipment.

A squadron medical officer's duties included completely identifying himself with the aircrew by being present at briefing, visiting them while they were waiting at their dispersals before take-off, being on the spot at take-off and return and by being on instant call during the interim period in case aircraft returned early or damaged. At interrogation, by wandering quietly among the crews he learned what experiences they had met and their reactions to them.

At the afternoon sick parades for aircrew, he would see personnel who were sick or exhausted from the previous night's operations and have to decide whether they were fit to fly again that night or whether they would be a danger to the rest of the crew. This responsibility was particularly great when the intensity of operations made it imperative that every man who could possibly fly should do so.

The social duties of a squadron medical officer were no less arduous than those which were strictly professional. It was essential, for instance, that on 'stand-down' nights he should enter whole-heartedly into the aircrews' entertainment, for in the atmosphere of friendly intercourse individuals would talk more freely about themselves—their marital and family ties and personal problems; such occasions as these, therefore, offered excellent opportunities for medical officers to gain their confidence. Without this latter prerequisite, the most painstaking efforts of a medical officer could be rendered completely ineffective.

AIRCREW ACCOMMODATION AND THE COMMON COLD

Once Bomber Command started flying regularly at high altitudes one of the biggest problems encountered by medical officers was the common cold, with its attendant risk of aural damage. The majority of bomber stations consisted of dispersed prefabricated huts* of relatively

* *See* Volume I, Chapter 7.

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flimsy construction which, especially in winter, were frequently draughty and cold, while poor ventilation meant that they quickly became overheated and humid when the stoves were alight and condensers of moisture when the fire had gone out. Such sleeping accommodation afforded a chilly welcome to aircrews returning from operations in the early hours of the morning, exhausted and cold. Furthermore, after mid-1943 the huts were usually unavoidably overcrowded because of the increased size of squadrons necessitated by the sustained offensive against Germany. All these factors combined to produce ideal conditions for the flourishing of upper respiratory infections. In fact, on many occasions it would have been impossible to find sufficient crews if medical officers had prevented all personnel with colds from flying, although, theoretically, even a mild cold should have 'grounded' the sufferer.

Medical officers were faced with a further difficulty in that aircrews were superstitious about being split up and carrying an unfamiliar member and he had therefore to decide whether to allow an individual to fly with a cold or risk discontent from an apprehensive crew.

PHYSICAL FITNESS

The Command physical fitness section was initially under the control of the Training Branch of the Air Staff but was transferred in August 1943 to the Personnel Branch of the Administrative Staff; a Command Physical Fitness Officer was appointed with general responsibility, while to facilitate training the Command was divided into three areas, Northern, Midland, and Southern, each area having its own physical fitness officer.

Medical officers realised the importance of physical fitness, with its direct bearing on morale and fighting efficiency, and Command instructions stressed the necessity for close liaison with the station physical fitness officer in this matter. Some stations were poorly supplied with recreational facilities but it was considered that everything possible should be done to fill in the spare time of aircrew personnel, on or off duty, although this was particularly difficult in bad weather. Efforts were made to arrange classes for physical training and gymnastic exercises and to encourage individual and team games which, while not interfering with flying duties, would benefit as many aircrew as possible. These endeavours met with varying success. Voluntary amusements involving physical effort were not as a rule popular with aircrew, who were in many instances lax in regard to discipline; medical officers found, however, that it was possible, in conjunction with the physical fitness officer and with the co-operation of station and squadron commanders, to organise a number of games in which aircrew soon

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realised it was to their own advantage to join, from the point of view of general and operational fitness.

In spite of all that was done, however, few flying personnel managed to become really interested in sport or ordinary activities with the shadow of operations over them continually; many medical officers felt this was also the reason why aircrew preferred purely social recreation and were liable to over-indulge in alcohol. As the war progressed, this situation improved, possibly because of the better training and also the fact that later crews were able to see more prospect of a successful conclusion to the war than had been apparent to their predecessors.

LEAVE AND THE MEDICAL OFFICER'S RESPONSIBILITY

It was realised that regular leave periods at fixed times known beforehand to aircrew personnel assisted considerably in the preservation of fighting morale and warded off staleness. In addition to the normal leave entitlement, however, special leave concessions were often made in the case of personnel who had suffered emotional as distinct from physical shock; for example, an unpleasant or horrifying experience such as a crash or difficult bale-out might be considered sufficient justification for a special grant of leave. Recommendations were made by the medical officer in cases where he felt leave, rather than a speedy resumption of flying duties, to be necessary for the restoration of confidence.

Sometimes it happened that crews or crew members lost a period of leave through being posted; the medical officer, by keeping in touch with the leave position, could ensure that their new commanding officer was made aware of the situation.

MINOR COMPLAINTS AND THEIR SIGNIFICANCE

The medical officer was often approached officially and unofficially by aircrew personnel suffering from minor complaints and he had to discriminate between those genuinely ill and those in whom exaggerated trivial ailments were but a cloak for wavering morale. In the latter case, careful handling was required and the crew members concerned had to be dealt with sympathetically but firmly, to ensure that an easy way of escape from flying duties was not opened to them. The medical officer could exercise useful and successful co-operation by securing for any such personnel a few words of encouragement and suitable personal attention from the commanding officer of the unit.

VENEREAL DISEASE

The aircrew incidence of venereal disease was higher than for other personnel, reaching 34·5 per thousand per annum in 1942 and 35·5 per thousand in 1943; it dropped to 26·0 per thousand in 1944 and remained at approximately that level until May 1945.

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This considerable incidence in aircrews had many causes: their youthfulness and inexperience of life, the strain arising from their occupation and their uncertainty concerning the future, greater freedom from station duties, more leisure and leave, good pay, and the hero-worship with which the nature of their duties surrounded them, all had an influence on the numbers of personnel who exposed themselves to the risks of contracting the disease. Such influences often overruled any sense of morality, family ties and crew spirit, even in the strongest-willed individual.

Apart from all other considerations, the need to obtain the maximum war effort from crews made it imperative that strong measures should be taken to deal with the disease and the problem was tackled vigorously throughout the Command. Medical officers constantly stressed the fact that the only sure way to prevent venereal disease was to avoid the possibility of contracting it and they also emphasised that it was not impossible to refrain from sexual intercourse; such efforts at dissuasion, however, appeared to have little effect. It was found that imposing restrictions on the liberty of aircrew was worse than useless, the resultant discontent and resentment causing a greater setback to the war effort than the disease itself; such methods demanded the provision of compensatory attractions, often quite beyond the capabilities of stations, although station commanders did all in their power to promote welfare by organising recreations and healthy activities with the object of keeping personnel within station bounds during their free time and thus away from the source of infection.

Prophylactic measures consisted in maintaining early treatment rooms supplied with running water and early treatment packets containing soap and tubes of mercury ointment with full directions for their use; such a room, suitably placed (for example, behind the guard room), was to be found on each station, while the utmost endeavour was made to persuade personnel to report to the medical officer if they were in any doubt whatever; individuals were also encouraged to seek private interviews with the medical officer on any points arising out of lectures on the subject of venereal disease.

Throughout the war years the executive and medical branches strove to reduce the incidence of the disease but although their efforts met with some degree of success, a number of towns remained sources of danger and the results in these areas were very disheartening. Many medical officers, in fact, felt that in spite of lectures, films, posters and influence from higher authority, very little lasting impression had been made on the problem. This view was enhanced when, after the general use of 'sulpha' drugs and antibiotics had become common knowledge, many personnel unfortunately acquired the mistaken idea that the disease could be cured as easily and as quickly as it was contracted.

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First Aid

During November 1944, a total of 14,849 operational sorties were flown by Bomber Command at a cost of 456 casualties (including 112 which proved fatal), in aircraft that managed to return to this country. The object of this narrative is to detail the methods by which it was endeavoured to prevent or minimise injuries by the use of first aid in its broadest sense. It is proposed to treat the subject under three main headings:

Treatment of casualties in flight and their removal from aircraft on and off aerodromes.

First-aid lectures and demonstrations to aircrew.

The use of emergency runways.

All accidents which occurred during operational training or during duty with operational squadrons were investigated and classified as failures due to technical faults, preparation, pilot error, enemy action or 'unclassified'; the majority of failures could be included under the headings of pilot error or unclassified. During non-operational flying, accidents were generally due to faulty procedure arising from inadequate or poor instruction, failure to adhere to training regimen or lack of opportunities for training in bad weather or cloud flying. During operational flying the main causes were:

The failure of captains to give systematic instruction and routine checks.

Frequent changes of crew upsetting established crew procedure.

Lowered physical and functional efficiency due to cold and/or anoxia.

The numbers of accidents in 1943 and 1944 are given in the following table:

	Operational		Operational training		Totals	
	1943	1944	1943	1944	1943	1944
1. Nos. of aircraft involving casualties	653	716	664	648	1,317	1,364
2. Personnel involved .	4,325	4,464	4,035	4,072	8,360	8,536
Dead . .	886	1,126	1,966	1,986	2,852	3,112
Injured . .	1,129	1,070	1,179	1,056	2,308	2,126
Uninjured .	2,310	2,268	890	1,030	3,200	3,298
3. Percentage dead .	21	25	49	49	34	36
,, injured .	26	24	29	27	28	25
4. Approximate sorties .	59,700	59,960				

It will be seen that the casualty rate was heavy and that it was imperative that all possible means of decreasing it should be attempted. With this object in mind, No. 7 Group was formed on November 1, 1944, to control and direct the training of all aircrews in heavy bombers. The

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Group comprised 16 heavy conversion units, 5 aircrew schools and the newly formed Bomber Command Instructors' School and the personnel (trainees and staff) totalled nearly 40,000. The three chief aims were:

To standardise training methods.
To reduce the accident rate.
To improve bombing accuracy.

How far these objects were achieved will be seen by the table below which contrasts the position on the formation of the Group with that ten months later:

	November 1944	August 1945
Group accident rate per 10,000 hours	25·5	2·02
Fatal accidents . . .	14 (85 aircrew killed)	Nil
Group average bombing error (20,000 ft. day and night) .	240 yds.	156 yds.

This introduction will have shown that the casualty rate was a matter of import to all medical officers, for it was to them that aircrew looked not only for skilled assistance when crashes occurred but also for advice on treatment to be given to wounded personnel either in the air or after crashing before such professional assistance became available. Throughout the war years continual efforts were made to improve the facilities at station sick quarters for dealing with victims of aircraft accidents, and the arrangements for their transmission to hospital when necessary, and also to educate the aircrew to as high a degree of first-aid knowledge as was practicable.

MANAGEMENT OF CASUALTIES

In making arrangements for the collection and prompt first-aid treatment of flying casualties, all station medical officers realised that more accidents occurred off the aerodrome than on it and also that they would be called upon to deal with types of aircraft other than that normally flown from their own station. At all stations where medical personnel, ambulances and sick quarters were available, a team was always ready to proceed to a crash or forced landing immediately information was received, or, if an aircraft returned after sustaining damage from enemy action, to remove and treat any casualties promptly.

In view of the psychological factors involved it was considered that removal of the wounded from aircraft was essentially a duty of the station medical personnel; accordingly the latter, together with selected members of ground crews, were trained in methods of removing

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casualties from the type of aircraft with which the station was equipped. The aim was always to avoid any unnecessary movement which would increase the severity of an existing injury or inflict additional suffering.* Three chief methods were available, man-handling, Neil-Robertson stretcher and crane hoist. (*See* Plate XXXIX.)

Memoranda† on methods of removing casualties from the various bombers in service, issued by Bomber Command, were most useful and familiarised personnel with the difficulties they would meet in dealing with aircraft of which they had perhaps no experience. As opportunity arose medical officers and staff inspected visiting bomber aircraft different from those on their own station, for the greater the knowledge of the build of the aircraft, the more expeditiously could casualties be removed from them. The ambulance arrangements are described in the Transport section earlier in this Chapter.

Unless other operational contingencies, such as the landing of other damaged aircraft, were expected, it was customary for the medical officer to proceed to all crashes, even if they occurred off the aerodrome, either with the heavy ambulance or following it in the light ambulance. In order to ensure his immediate availability to attend a crash, the medical officer, when not in sick quarters or with the ambulance, kept the duty medical N.C.O. informed of his movements within the station during all flying and whenever operations were in progress.

Often the ambulance became lost while searching for crashes outside the station, particularly when they occurred during the hours of darkness. Such experience showed that in no circumstances should ambulances set out until the exact location of the crash is known, either from an eye-witness or through the Operations Room or Flying Control. By this means, and using the grid reference maps always available in the ambulance, much valuable time was saved. As already mentioned ambulances provided with a wireless link had a great advantage during these urgent searches.

It was essential that the driver should have a thorough knowledge of the local countryside—names of villages, farms, country houses, all main and by-roads and local landmarks. Many medical officers cycled or motored around their stations in off-duty time acquainting themselves with the local geography and on many occasions this knowledge paid good dividends. In addition to having a knowledge of the locality an ambulance driver had to be able to drive his ambulance over rough or muddy cross-country areas without causing undue discomfort to the patients, and this required more than average driving skill. The employ-

* Instances of unskilled removal from aircraft increasing damage in spinal fractures were recorded on occasions.

† *See*, for example, Appendix E, page 21.

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ment of W.A.A.F. drivers was inevitable in view of the manning position, but wherever possible their use was limited to the light ambulances.

CRASH PROCEDURE

The procedure at each crash varied considerably for no two were alike and no hard and fast rules could be made; guiding principles were laid down but the medical officer in charge used his own initiative in deciding the best methods to adopt in a particular incident, depending on the nature of the crash. General experience showed that the majority of casualties in modern aircraft accidents were either dead or dying or only slightly injured, the latter being found especially in trivial accidents such as swings on take-off, heavy landings and taxi-ing mishaps.

The slightly injured personnel, if still in the aircraft, were assisted to escape, while those unable to move were man-handled out of the various positions in the aircraft, using splints, Neil-Robertson or sling stretchers and every other available appliance. Even with such provision the removal of casualties was no easy task, especially when the aircraft had belly-landed or when extensive structural damage had been sustained; with the added risks of fire and of bombs exploding and with the member of aircrew in full flying equipment and perhaps grievously wounded, the dangers and difficulties were very great and the improvisation and ingenuity shown reflected very great credit on the medical personnel concerned. (*See* Plate V.)

Casualties, on removal or even before it, needed first-aid treatment, and the first consideration was to render the patient free from pain as soon as possible. Personnel suffering severe injuries such as concussion, fractured skull or burns, who were not dead or dying, required priority in attention and were given the maximum of first aid possible within the limited, though adequate, facilities available, complicated and lengthy treatment being avoided at this stage. Plate VI illustrates the difficulties confronting rescue personnel when a crashed plane caught fire.

Disposal of Casualties. Stations held comprehensive information regarding civil hospitals and if the location of the crash and the condition of the injured indicated its advisability casualties were taken direct to the nearest one suitable; this procedure had official sanction but it was usually preferable to take the patients to station sick quarters in view of the ample facilities there for heat, fluids, resuscitation and plasma. Medical officers had great confidence in their crash rooms and at station sick quarters in Bomber Command experience proved that the expense incurred in providing such accommodation and full equipment was amply repaid.

The provision of a suitable mortuary to which the dead could be conveyed was another matter which required careful consideration and it was generally found that a building adjoining the sick quarters, with

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tiered metal stretchers, adequate lighting and water supply, was the most satisfactory, it often being necessary to house several bodies at the same time.

Preparation for Casualty Reception. At station sick quarters a day and night orderly was always on duty. In the event of a crash or casualties being expected* the necessary orderlies on the station were summoned and under the direction of the medical officer or senior N.C.O. prepared the crash annexe and wards for the reception and immediate treatment of casualties. By means of suitable lectures and demonstrations medical officers ensured that all nursing orderlies fully realised the importance of shock therapy. Full use was made of the annexes for the initial reception of casualties, fitted as they were with heat cradles, oxygen supply, drip stands and transfusion apparatus with ample serum and plasma. The maintenance of oxygen cylinders in working order was essential and to this end periodic testing was imperative. On many stations medical officers set up oxygen apparatus from crashed aircraft so that oxygen could be given to four or six people at a time. The treatment of shock, splinting of fractures, re-dressing and insufflating of 'sulpha' drugs on wounds, and suitable burn dressings, were procedures with which all the sick quarters staff were familiarised. The possibility of having to call a surgeon to sick quarters was borne in mind and arrangements were made accordingly, many of the larger hospitals providing a surgical 'flying squad' for this purpose.

The success of hospital treatment depended largely on the quality of the initial treatment at station sick quarters and in this respect medical officers who had previous casualty experience were in an advantageous position, particularly as text book cases rarely occurred. Nevertheless, previous surgical training on orthodox lines enabled all situations to be adequately met.

FIRST-AID LECTURES TO AIRCREW

Aircrews received frequent instruction in the rudiments of first aid in the air, to enable them to deal with wounds caused by enemy flak or fighters and to give help after a crash landing before the arrival of skilled assistance.

The lectures, given by medical officers, were based on the first-aid kit carried in aircraft and emphasised only the broad principles of first aid; medical and technical terms were avoided as far as possible and no attempt was made to describe anything but the simplest forms of treatment. First aid in the air was, in fact, largely a matter of common sense, but it was stressed that the only treatment available to a wounded man while airborne was that given by other members of the crew, who could

* S.S.Qs. 'stood to' when a damaged or defective aircraft was attempting a landing. This procedure became a very frequent occurrence in the latter years of the war, though fortunately many of these incidents did not cause casualties.

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ensure that he was handed over to the medical personnel at base in the best condition possible. The treatment given in aircraft, on many occasions, made all the difference between life and death.

It was the policy of most medical officers to vary the lectures as much as possible in order to avoid the great danger of aircrew treating first-aid instruction as a standard lecture forming part of the curriculum and thus, perhaps, not giving it the attention merited. It was also customary to allot a period of the lecture to questions; this was a very necessary precaution as medical officers sometimes forgot that they were lecturing to the laity and used medical terms that were unfamiliar to their audience. The three main items included in the lecture are outlined at (1) to (3) below, but the lecture also gave the medical officer the opportunity to refer again to other closely allied subjects such as oxygen, frostbite, colds, sinuses and the care of flying clothes and equipment.

(1) *Shock: Effects and Treatment.* In the majority of cases of injury sustained in the air shock formed the chief hazard and aircrew were therefore fully instructed in the simple treatment of this condition. It was explained that in shock the various mechanisms of the body were thrown out of gear, the heart was functioning temporarily with the disadvantage of abnormal blood circulation and fluid was being lost into the tissues, causing the patient to feel cold and thirsty. The fact that cold, pain, mental disturbance, lack of oxygen and thirst all aggravated the condition indicated that treatment should be undertaken on the following lines:

(*a*) Rest in a comfortable position was the first essential and this often meant removing the patient from his crew position to a convenient place in the aircraft near an oxygen point. The removal of personnel from such positions as gun turrets created considerable difficulty especially if the member of crew rendering first aid was using a portable oxygen bottle and had therefore to complete the removal in ten minutes (approximate capacity of oxygen bottle). It was, however, particularly important to remove injured crew from turrets as a broken clear-vision panel would render the position extremely cold.

(*b*) Warmth was the next essential and crews were warned never to remove clothing from a wounded man unless it was necessary to apply a tourniquet or dress a wound, in which event the clothing should be replaced as soon as possible.

(*c*) Freedom from pain was obtained by injecting the contents of one of the 'tubunic' morphia ampoules included in the first-aid kit; as pain was often delayed by 20 to 30 minutes following the injury, it was wise to give the injection as soon as possible and it was emphasised that a patient under the effect of morphia and thus pain-free, could often carry out his duties in the aircraft. Many instances of this were seen during the war years when wounded pilots, after morphia dosage, successfully and efficiently landed their heavy bombers.

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PLATE V: Rescue Personnel wearing Asbestos Suits. Note special Foam Nozzle, Gauntlets and Vision Panel

[facing p. 80

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PLATE VI: The Difficulty and Hazard involved in attempting Rescue Work on Crashed Aircraft. The Snow-like Material is Foam from the Extinguishers

facing p. 81]

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At this stage the medical officer usually opened a sample first-aid pack and showed where the tubunic ampoule was kept. He then demonstrated by means of a large scale model or drawing on the blackboard, how the ampoule worked and where it could conveniently be injected. It was observed in practice that many aircrew had difficulty in making the injection and often injured personnel arrived on stations without the injection having been made and consequently in a poor condition.

(*d*) All aircrew carried fluids in thermos flasks and they were encouraged to give injured members, if conscious, all the fluids they desired. The only exception to this rule was in cases of obvious abdominal injury when no fluids of any description were to be administered.

(*e*) Reassurance: It was stressed that, whatever the condition of the patient, he should be reassured and told not to worry; if anything was wrong with the aircraft or danger was imminent, the fact should be kept from him as such knowledge would only tend to increase the degree of shock.

(*f*) Oxygen: It was emphasised that the wounded man needed oxygen more than any other member of the crew and that any first-aid treatment was pointless at altitudes over 10,000 ft. if his oxygen supply was not guarded. It was advised that either the wounded man's oxygen should be turned up to a level of approximately 5,000 ft. above the normal rate for the altitude of the aircraft or the pilot should bring the plane down to a lower level if this could be done with safety. It was also stressed that even if the patient became unconscious his mask should not be removed in any circumstances.

(2) *Haemorrhage.* It was pointed out, in the first place, that a shell dressing would check all but the most serious haemorrhage. Although experience showed that major arterial haemorrhage was a relatively unusual occurrence, it was essential that aircrew personnel should know how to deal with it. The signs of true arterial haemorrhage were therefore carefully explained and instruction given concerning the correct pressure points and management of the St. John's type tourniquet included in the first-aid outfit. On many occasions the life of a wounded member of aircrew was saved by the correct application of a tourniquet but there were other instances when it was applied and managed so badly that many medical officers doubted whether it should continue to be included in the first-aid kit.

(3) *Fractures, Head and Chest Wounds.* These were dealt with very simply, only the bare essentials of treatment being given; it was stressed that after treatment for shock and the administration of morphia, masterly inactivity was the patient's best ally.

THE EMERGENCY RUNWAYS

In 1943–4, with the increased day and night bomber offensive and the resultant damage to crews and aircraft, Bomber Command conceived the idea of building emergency runways, to which all 'lame ducks' could

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be diverted and where every modern facility for crash and belly-landings, fog dispersal* and directional landing aids, would be available for the reception of damaged aircraft. Three such runways were constructed. The first in operation was at Woodbridge, Suffolk, which opened on November 18, 1943. The next opened during the early months of 1944 and was situated at Manston, Kent, under the control of Fighter Command. The third opened up at Carnaby in Yorkshire during the summer of 1944.

Many damaged Royal Air Force and American bombers were successfully diverted to these runways with a resultant saving of life. The runway was about 3,500 yards long and 250–300 yards wide and contained three electrically lighted runways in one. There were grass under- and over-shoot areas where belly landings could be made with confidence, and there was thus ample space for bombers to land with unserviceable brakes or only one wheel and swerve to a standstill without hitting any obstruction. These runways gave aircrew confidence for they knew that if their aircraft were damaged they could use these emergency runways with all the latest landing devices, medical aid and fire fighting appliances to hand.

The work done on these emergency runways can best be judged by reference to the observations made by the Station Medical Officer at Woodbridge. In the first year of opening, this runway dealt with 571 casualties which were received chiefly from R.A.F. and American bombers. The casualties were divided into classes according to their clinical condition on arrival:

Dead on arrival	72
Dangerously ill (great danger to life)	38
Seriously ill (danger to life not immediate)	39
Moderately ill (general condition good, and good prognosis justifiable)	98
Slightly injured (local and general condition good)	175
Minor injuries	149
	571

A careful log was kept of the types of injuries sustained as this was of considerable value in designing safety equipment for the aircraft concerned; furthermore a record of the patient's condition in relation to the first-aid measures that had been used indicated to the medical authorities the standard of first-aid training of aircrew and allowed modifications in the first-aid equipment to be made wherever necessary.

Further Facts from Analysis of Casualties at Woodbridge. A study of the tables at the end of this section will give some idea of the casualty rates and types of injuries recorded at Woodbridge after the opening of the emergency runway. The bulk of the injuries, that is, 66 per cent. of the total, were those affecting the limbs, and of these the

* Popularly known as F.I.D.O. (Fog, Intensive, Dispersal of).

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number of leg wounds was one and a half times that of arm injuries. It will be noticed that wounds of the abdomen and chest were relatively few, a surprising fact considering operational conditions. The majority of injuries were caused by enemy flak and here again it was remarkable how few injuries were sustained in relation to the 'peppering' of the aircraft. The slightness of many of the injuries was due to the angle of the shrapnel and its lucky diversion by aircrew kit; on one occasion, for instance, a member of aircrew had taken off his parachute and placed it where he had been standing, when a piece of shrapnel came up through the floor of the fuselage and passed through the parachute which so retarded its flight that the crew member was able to catch the fragment in mid-air!

The effectiveness of the first aid rendered by aircrew could be judged from the records of many aircraft; the standard varied considerably but it was generally felt that it should have been much higher. Medical officers at stations did all in their power to impart instruction in simple, practical first aid in the air, but judging from the Woodbridge results often this knowledge was not applied. It was thought at first that this might be due to the difficulty of working in the dark or in poor light, but when the R.A.F. began participating in daylight raids, no improvement was observed. On many occasions a member of aircrew bled to death where a simple tourniquet or even a shell dressing would have saved his life, and very frequently wounded aircrew arrived without having been given morphia or any form of treatment. The reason for this seeming neglect may lie in the fact that during their training, aircrew had so many lectures and demonstrations that first aid, however interestingly taught, was looked on as 'just another lecture', beside the fact that, quite understandably, many aircrew did not want to think too much about the casualty side of flying. It should be remembered, moreover, that the amount and type of clothing worn by aircrew made it exceedingly difficult to locate and treat wounds and the failure to render first aid may often have been due, not to carelessness or lack of knowledge, but to the fact that treatment in the confined space of an aircraft under these circumstances, was practically impossible.

CRASH LANDINGS ON UNPREPARED GROUND

Whereas crash and belly landings on the emergency runways were characterised by an absence of injury, such landings off the airfield invariably resulted in high death and injury rates, and fires and severe breaking up of the aircraft were the rule. This is illustrated by the following examples:

(*a*) A Liberator aircraft with two engines rendered useless by flak (fragments of exploding anti-aircraft shells) crash-landed in a fir wood just off the runway. Although the trees made a soft bed, the plane

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was severely damaged and all but one of the crew were killed, having received multiple injuries.

(*b*) A Halifax aircraft, shot up by flak and night fighters over enemy territory, crash-landed in the fir wood near the runway but unfortunately struck a concrete sub-power station. A serious fire broke out, and the impact reduced the aircraft to a twisted mass of wreckage. Three members of crew suffered instantaneous death due to multiple injuries and burns, three were moderately injured and safely evacuated, while, surprisingly, the remaining member of the crew was physically quite unscathed.

CONCLUSION

From the foregoing pages, it will be seen that 'First Aid' was a phrase meaning much more to the medical officer in the Royal Air Force than to his colleague in civilian practice. It embraced all possible means by which a medical officer could prevent injuries and, if they did occur, every method by which the casualties could be treated before admission to a hospital. This chain was made up by initial lectures to aircrew, treatment of injured aircrew by their colleagues, skilled treatment in station sick quarters and finally, when the patients' condition permitted, removal under the medical officer's personal care.

TABLE I

Analysis of Casualties. November 1943–November 1944. R.A.F. Station, Woodbridge

Month	Dead on arrival	Injured	Dead due to crash*	Injured due to crash*	Minor cases	Monthly totals	Total A/C landed
1943							
November	—	15	—	—	—	15	
December	1	15	8	3	—	27	157
1944							
January .	2	4	—	—	—	6	
February	1	11	—	—	—	12	72
March .	5	15	8	5	—	33	125
April .	3	17	3	1	—	24	159
May .	1	23	3	10	13	50	110
June .	5	24	—	—	19	48	147
July .	5	40	1	4	21	71	191
August .	4	37	—	3	15	59	187
September	6	59	—	—	9	74	266
October .	7	27	2	12	11	59	306
November	3	21	4	3	7	38	—
Totals .	43	308	29	41	95	516	1,720

* Crashes refer to aircraft landing on the emergency runway and include the few aircraft that landed in the immediate neighbourhood of the runway. Belly and crash landings on the runway were characterised by absence of added injury to aircrews, whether already injured or not. The length, breadth and good lighting of the runway gave a good safety margin for manoeuvring even the most severely damaged aircraft.

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TABLE II

Analysis of Wounds suffered by Bomber Crews on Operational Sorties with Prognosis. Where more than One Wound was present the Most Serious has been recorded. November 1943–November 1944. R.A.F. Station, Woodbridge.

Situation of wound	Dangerously injured	Seriously injured	Moderately injured	Slightly injured	Totals
Eye—foreign body	1	–	3	17	21
Abdomen + thoracic wounds	3	–	1	–	4
+ other wounds	2	–	1	–	3
Pelvis: fractures	1	–	1	–	2
Face and neck: alone	1	1	1	13	16
+ other wounds	1	2	1	4	8
Scalp	–	1	7	6	14
Skull	3	1	2	–	6
Trunk	3	1	2	6	12
Chemical irritation*, lungs	–	–	1	3	4
Frostbite: other than limbs	–	–	2	2	4
Burns: limbs	1	–	2	5	8
trunk	–	–	–	1	1
face	–	1	1	4	6
Miscellaneous	–	–	1	9	10
					— 119
Upper Limb					
(*a*) *Compound fractures*					
alone	–	2	1	–	3
+ other wounds	4	–	2	–	6
(*b*) *Simple fractures*					
alone	–	–	1	–	1
+ other wounds	–	1	1	–	2
+ leg injuries	–	2	–	–	2
(*c*) *Soft tissues*					
alone	–	2	12	35	49
+ other injuries	–	1	6	11	18
(*d*) *Frostbite* (*hands*)					
alone	2	–	–	6	8
+ feet	–	1	–	1	2
					— 91
Lower Limb					
(*a*) *Compound fractures*					
alone	9	2	–	–	11
+ other wounds	3	2	–	–	5
(*b*) *Simple fractures*					
alone	–	1	2	–	3
+ other wounds	2	1	1	–	4
(*c*) *Soft tissues*					
alone	–	8	21	35	64
+ other wounds	–	3	13	9	25
+ upper limb	2	6	11	6	25
(*d*) *Frostbite* (*feet*)	–	–	1	1	2
					— 139
Totals	38	39	98	174	349

* Fumes from burning portions of aircraft such as rubber and fabric.

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Oxygen

DEVELOPMENT OF OXYGEN INSTALLATIONS IN AIRCRAFT

The development of oxygen equipment to give an adequate supply of oxygen and thus maintain a healthy physiological state was not easily accomplished and presented many problems. The increasing performance of aircraft during the war years required equal progress in the technical provision for physiological efficiency, and, although this was appreciated, many delays and difficulties were encountered. In Bomber Command the development of aircraft oxygen systems required a close co-operation between all branches; engineering, training and medical branches were especially involved and liaison was maintained between research workers at the Royal Air Force Physiological Laboratory and designers of aircraft and equipment.

It is perhaps not inappropriate at this point to give a brief history of the introduction of oxygen technique into aviation and a résumé of the results of lack of oxygen (or anoxia) occurring at altitude. In 1875 Tissandier and two companions made a balloon ascent, which has become the first milestone in oxygen technique. Following the advice of a famous physiologist of that period they provided themselves with a supply of oxygen to combat the effects of high altitude, but since their supply was limited they arranged to use it only when symptoms warned them of the need. As could have been predicted with present knowledge, the balloonists were never warned. The balloon ascended to 28,000 ft. and then descended of its own accord. Tissandier recovered but his two companions were dead.

Probably the first effect of oxygen lack is impaired vision. Night vision in particular may be appreciably reduced at altitudes as low as 4,000 ft.* At altitudes of 8,000–10,000 ft. few other effects of oxygen lack are detected. However, a prolonged exposure of many hours may produce marked fatigue, sleepiness and occasional muscular aches and pains much like those experienced after violent and unaccustomed exercise. At altitudes of 10,000–14,000 ft. the body is forced to make definite adjustments to compensate for the low oxygen tension. Respiration is increased, principally in depth, although this is rarely appreciated—in fact the sensation of panting or suffocation is characteristically absent in anoxia. These compensatory adjustments on the part of the body are quite effective at these altitudes unless the exposure is prolonged, in which event mental and muscular fatigue, emotional changes, and incoordination become marked. At altitudes of 20,000 ft. or above unconsciousness may be expected to occur. In certain individuals it may occur at lower altitudes. *The unconsciousness is not preceded by any warning*. It is not uncommon in low pressure chamber experiments for

* *See* Chapter 2, Fighter Command, Night Vision Section.

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a person to protest that he is feeling all right and that he does not need oxygen yet, when it is obvious to everyone else that the person is within seconds of complete unconsciousness. The coma may take the form of fainting in which the person collapses and becomes limp, or he may become rigid with a glassy-eyed stare.

Exposure to severe anoxia or prolonged mild anoxia is not without distressing after-effects. Headache and lethargy are common, and nausea and vomiting with prostration may follow severe anoxia, but even with prolonged unconsciousness apparent recovery follows within twenty-four to forty-eight hours of a single anoxic episode. It is, however, important to stress that the more frequent the exposure the more prolonged the effect. Repeated flights accompanied by anoxia produce a gradual reduction in the altitude tolerance and increased persistence of the after-effects on landing. A pilot who can withstand occasional flights without oxygen at 15,000 ft. may find that he is inefficient at 10,000 ft. if such flights are repeated too often.

The equipment used in the early stages of the war had been designed only a few years previously and, though the aircraft themselves were of advanced construction, the comfort of the crews had received little consideration; in particular, the oxygen apparatus, for which there was no adequate face-piece, showed little evidence of improved design or efficiency. It should be stressed, however, that the experience of operational conditions had not yet brought the importance of correct oxygen drill and equipment into its true perspective. In this early phase cases of anoxia were almost invariably due to the limited efficiency of the equipment and unawareness of its importance.

In the later phases of the war the aircraft originally used had been either replaced entirely by new types or modified to a very great extent, this being the direct result of experimental research and operational experience. From the end of 1942 onwards there were relatively few instances of anoxia and those that did occur were mainly attributable to human factors such as carelessness, forgetfulness or inattention to instructional detail on the part of aircrew, rather than to technical failure. The engineering branch, in addition to the installation and maintenance of the oxygen equipment, carried out inspections before sorties, checking the high pressure system, regulators, economisers, flow meters and cut-out valves, thus making it possible to remedy defects before flight. The technical staffs, through their section leaders, made each crew responsible for testing their oxygen equipment immediately before each flight, and where a flight engineer was included among the crew, it was one of his duties to ensure that the oxygen equipment was working efficiently during flight. Although the onus on the individual was reduced to a minimum, each member of aircrew had to realise that his oxygen equipment was a vital link in a successful sortie. It was for

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those in charge of training to ensure that this responsibility was appreciated, hence the continual necessity for intensifying practice and using personal equipment on the ground and in decompression chambers.

In the early stage of the war lectures to aircrew on oxygen, given by a medical officer, were considered sufficient, but during the later phase, with increasing operational altitudes, the necessity for more advanced training and actual practice in the use of oxygen equipment became apparent. Hence from the latter part of 1942 synthetic oxygen drill and practice in decompression chambers, under the supervision of medical officers, was introduced in all operational training units. This training allowed practice to be given in the use of both portable and main oxygen equipment; crews gained confidence and learned to appreciate the limitations of the equipment installed in the type of aircraft in which they would operate. The decompression (low pressure) chamber was a training instrument of the greatest possible value and importance and their number was increased during the war to enable all trainees to be thoroughly instructed in the essential aspects of oxygen.

All oxygen failures were reported to the engineering branch, and medical officers on bomber stations supplemented these reports with all available medical details. By this means the exact nature of the failure, whether preparation, manipulation, technical or unclassified, could be recorded. These analyses were periodically reviewed at the Command administrative conferences and appropriate steps could then be taken to correct technical or manipulative defects.

INSTALLATION OF OXYGEN EQUIPMENT IN BOMBER AIRCRAFT

In July 1939, Air Ministry issued to Bomber Command the following table which summarised the endurance of the 'direct flow' type of oxygen equipment for the various bomber aircraft in use:

Aircraft	Crew	No. of 750-litre bottles	Duration at 15,000 ft.	Duration at 20,000 ft.	Duration at 25,000 ft.
Blenheim I	3	3	4 hr. 6 min.	3 hr. 20 min.	2 hr. 17 min.
Battle I	3	3	,, ,,	,, ,,	,, ,,
Whitley I	5	10	8 hr. 12 min.	6 hr. 40 min.	4 hr. 34 min.
Whitley II	5	10	,, ,,	,, ,,	,, ,,
Whitley III	5	10	,, ,,	,, ,,	,, ,,
Whitley IV	5	10	,, ,,	,, ,,	,, ,,
Wellington	5	15	12 hr. 18 min.	10 hr.	6 hr. 51 min.
Hampden	4	8	8 hr. 12 min.	6 hr. 40 min.	4 hr. 34 min.

At this time crews considered that in most instances the oxygen capacity was insufficient for the flight endurance of the aircraft. The official opinion was that oxygen was unnecessary below 15,000 ft., and

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crews were therefore instructed that emergencies should be met by emergency measures; oxygen was to be conserved by all crew members and used in proportion to the rigours of their duties, being regulated to deliver only that amount of oxygen which the physical activity demanded. It was not to be turned on to 5,000 ft. before the flight commenced, but was to be kept 5,000 ft. in advance of any height over 10,000 ft. reached during the flight; if this procedure was followed supplies should be adequate and no ill-effects to any of the crew would be likely. However, during September 1939 crews of Blenheim aircraft carrying out reconnaissance flights between 18,000 ft. and 20,000 ft. found that the oxygen supply was quite inadequate and it became necessary to increase the number of bottles in the Blenheim IV from three to five (2,250 l. to 3,750 l.). By October 1939 a revised table was issued for bomber aircraft as under:

Aircraft	Present installation (750-litre bottles)	Revised installation (750-litre bottles)
Blenheim I . .	3	4
Blenheim IV .	3	6
Battle . . .	4	4
Whitley II and III .	10	11
Whitley IV and V .	10	9
Wellington . .	16	16
Hampden . .	8	8
Wellesley (2 crew) .	6	8
Wellesley (3 crew) .	6	11
Skua (bomber) .	2	3

Operational Experience in Relation to the Proposed Equipment. During the early months of the war there were considerable variations in the operational duties allotted to aircraft in Bomber Command, and only by considering the type of aircraft in relation to its particular duty is it possible to outline the problems that arose.

In practice it was found that the sixth bottle recommended for the Blenheim IV (*see* table above) could not be fitted satisfactorily and five bottles only were therefore supplied. During March 1940, Blenheim aircraft were still arriving from the production lines with only three bottles and it fell to the station to undertake the necessary modification. Also at this time, some type of guard for the apparatus was requested because of the possible danger of the bottles exploding*.

In October 1939, oxygen requirements for Hampdens were reviewed by No. 5 Group. At this time Group flights over 15,000 ft. were only of short duration and the oxygen apparatus was satisfactory for this type

* Oxygen bottles before the war were constructed to withstand ·303 bullet impact but when the enemy used heavier calibre ammunition it was necessary to redesign and wirewind the bottles, the new type being introduced at the end of 1940.

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of work. A crew of four was carried and eight bottles of oxygen were supplied; it was recommended that four additional bottles should be carried if stowage in the very limited space could be arranged. In early 1940 the Command pressed for the provision of a continuous and individual oxygen supply for the navigator, as he was required to move from his normal position in the nose of the Hampden to a position aft of the pilot for the purpose of taking solar observations. The pressure of urgent work at the manufacturers caused unavoidable delay in the production of suitable equipment for this purpose and squadrons were therefore instructed to carry out locally one of the following modifications:

(*a*) A 9-ft. length of oxygen hose to be attached to the existing 5-ft. length, giving the navigator a total length of 14 ft. of hose which would allow him to move from the forward position to the top centre position without uncoupling his oxygen connexion; this, however, proved to be a very cumbersome arrangement.

(*b*) One or two oxygen sockets to be suitably placed between the centre and forward positions and connected to the navigator's oxygen regulator so that the original and the new sockets were controlled from the same point. This meant that as the navigator changed connexions he was temporarily without oxygen, although possibly not long enough to cause inconvenience, except at night, when it was difficult to locate the sockets. It will be seen therefore that neither of these methods was entirely satisfactory. Problems also arose in the stowage of the extra bottles, the navigator's extra bottle interfering with bombing-up and those for the remainder of the crew interfering with the new cross balance pipe of the petrol system.

Events Leading to the Introduction of the Oxygen Economiser. By December 1940, information from operational Hampden squadrons indicated that the oxygen consumption rate was greater than specified figures suggested and that this could not be attributed to inaccurate operational procedure. In January 1941, the Command submitted a recommendation to Air Ministry for additional bottles based on flight tests on the Hampdens. On long operational flights the crew sometimes had to restrict the rate of oxygen delivery to a lower figure than that laid down and pilots were compelled to fly at lower altitudes as much as possible to conserve supplies. In a further communication the Command stressed the urgent need for additional bottles, pointing out that the Hampden aircraft with their present fuel tankage of 654 gallons were capable of ten-hour flights, and that the existing oxygen storage, which was only capable of providing crews with oxygen for four hours sixteen minutes when flying at 15,000 ft., was therefore quite inadequate and created a considerable operational hazard.

The Oxygen Economiser. Before the introduction of the economiser, oxygen had been delivered to the mask in a continuous flow at a rela-

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tively low pressure; this method, though comparatively effective, was extravagant, as all oxygen delivered during the expiratory phase was wasted. The principle of the economiser was that oxygen was drawn into the mask from a canvas reservoir bag, during the inspiratory phase only. Thus the amount of oxygen used to accomplish the same purpose was roughly halved. A further advantage in this system was that a greater concentration of oxygen could be obtained at altitude than by use of the direct system. (*See* Plate VII.)

Difficulties in Fitting the Economiser. In early February 1942, economisers were installed on the Hampden aircraft using, for trial purposes, the existing Mark VIII regulating valve. The necessary parts for the installation of the economisers were manufactured in the workshops of R.A.F. Station North Luffenham. The limited space on the Hampden aircraft and the variety of ancillary equipment which operational requirements demanded, raised many problems in incorporating the modifications. Since an astrograph had been fitted at the navigator's station, the economiser in the scheduled position did not allow sufficient clearance; this difficulty was overcome by designing two brackets to support the economiser elsewhere. At the pilot's position, the de-icing apparatus and the detonator switches made it impossible for the economiser to be installed as detailed and a new position above the navigator's seat had to be used. In the wireless operator's position the detailed situation was already occupied by accumulators for the electrically operated gun mounting and the economiser was therefore fitted to a bulkhead in front of the Direction Finding loop aerial. The difficulties involved and the time consumed in carrying out these comparatively simple modifications will be realised when it is stated that 40 man-hours were required to complete the alteration and installation of the apparatus in one aircraft. (*See* Plate VIII.)

OXYGEN PROBLEMS IN NEW HEAVY BOMBERS

1. *Stirling Heavy Bomber.* These aircraft were first put into service in September 1941, and it was possible to utilise experience already gained in the type and layout of their oxygen system. This consisted of a Mark X oxygen system with Mark II economisers, except for the turrets which remained on direct flow. This system worked well, though in November 1941 it was found necessary to increase the oxygen supply to the rear gunner because of his exposed position. It was found convenient to install a further oxygen point at the astrodome; previously it had been necessary for the observer to share an oxygen point with the flight engineer. As these aircraft were used for leaflet raids a further oxygen point had to be installed at the flare chute down which the leaflets were disseminated by hand, for this task required considerable physical effort. (*See* Plate IX.)

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2. *Manchester Heavy Bomber*. These aircraft were delivered to Bomber Command in January 1941, and after operational trials several modifications in the oxygen system were found necessary. The points in the cabin for the second pilot and second wireless operator had to be moved as they were inconveniently situated. No provision had been made for oxygen in the front turret, and though a point was available for the rear turret, it was situated outside the turret, thus precluding easy regulation by the occupant.

3. *Halifax Heavy Bomber*. These aircraft, introduced in March 1942, though incorporating many improvements were subject to criticism after operational trials, as the mid-turret gunner was not obtaining sufficient oxygen, and a modification was necessary to remedy this defect.

4. *Lancaster Heavy Bomber*. In January 1942 these aircraft were introduced and equipped with a Mark X system with economisers at all crew stations except the three turrets where, as with the Manchester, it was found that the gunners were not getting sufficient oxygen, and the installation of Mark I jets was ordered. During August 1942 the fitting of economisers in the turret positions was undertaken locally and this proved satisfactory, though considerable care had to be exercised in the installation to avoid the turrets fouling the economisers. In consequence of operational reports of failure of the mid-upper turret system, the pipe line was moved, as it had previously been in close proximity to the hand rail and thus damaged by crew moving around in the aircraft during heavy weather.

5. *Boston Medium Bomber*. These aircraft were introduced into the Command during July 1941. Simultaneously with the delivery of the first batch of aircraft the Air Ministry was informed by the Ministry of Aircraft Production that the oxygen systems of certain of these aircraft had not been adequately cleaned and it was necessary for all systems to be carefully checked before use. The oxygen equipment of the Boston aircraft, which had a ceiling of 25,000 ft. and an endurance of three hours, was Mark X regulators with standard bayonet sockets and eight standard bottles; no economisers were fitted. This system proved satisfactory after two minor adjustments—the re-positioning of the bayonet sockets for the lower and rear firing positions. It was also found that the main oxygen cock was in a bad position and very stiff to operate; re-positioning, however, would have entailed an unwarranted modification and the instrument N.C.O. was therefore detailed to ensure that the cock was in the 'on' position before flight, while the pilot was made responsible for the check.

PORTABLE OXYGEN EQUIPMENT

As a result of experience it was found necessary to incorporate in most multi-seat aircraft capable of flying at oxygen altitude portable oxygen

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sets in the proportion of one to each crew station. The necessity for each crew member to possess a portable apparatus may not at first be evident, but it should be remembered that, apart from ordinary duties requiring movement from one part of the aircraft to another, the duration of most of the sorties made the needs of nature apparent and the Elsan toilet was invariably situated in the rear of the fuselage. This requirement was visualised before the war and service trials were initiated and reports studied. By September 1940, portable oxygen sets had been issued to all operational stations. Originally the set was used when it was necessary to move about the aircraft at 20,000 ft. or over, but a considerably lower limit was set in the later years of the war in the light of operational experience. The supply from the bottles was arranged to give six litres of oxygen per minute, this being found the most conservative rate of flow compatible with average usage. It was adequate for hard physical labour at 20,000 ft. and for fairly hard labour, such as carrying ammunition from the centre section to the tail, at 25,000 ft. Under such conditions it was advisable to move slowly and deliberately as more economical use was made of the oxygen if the respiration rate was kept low. At 30,000 ft. the supply was sufficient for light work and allowed free movement around the aircraft. After considerable trials it was found that the apparatus was satisfactory in general when used correctly, but its manipulation, especially in the dark, could have been simplified. The apparatus remained standard until, after service trials at R.A.F. Station Witchford, in early 1944, a new portable type set was introduced which had the advantage of easier manipulation and the addition of a permanent recording gauge of contents. (*See* Plates X(a) and X(b).)

Oxygen Mask Face-piece and Microphone Development. At the outbreak of war aircrew personnel were equipped with the type 'D' oxygen mask which acted as a carrier for the carbon microphone then in use. This oxygen microphone face-piece, modified to carry an electromagnetic microphone, remained in general use throughout the Command until January 1941, although the type 'E' mask became available in limited numbers and was given its first operational trials in the autumn of 1940 on Spitfire aircraft of Photographic Reconnaissance Units stationed at R.A.F. Stations Benson and Oakington. (These aircraft were engaged in photographic reconnaissance over enemy territory and carried no armament, relying on speed and altitude to escape enemy attention; they were thus suitable for trials of the mask at high altitudes.)

The trials were carried out in fine weather and in aircraft with reasonably good cockpit heating; these two factors, which limited failures of the mask from ice formation, were not fully appreciated at first, but later experience proved their importance and also emphasised the necessity for taking into account all ancillary equipment pertaining to the particular aircraft in which it would be used, as well as the fact

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that trials should cover all the conditions which might be met on operations.

Towards the end of May 1941, Fortress aircraft (B.17C.) were delivered to No. 90 Squadron for high-flying tests (30,000 ft.) and were first used on operations in high level attacks on Kiel in early July 1941. These aircraft were originally equipped with American A.6 regulators and B.L.B.* auro-nasal masks which were found to give a very irregular flow. Other drawbacks were the freezing of the rubber bellows in the rebreathing bag, condensation with subsequent icing of the mask and the unreliability of the carbon microphone, endurance at 30,000 ft. being limited to four and a half hours.

Introduction of the 'G' Mask. The experience gained during the six months of altitude flying in the Fortress aircraft had an important bearing on the development of oxygen microphone face-pieces.

The type 'E' mask, as developed by the R.A.F. Physiological Laboratory, was fitted with a reed valve for use with an economiser and was in limited supply during 1941. The main oxygen inlet passed through the lower Venturi tube and entered the mask at the lowest point. In the exposed postions in the Fortress aircraft it was found that the reed valve easily froze and there was danger of the main oxygen entry becoming blocked by ice. It was therefore necessary to modify the mask. The type 'F' mask, also designed by the R.A.F. Physiological Laboratory, was a modification of the type 'E', so designed that the main oxygen entry passed into the mask high up on the side, thus greatly reducing the possibility of icing. Crews found, however, that these masks were uncomfortable after about an hour's flight because of the pressure of the adjustable metal nose clip on the bridge of the nose and the tendency of the mask to swing away from the lower part of the face when the head was bent forward. This mask was never generally issued.

As a result of the experience gained during these early flights at altitude in exposed positions and after much inquiry and research the laboratory completely re-designed the mask and the type 'G' mask was produced. Meanwhile work still went on apace with the previous types of mask, so as to modify or improve them while awaiting the delivery of the new 'G' type masks.

Trials with the 'G' Mask. By the middle of March 1942, limited numbers of 'G' masks were being produced from the two existing moulds and 200 were despatched for further operational trials at R.A.F. Stations Oakington, Wyton and Mildenhall. These trials were successful, apart from one complaint which was found to be common among the questionnaires issued and to warrant investigation. It was stated that the mask permitted a leak of oxygen past the nose which caused great

* Boothby, Lovelace, Bubillion.

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discomfort through watering of the eyes and misting of the goggles. It was felt that the chamois lining and wire stiffening of the production model, with such improved fit as would be obtained from having three sizes available, would overcome the difficulty. In view of the great superiority of the 'G' mask over the 'E' mask, especially in its freedom from ice formation in the oxygen supply pipe, immediate production of the 'G' mask was justified as an urgent operational requirement. (*See* Plates XI and XII.)

General Issue of the 'G' Mask. Many difficulties were experienced in the production of the mask in sufficient numbers in each of the three sizes and it was some months before it was in general use. During June 1942, groups were informed that the 'G' masks were now going into production and would shortly be available for issue to stations. Medical officers were informed of the efficiency of these new masks in providing an adequate supply of oxygen and were requested to make contact with squadron commanders and equipment officers on stations to ensure that the masks were taken into use as soon as possible after receipt. Notes on the oxygen economiser system for use with the 'E' type mask had previously been circulated to all units and Command now issued the amendments required to make the notes applicable to the 'G' mask. It was particularly stressed that the masks were in three sizes and that choice of the correct size would obviate the danger of leakage and minimise pressure on the face.

The result of equipping all operational personnel with 'G' type masks and economisers was noteworthy, as was shown by the fact that during March 1943, only 5 sorties were abandoned owing to failure of oxygen equipment. Great stress was continually laid on the importance of the personal equipment factor. At operational training units, training in the use of oxygen was intensified and test rigs, as originally installed throughout the operational Commands, were adopted by operational training units for demonstrating the working of the economiser and the advantage of using correctly fitting masks. (*See* Plates XII and XIII.)

Further Problems with the 'G' Mask. In June 1943, problems arising from the formation of ice on the 'G' mask under severe conditions of low temperature were reviewed with the R.A.F. Physiological Laboratory, as it was expected that during the winter of 1943–4 frequent operational flying of night bomber aircraft above 23,000 ft. would be required; since at these levels winter temperatures were invariably 15 degrees lower than the summer temperature, it could be expected that crews would be operating in the region of minus forty degrees centigrade. Previously long periods at these temperatures had been rare and icing problems with the 'G' mask therefore exceptional. To combat these conditions the R.A.F. Laboratory developed a shroud to envelop the expiratory valve and an electric microphone heater for use with the

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existing 'G' masks. This equipment was considered to be particularly suitable for gunners manning the new type turrets, where the clear vision openings were even more extensive than those in existing turrets. These adapted masks were supplied to both No. 5 and No. 8 Groups and reports on the first 500 masks indicated that the microphone heater was efficient and not only prevented the microphone from icing but raised the temperature inside the 'G' mask and so reduced the possibility of ice formation and consequent frost-bite of the face.

It will have been appreciated that the oxygen mask had undergone considerable modification and that continual improvement was always necessary to keep up with the increased performance of the new aircraft. However, the 'G' mask remained the standard type of mask in Bomber Command throughout the remainder of the war, though at the end of 1945 an improved version of the 'G' mask known as the 'H' mask, which had undergone satisfactory testing by the R.A.F. Physiological Laboratory, was being introduced in operational squadrons.

Oxygen, Night Vision and Adaptation. Physiologists had for many years been aware of the part played by oxygen in the blood stream in producing the necessary chemical changes in the retinal pigments responsible for night vision. It was not, however, until the necessity for crews to be dark-adapted at or immediately after take-off became of operational significance that the vital importance of a generous oxygen supply became fully recognised. The fact was dramatically brought home to the authorities through the enemy's tactics of placing night fighters in the vicinity of R.A.F. airfields; it was realised that, if our crews were not as fully adapted as possible, they would be at a very great disadvantage in countering attacks by enemy crews who had been airborne for some considerable time, thus being completely dark-adapted.

Investigation of the phenomenon showed that at ground level adaptation from light to dark was three-quarters accomplished in ten minutes and nearly complete in half-an-hour. It was also demonstrated that any lack of oxygen at altitude caused a very serious diminution of night vision and it was shown that at 6,000 ft. the drop in acuity was between one-fifth and one-tenth if oxygen was not taken; Plate XIV illustrates this point excellently.

The solution to the problem was twofold. Firstly, crews were required to wear dark goggles before take-off in order to become dark-adapted before commencing to fly, and secondly, oxygen was turned on at take-off or, by many crews, even earlier. In the latter instance, a high concentration of oxygen in the blood would be obtained, thus securing an adequate supply to the retinal pigments. Nearly all aircrew personnel appreciated the vital necessity of ensuring that oxygen was supplied in the quantities appropriate to the height of the aircraft; nevertheless the medical branch availed themselves of every opportunity of keeping the

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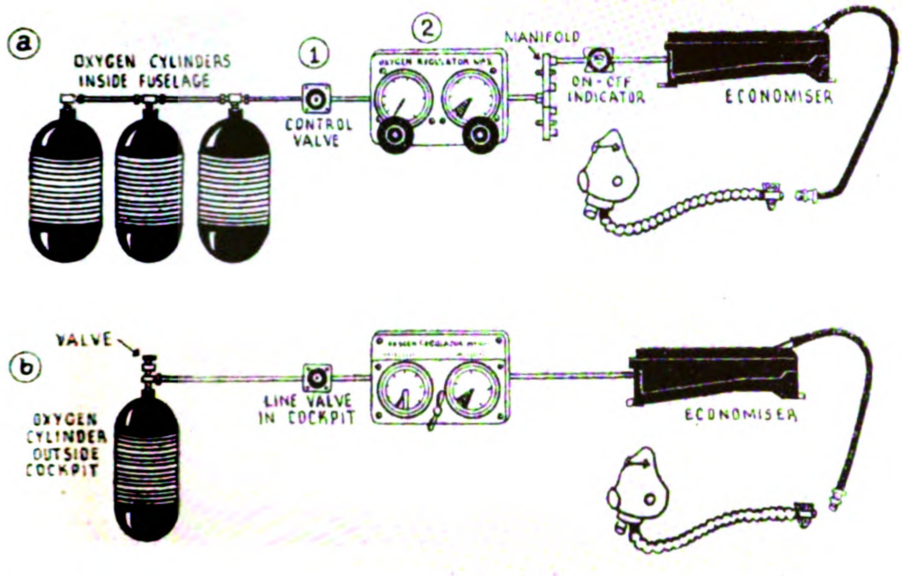

PLATE VII: Diagrammatic Illustrations of the two commoner Oxygen Layouts in Bomber Aircraft

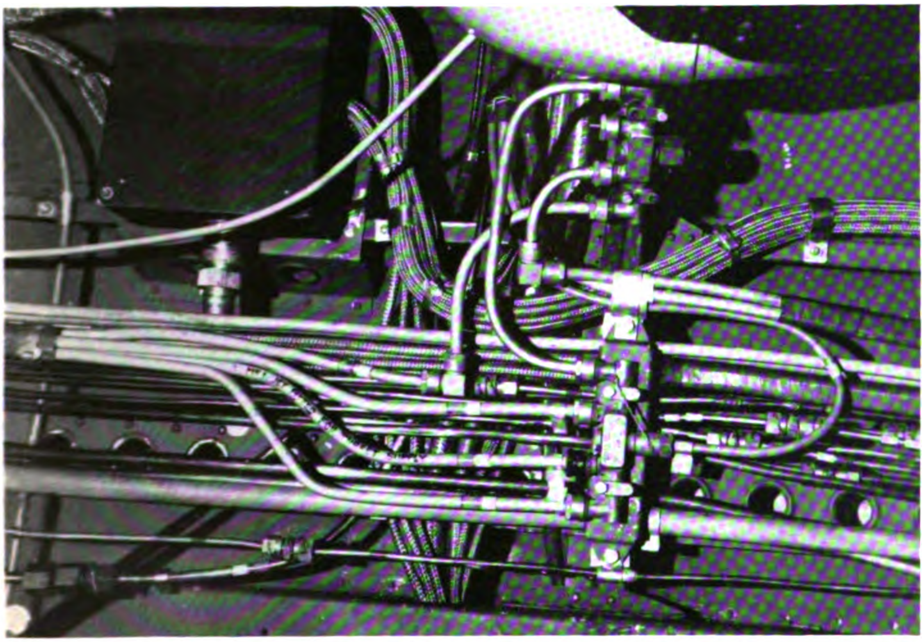

PLATE VIII: Illustrating the Complex Installation of Oxygen Lines among the other Hydraulic and Electric Systems of a Bomber Aircraft

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PLATE IX: A Member of Aircrew jettisoning Leaflets through the Flare Chute. Note Oxygen Mask is not worn and Danger of Anoxia a very real one in view of the amount of Physical Effort employed

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PLATE X (a): Uncoupling the Main Oxygen Hose prior to attaching the Portable Apparatus

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PLATE X (b): Portable Oxygen Apparatus

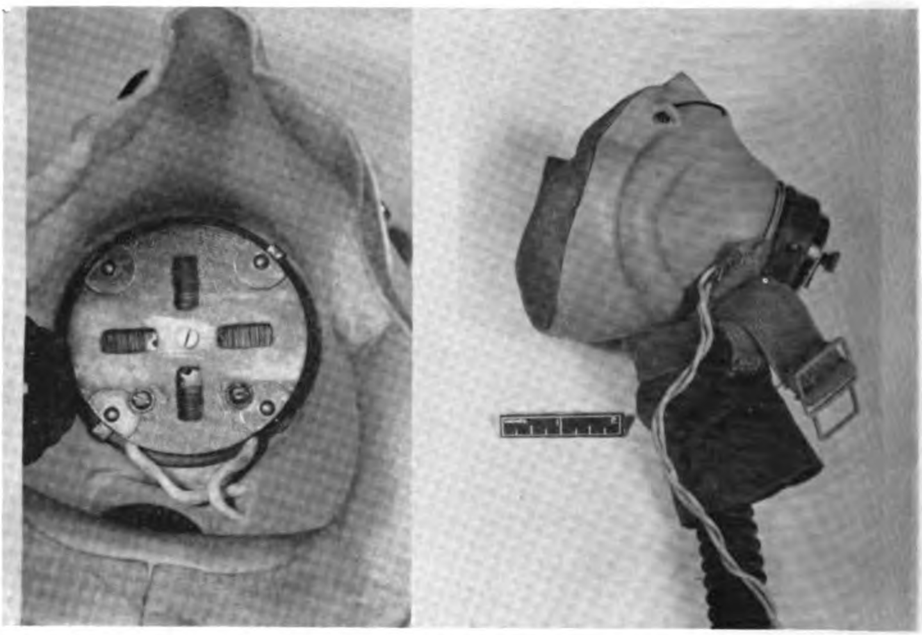

PLATE XI: The 'G' Mask. *Left*, showing Inside and Microphone. ***Right***, the De-icing Shroud is clearly visible around the Entry Hose

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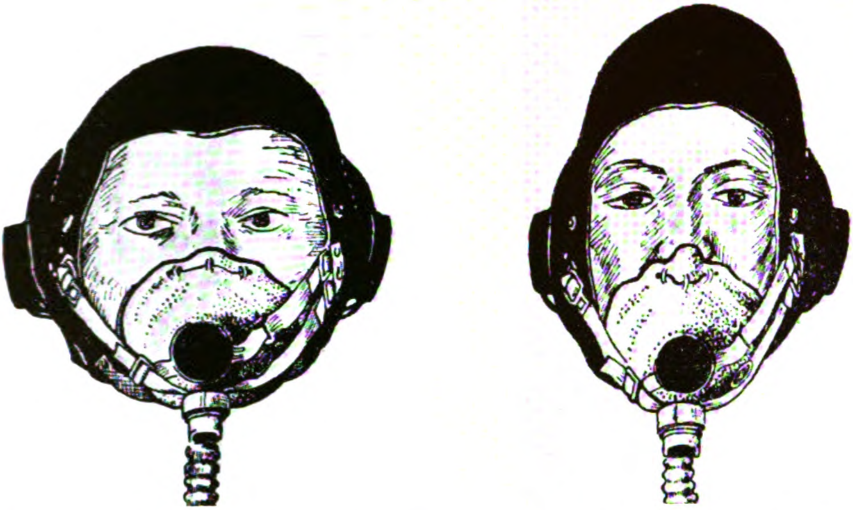

PLATE XII: Oxygen Masks. *Left*, Correctly Fitted. *Right*, Incorrectly Fitted

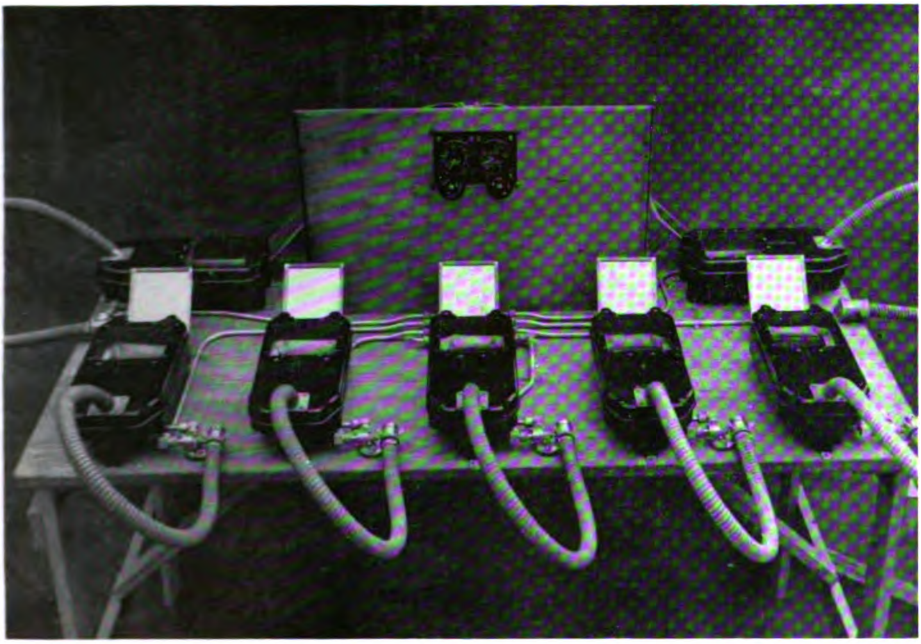

PLATE XIII: A Batch of Economisers for testing Oxygen Equipment. Note Mirrors by which Aircrew could check the Fit of Masks

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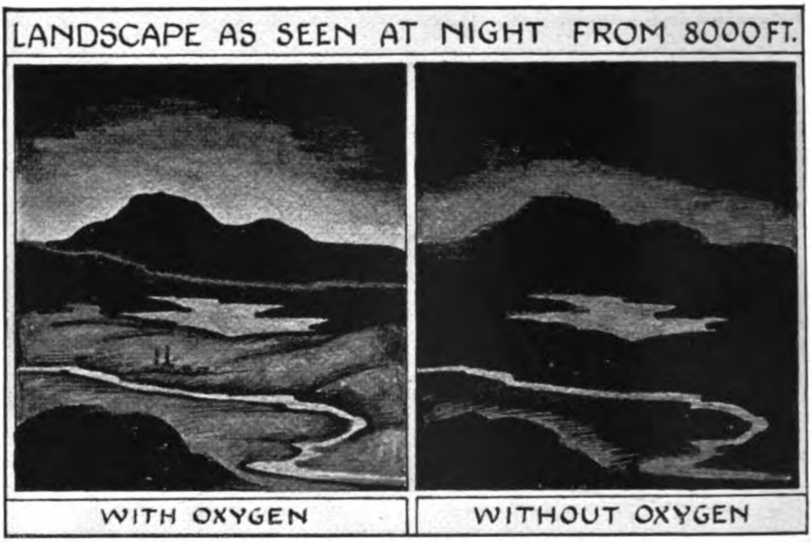

PLATE XIV: Photographs illustrating the Advantage gained by the Use of Oxygen at Night

PLATE XV: Interior of a Decompression Chamber

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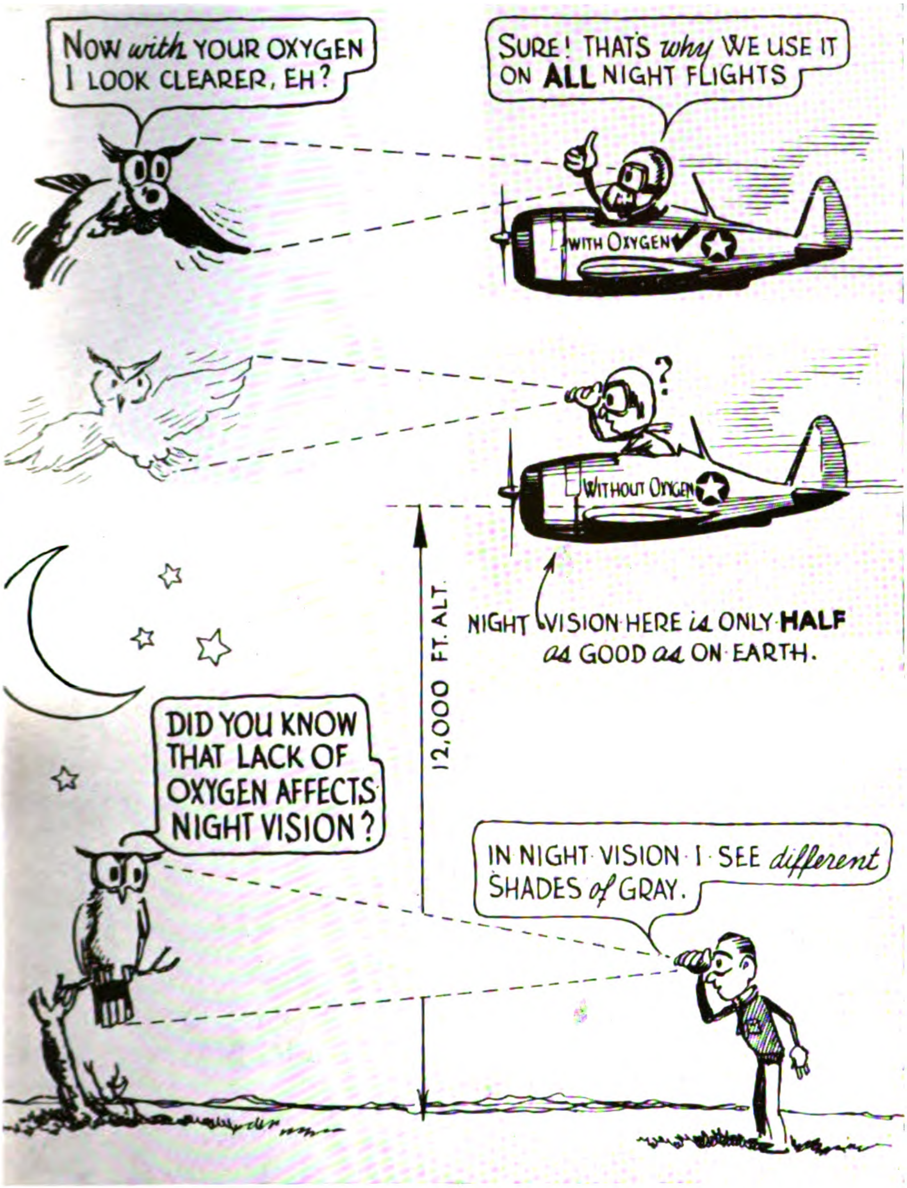

PLATE XVI: Poster illustrating Value of Oxygen in Night Vision

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PLATE XVII: The Rotating Hexagon Test

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matter continually in the minds of all flying personnel and at all medical lectures the facts outlined above were stressed, while semi-humorous cartoons emphasising the importance of oxygen were prominently displayed in crew-rooms and dispersals. (*See* Plate XVI.)

DECOMPRESSION CHAMBERS

A decompression chamber consisted of a large stressed steel cylinder capable of accommodating at least six persons and a considerable amount of apparatus, including regulation oxygen flying equipment. It was possible by means of an exhaustion pump to decrease the atmospheric pressure in the chamber at will, thus simulating conditions at any specified altitude. Observation portholes were placed in the sides of the cylinder to allow a close watch to be kept on the occupants—a very necessary safety precaution—and also to allow lecturers to demonstrate to classes watching from outside. A telephone link between the occupants and the chamber operator was standard equipment.

These chambers were originally, in view of their bulk, completely static and situated in experimental establishments, but in the later years of the war, when their vital importance in training had been fully realised, a portable chamber mounted on a lorry chassis was introduced and played an important part in the initial training of all aircrew.

The main decompression chamber at Farnborough was used for much original work and testing of new apparatus before operational trials and also as a demonstration model to medical officers on their aviation medicine course and to personnel under training as chamber operators.

Further use was made of the Farnborough chamber to select aircrew for very high altitude flying; this allowed further training to be given in oxygen technique and also eliminated personnel particularly susceptible to 'bends' (symptoms due to liberation of nitrogen bubbles in the body at high altitudes). From these tests it was possible to select suitable crews to man the first Flying Fortresses used in the Service, which carried out the successful high-level attacks on Kiel in July 1941.

Towards the end of 1942, mobile decompression chambers under the control of medical officers were in extensive use at operational training units and by allotting one chamber to three stations, allowing a period of three days at each station and the remaining four days for travelling and maintenance, it was possible to pass the majority of the trainees through the chambers during their first fourteen days at an operational training unit; this period was normally allotted to ground training and chamber demonstrations were included in the syllabus. (*See* Plate XV.)

By May 1943, instruction in the chambers had become more strict and the training of captains of aircraft was not considered complete until

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they had received demonstrations of anoxia including the use of the portable oxygen bottle. In the last months of 1943 all medical officers and N.C.Os. in charge of decompression chambers were asked to supply notes on their experiences in training personnel; the information thus obtained was summarised and issued in a directive in an effort to standardise all teaching on the most suitable lines.

Though these chambers were relatively expensive pieces of apparatus and it was necessary to provide skilled personnel for their operation, demonstration and maintenance, their introduction was a major advance in instilling into all flying personnel the importance of correct oxygen technique, for valuable lessons were learnt from mistakes which were remediable in a chamber, but which would have had disastrous consequences had they occurred in flight.

EXAMPLES OF ANOXIA ON OPERATIONAL SORTIES

In the following paragraphs typical cases of anoxia developing on operational flights are detailed as evidence of the importance of an efficient oxygen system and of crews trained in operating the apparatus intelligently and correctly:

No. 1. Report on Oxygen failure, No. 5 Group, January 26, 1942, Hampden Aircraft. Captain/Sergeant, mask type 'E' with no economiser, heating apparatus not working. This aircraft took off at 1700 hours and landed at 2240 hours. During flight 14,000 ft. was reached and three hours were spent at 10,000 ft. At 14,000 ft. the outside temperature was found to be in the region of minus fourteen degrees centigrade. The captain stated that he started to climb from base and reached 13,000 ft. in thirty minutes. Oxygen was not being used though the mask was correctly positioned on his face and he noticed that breathing was very difficult and removed the mask. The temperature at 2,000 ft. was minus eight degrees centigrade. He found the inlet to his oxygen mask blocked with ice but since he had no automatic pilot he could not make a serious effort to clear it. At the same time he noticed that the corrugated delivery tube crackled when pressed. He thus had no alternative but to proceed without a mask. A height of 10,000 ft. was maintained for about three hours during which period he placed the oxygen tube in his mouth.

No. 2. Report on Oxygen failure, No. 5 Group, May 23, 1942. Wellington Aircraft. Four members of a crew using 'E' type masks without economisers during an attack on Hamburg. Extracts from this report read: 'Sergeant K—stated oxygen turned on at 12,000 ft. and on reaching 17,500 ft. found breathing difficult, improvement was effected by loosening the mask from the helmet and he continued wearing the mask loose without much trouble, except that he did not feel as well as usual. When the observer should have given him an alteration in course towards the target, the required information was not received and

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shortly after the wireless operator reported that the observer was not fully conscious. His mask was removed at 13,000 ft. and the inlet which had been completely frozen up was cleared, the mask re-applied and the observer regained consciousness.'

No. 3. Report on Oxygen failure, April 28, 1942, Halifax aircraft. Night sortie. Oxygen equipment consisting of Mark X regulator and type 'E' masks with economisers. The duration of the flight was 6¾ hours of which 4¾ hours was at oxygen height; an altitude of 20,000 ft. with an outside temperature of minus twenty-seven degrees centigrade was recorded. The rear gunner stated that while over the target area he began to feel queer, the feeling gradually increasing until he started to gasp and wondered if he could have become wounded without being aware of it. He then realised that his oxygen might have failed and informed the captain of this possibility. The flight engineer was then dispatched to the rear gunner with a portable oxygen bottle. The gunner did not, however, trouble to use this as the aircraft was then over the target area and he had to keep a sharp look out. He remembered getting angry with the engineer and after leaving the target he said that he felt better and was all right on landing at base except for a slight headache. The captain of the aircraft stated that while over the target area at 20,000 ft. the gunner was heard talking to himself on the intercommunication system in a 'thick' voice and saying in no uncertain terms that he was 'not worrying about night fighters'. On being asked by the captain if he was all right, the rear gunner complained that he was very cold and thought that he needed more oxygen. The captain said he then told the flight engineer to take a portable bottle to the rear turret and turned the main oxygen supply up to 40,000 ft. He heard the rear gunner refuse the bottle and start to argue with the engineer. This particular failure was traced to a leak in the indicator at the point beside the flare chute. The oxygen failure was therefore due to a defect in the oxygen pipeline and not to mask or economiser.

The above illustrations have been given at some length as they show the type of failure and the circumstances in which they occurred and to a lesser extent the possible remedies that could be carried out while in flight. It will be seen that in the three cases given no catastrophe occurred but there were many occasions when the outcome was serious.

The record of failures in the table below gives some idea of the size of the problem as it affected Bomber Command:

Sorties Abandoned in Bomber Command due to Oxygen Failure.
November 1, 1941–January 30, 1942, 19 failures in 5,000 sorties.

January 1943	No. 1 Group	10 failures
	„ 4 „	2 „
	„ 5 „	27 „
	„ 6 „	5 „

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February 1943 No. 1 Group } 30 failures.
,, 5 ,,

Failures in all Bomber Command Groups

March 1943	5
May ,,	5 (one fatal)
September 1943	14
October ,,	14
November ,,	42 (5,727 sorties flown)
December ,,	10
January 1944	10 (6,300 sorties flown)
February ,,	22 (all occurring in Lancaster aircraft)
March ,,	15
April ,,	2
May ,,	3 (11,000 sorties flown)
June ,,	2
July ,,	0
August ,, / September ,,	4 (17,700 sorties flown)
October ,,	3 (17,200 sorties flown)
November ,, / December ,,	0
January 1945	4 (11,465 sorties flown)
February ,,	1 (16,792 sorties flown)
March ,,	0
April ,,	1 (13,972 sorties flown)
May ,,	0

Night Vision

THE DEVELOPMENT OF THE CENTRAL NIGHT VISION SCHOOL AT UPPER HEYFORD

Good night vision became of increasing importance as night flying assumed progressively greater tactical importance. This was exemplified in the Pathfinder Force, formed in August 1942. The duty of the squadrons of this force was to locate and indicate* the target for the main bomber force. The target was identified by many means, of which radar and other electrical devices were the most important, but in spite of this it was essential for someone to see the target and for this reason night vision was very important especially for air gunners and bomb aimers. The Upper Heyford Night Vision School was inaugurated by a senior medical officer, who had made many sorties with the Pathfinder Force for the specific purpose of night target recognition. Pathfinder Force had two types of bomb aimer: the 'blind' bomb aimer using radar

* Usually by coloured flares or ground markers.

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devices and the 'visual' bomb aimer. Visual bomb aimers were important because they were usually responsible for the master bombing and on their accuracy depended the success of the raid; it was with them therefore that the senior medical officer was chiefly concerned. From his preliminary sorties the senior medical officer had produced a book of maps of the main European targets with particular reference to all possible landmarks in relation to reflection of light and these maps showed clearly the landmarks that would stand out at night. He then organised classes for bomb aimers and demonstrated his technique; this, coupled with their own experience, produced many good bomb aimers and the standard of night visual bomb aiming was considerably improved.

Early in the war, Vitamin A was issued as a probable stimulant to the night visual capacity and continued to be used as a normal day to day addition to crew diet. The value of this in increasing night visual capacity in crews, who enjoyed a good mixed diet, was not proved conclusively, but there grew up a belief that the administration of Vitamin A improved the general health and warded off colds and other minor illnesses.

During the early phase of the war the Consultant in Ophthalmology carried out numerous investigations into the night visual capacity of aircrew personnel, both at operational stations and at operational training units. A proposal to test the night visual capacity of all crews throughout the Command was made by the Medical Directorate in the summer of 1940, but the commitments of Bomber Command at this time were heavy and the Air Officer Commanding-in-Chief pointed out in his reply that night visual capacity was not the only attribute of a highly trained member of operational crew, and although it was of the utmost importance that all members of crews should possess adequate night visual capacity, personnel lacking this requirement ought not to be eliminated in the initial stages of training; it was agreed, however, that any member of aircrew having or suspected of having night visual inefficiency should be examined.

It was important to select for night flying duties those who had not only good light and dark adaptation, but also good form sense. The test employed in the Royal Air Force to estimate night visual capacity was the Rotating Hexagon Test and all members of aircrew were examined on this apparatus at the Aircrew Reception Centres. (*See* Plate XVII.) The maximum score was 32, but if the candidate scored 8 or more marks he was passed fit for aircrew duties and the result was recorded in his flying log book. It was possible by this test to grade personnel into those having good or moderately good visual capacity.

During August 1942, arrangements were made by Bomber Command for a mobile night vision testing team to visit operational stations and

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operational training units and to carry out tests on personnel who had not been examined at the Aircrew Reception Centres. Considerable numbers of personnel were involved and, on the advice of the Principal Medical Officer, a letter was addressed to Air Ministry by the Air Officer Training, emphasising the importance of having these tests carried out before personnel arrived at operational training units, as considerable confusion was caused if a member had to be withdrawn from a bomber crew owing to his inability to pass the test.

As a result of observations made on operational aircrew at R.A.F. Stations Scampton and Dishforth by an ophthalmic specialist, a system by which people could be trained to see better in the dark was evolved. Crews were taught dark adaptation and exercises were devised by which their night vision was improved for their particular task, for it was argued that vision consisted of a combination of experience and interpretation of that experience. With the co-operation of the Consultant in Ophthalmology and Headquarters Bomber Command a school of night vision training was started at R.A.F. Station, Upper Heyford in July 1942.

The Ophthalmic Specialist who had been responsible for the initial experiments and training at R.A.F. Station, Scampton was posted to R.A.F. Station, Abingdon in order that he could assist at this station and at Upper Heyford in the special research in night vision and the aircrew training classes. The development of night visual training continued during September 1942 at Upper Heyford where synthetic equipment, with the exception of the epidiascope, had been set up. The medical officer in charge drew up schemes of lectures and co-ordinated all information, maintaining close contact with the organisation side of Bomber Command, and a W.A.A.F. Orthoptist officer was posted to the school in anticipation of the first course which it was hoped would commence in October 1942. During the month the Flying Personnel Medical Officer* visited the four pathfinder squadrons and with the co-operation of the Officer Commanding, Pathfinder Force, delivered a lecture to the pathfinder crews, giving them all available information on night visual research; the crews were then requested to submit any details or suggestions which they thought would be useful as a result of their considerable operational experience. The further information thus obtained was reviewed by the Command Navigation and Armament Officers and one copy was then passed, with their comments, to the Night Vision School and another to the Physiological Laboratory of the Royal Air Force.

By October, all possible information had been collated and by the following month arrangements for night visual training were complete

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* *See* page 137.

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and pupils for the first course arrived. This course was designed to last 5 days and it was possible for the medical staff to give personal supervision to each member of aircrew attending. The results indicated that a very definite improvement in night vision could be made and it was decided after analysis that the setting up of a separate night vision centre for each Group was justified. No special medical arrangements would be necessary at such centres.

ADVANCEMENT IN TRAINING AT UPPER HEYFORD

The question of improving target maps for use during night bombing was under review and valuable operational information and suggestions to this end were submitted to the Physiological Laboratory.

The Sodium Day/Night Flying Unit was also stationed at Upper Heyford and circulated papers on day/night synthetic flying training, pilot training, day/night navigational training and bomb aimer training. Up to this time, in view of:

(i) the greatly increased night flying experience of all instructors;
(ii) the change-over to one-pilot crew, which halved the number of pilots who had to be given dual night training;
(iii) the increased amount of night flying which had been carried out by pupils before reaching the operational training unit

and for reasons associated with the normal training programme, the day/night synthetic training had not been fully exploited in Bomber Command. It was considered that the most suitable place for such training would be the advanced flying units.

The Training of Air Gunners and Bomb Aimers. The systematic training of aircrew in night vision was achieved by means of various ingenious 'gadgets' which reproduced visual conditions on the ground and in the air under varying degrees of illumination. Night vision could be improved very quickly and at Upper Heyford it was found that an improvement of 30–100 per cent. was possible after seven days' training. That interpretation was based on experience was illustrated by the fact that, when a man first went up in a bomber and was looking for a fighter aircraft, he saw only a 'blob', which came into his angle of vision and meant nothing to him; on his second flight, however, he realised the 'blob' was a fighter. It was found that if personnel knew what they were going to see, they would see it more quickly, and for a similar reason bomb aimers were taught to memorise the target, thus avoiding a loss of night adaptation through having to look at a map with a torch. Practice in seeing objects at night was therefore a most important factor in the improvement of night vision.

Crews were instructed in the simple anatomy and physiology of the eye, especially the functions of the rods, cones and visual purple, and in dark adaptation. The latter had to be demonstrated to them before they

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would believe it, and for this reason they were brought into a darkened room where an epidiascope showed a picture of a night fighter on a screen; at first they could not see it and declared that there was nothing on the screen, but after half an hour, when they had become night adapted, they could see it plainly. Later, Canadian synthetic equipment, with a large range of objects, was used for this purpose. It was demonstrated that a blue light could be seen fourteen times as far away as a red light and this insensitivity of the eye to red light was made use of by the wearing of red goggles for night adaptation. These had the advantage over the normal dark goggles that the eyes could be used while dark adapting.

Recognition of Targets. Photographs of targets were examined and it was decided what would be most readily visible by night and the methods to be adopted to identify the target. Size was also important, as small objects could not be easily seen at night. Crews were taught to memorise the shape of various objects and, if possible, to liken them to some commonplace article to aid memory. Bomb aimers were helped by having pointed out to them salient landmarks which would assist in the identification of the target. It was emphasised that the phase of the moon must also be studied in order to make a correct run in, for according to the angle at which the moon's rays struck the earth, objects would appear lighter or darker—thus a ploughed field might sometimes appear lighter than a grass field and *vice versa*. The identification of water at night must be effected by the use of reflection from the moon; if the moon was low, the water would be picked up 5 miles away, while if the moon was high, the water would be almost immediately below before it could be seen.

A Perspex windshield reduced the vision by 10 to 15 per cent. and considerably more if it was dirty. Crews were taught to scan for aircraft by making a visual sweep from left to right, dropping the gaze a few degrees and making a visual sweep from right to left; it was found that this method, as well as being the most efficient, was less fatiguing and less boring over long periods. It was also pointed out that the most effective way of seeing an object in the dark was to look not directly at it but slightly above or below it, thus making use of the parafoveal vision.

All personnel were tested on the Hexagon at the commencement of their course on night vision. An epidiascope was used showing aerial targets, and an attachment could be used to simulate night conditions—for example, full moonlight, three-quarters, half or quarter moonlight or starlight. The Lamplough trainer was used, whereby the trainee followed the movements of an aircraft silhouette taking an irregular course and made a graphic record by a mechanical device so that his accuracy in tracing the path of the aircraft could be observed. A further test known as the 'Heyford Test' was devised whereby letters were shown for identification under varying degrees of illumination and

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trainees were required to identify them; this test could also be adapted to use models of buildings and other likely target material.

Future of Night Vision Training. During December 1942 and the beginning of 1943 close co-operation between the Training and Medical Branches was maintained in night vision training. The medical officer in charge of the school observed improvement in the night vision of all pupils who attended the five-day course and the crews themselves appreciated the value of the training. The importance of the training was noted by the Training Branch and extension of the night vision centres to Groups was decided upon. It was considered that since preliminaries had been completed, supervision of night vision training could now be undertaken by aircrew who had successfully taken the instructors' course at the Central Night Vision School, thus avoiding the necessity for appointing whole-time medical officers to the Group centres.

Improvements in Night Vision to Combat Enemy Fighters. By March 1943 Night Vision Training Centres were being developed at Group Conversion Units (heavy bomber) by the Central Night Vision School at Upper Heyford. The increased intensity of enemy fighter action in opposition to Bomber Command's effort focused attention on procedure for fields of search* and necessary modification to aircraft, which would assist the crews in carrying out search at night and so avoid exploitation of surprise by the enemy aircraft. In Halifax aircraft it had been possible to remove the mid-upper and nose turrets and an 'under blister' forward of the rear turret had been substituted. These aircraft had been operating during the preceding two months and though some success had been achieved the following difficulties had been encountered in the use of the 'blister':

(i) Fatigue, due to discomfort of the prone position and the necessity for flexing the neck when looking through the 'blister'.

(ii) Dangers encountered in evasive action when the observer might be thrown from his prone position.

(iii) Difficulty in providing a plug to supply electrically heated flying clothing.

(iv) Soiling of the 'blister' by dust and oil reducing visual range.

'Under blisters' in the bomb aimer's position of the Lancaster aircraft were also being developed. The 'blister' was half cut away giving an unobstructed view; the bomb aimer while using this 'blister' was able to observe the bomb burst, and he was also able, for limited periods, to use the 'blister' for search down and under the aircraft, and so assist the rear gunner in his search for enemy aircraft when passing through heavily defended areas where enemy night fighter attack was to be

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* Field of search. This was the area of sky that a member of the crew could cover from his particular station in the aircraft.

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expected. These two examples illustrate the diversity of problems in which the Central Night Vision School was asked to give assistance, both by modifying apparatus and by offering suggestions for its better use.

Further Advance and Problems Occurring in 1943. During May 1943 night vision training of instructors proceeded at Upper Heyford, while the group night vision training centres were now completing their equipment and at a few training had commenced. Special operational problems which concerned oxygen and vision were under constant consideration by the Central Night Vision School, Armament and Navigation Sections of the Pathfinder Force and experienced operational squadron commanders. Some of these problems were:

(i) The effects of altitude of 2,000 ft. and above on the detail of ground features.

(ii) The difficulties of range estimation from these heights.

(iii) The effect on gunners of fatigue resulting from prolonged and intense search and the practicability of allowing them rest periods during a long flight.

At this period Pathfinder Group was paying considerable attention to night vision training, which might influence pin-pointing and map reading for navigational purposes and map reading as it affected navigation in the target area, and many of the related problems were referred to Upper Heyford.

Binoculars for air to ground search where visual marking was applicable were being used increasingly in the Command and proved most valuable on operations by Pathfinder Force. Binoculars were not popular at first, as crews had not been sufficiently instructed in their use and in some cases the results were worse than if they had not been used; however, they became increasingly popular not only for scanning but for the identification of targets and for observing the results of bombing. It was found that coastlines could be picked out five miles further away and aerodromes could be identified by the various formations of searchlights 30–40 miles away. Binoculars had to be focused on the ground as this could not be done in the air; each eye was focused separately and then the interocular distance adjusted.

Further Assessment of Night Vision in Crews. Considerable uneasiness was caused by the fact that aircrew whose night vision ability was in doubt were still being employed on operational flying duties. By July 1943, arrangements were made whereby the medical officer at Upper Heyford would re-test such cases. Details of any aircrew who, as a result of tests at the group night vision centres being unsatisfactory, were considered unfit to perform their duties, were referred to Upper Heyford, where they were re-checked and details of their original Hexagon scores and subsequent tests at group schools were compared. From this check the School recorded at least 50 per cent. as having average

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proficiency and full reports were forwarded to the Consultant in Ophthalmology to collate failures with the scores to determine whether there were other aspects to account for the failures, such as incorrect assessments at the group schools, dull intellect or any psychological factors.

Arrangements were also made to maintain records of all air gunners and bomb aimers passing through the school in order to determine, if possible, the correlation between night visual capacity scores and the school's assessment of proficiency.

Increases in Group Centres. By September 1943, two more Night Vision Centres were being equipped at Nos. 1665 and 1678 Heavy Conversion Units in No. 3 Group. This meant that all crews passing into the squadrons would have had night vision training. By October, 1943, there were seventeen Night Vision Centres within the Command and the benefit from the training was favourably commented on by aircrews. As a routine, each member of aircrew who was considered to possess ability below the average at his group night vision centre was sent to the School at Upper Heyford, where night vision tests were re-made and an ability test was carried out to confirm previous findings. In only a few instances was it necessary to recommend removal from night observation. It was strongly stressed to the group centres that their purpose was to teach pupils how to make the best use of the night vision capacity they possessed and not to assess this capacity. Although this point had to be emphasised periodically, it was now more fully appreciated and the value of the centres was enhanced accordingly.

It is worth pointing out that the year 1943 saw a great change in the enemy's defensive tactics and that air gunners had been called upon to play an ever increasing part in the success of operations. The importance of night vision was still receiving emphasis and four more centres were opened in the latter part of 1943 in No. 4 Group. This meant that all air gunners received a five days' course in night vision training. It was difficult to assess the benefit of this training but it was considered that the 'risk of unseen attacks' had been considerably reduced thereby.

Part Played by Physical Fitness Officers. It is convenient here to digress and mention that physical fitness officers were concerned with the ability of aircrew to see well both by day and by night, and played an important part in the actual night vision training schemes. The competent air gunner needed rapid reaction time, coolness, co-ordination and excellent vision, but all these suffered if he lacked the physical efficiency and stamina to deal with the marked strains and stresses he underwent in a small turret, often exposed to extreme cold for many hours at a time. Physical training in the dark was first instituted at Royal Air Force Station Cranfield, which was a fighter training unit. The scheme was worked out by the medical officers connected with the night

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vision school and the physical fitness officers. The aim was to give air-crew confidence in moving about under low illumination and to teach them how to judge distances and pick out moving objects under these conditions. For this purpose the gymnasium was blacked out with standard black-out fittings, which kept out most of the light, and four 60-watt bulbs were suspended from the ceiling at equal intervals. These lamp-holders were fitted with simple home-made reflectors, so that no light shone directly into the eye. Pupils were supplied with light-proof goggles fitted with interchangable filters by which starlight and various moonlight intensities could be simulated. Exercises were in the form of games and were planned chiefly to develop:

(i) Confidence—by walking along marked lines on the gymnasium floor, 'follow my leader', climbing ropes.
(ii) Balance—by walking along a 'balancing rib'.
(iii) Co-ordination—by suitable ball games.

Team games of all descriptions were encouraged as it was essential to make the training popular and let the pupils know why they were doing it as without their co-operation the training would be worthless. By these means crews learnt facility of movement in the dark and gained increased confidence in night recognition.

APPARATUS USED FOR TRAINING

Some mention has already been made of the various types of apparatus used in the night training establishments. Although some of the apparatus was of a standard design, much of it was made locally on stations and any necessary minor alterations were carried out at individual centres. Brief reference is made here to some of the commoner aids in use.

1. *Night Vision Boxes*. In April 1944 the night vision boxes produced by the Physiological Laboratory to demonstrate the effects of anoxia on night vision were introduced into the Command and were issued to Groups which had decompression chambers, but some difficulty was encountered in finding sufficient time for the inclusion of chamber demonstrations in the pupil's curriculum.

2. *Fluorescent Light*. The introduction of this type of instrument panel lighting was pressed for by the Command, who considered that it gave the minimum of eye strain combined with little loss of night adaptation. It was, however, emphasised that an alternative lighting system should be installed so that in cases of failure the pilot would not be deprived of the use of his instruments.

3. *Radar Aids*. With the introduction of radar equipment into general use in 1942 further visual problems were encountered and all equipment was reviewed by the Bomber Command Development Unit and the Night Vision School; both development and tactical use of equipment were considered in connexion with physiological requirements, special attention being given to the following details:

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(*a*) Appreciation of the limitation of radar equipment used by gunners and wireless operators.
(*b*) The training required to give a higher standard of interpretation.
(*c*) Night vision training to develop alertness and improve brain/eye reaction time.
(*d*) Tactical instruction to limit the advantages held by enemy night fighters.
(*e*) Morale of gunners and confidence in their equipment.

4. *Shadowgraph.* Many uses were found for this instrument but it was particularly suitable for air gunners, who were able to carry out their exercises in well blacked-out shadowgraph rooms, using the standard night training filters. It was also found very suitable when used in conjunction with photometrically controlled lighting to determine the range at which gunners could distinguish single, twin and multi-engined aircraft.

5. *Target Indicators.* Tests in respect of visibility and recognition of target indicators were carried out, using the filter screens provided by the Consultant in Ophthalmology. The tests, the purpose of which was to determine the value of the filter screens for colour-defective/safe bomb aimers, were carried out on a clear night when red and green target indicators and incendiaries were dropped. Two bomb aimers under test, one protanomalous and the other deuteranomalous,* used the filters. It was found that, although giving the necessary correction, the filters had the disadvantage of making the white incendiaries coloured, a drawback that outweighed any improvement they may have effected.

Conclusion. It will have been seen from this account that the study of Night Vision and Eye Training, developing during the war years into a comprehensive organisation through which were passed the majority of aircrew trainees, was able to offer considerable assistance to the war effort of the Command. It was possible to eliminate the majority of those whose night or colour vision was below the acceptable standards and to aid those with average vision to a greater pitch of efficiency.

Frostbite

The great discomforts suffered by aircrew through the extremely low temperatures and other hazards to which they were exposed, have been graphically described in the Air Ministry publication 'Bomber Command'. Frostbite did not constitute a particular problem in the early period of the war, but as the operational activity of Bomber Command increased and aircraft flew at higher altitudes, greater speeds and for longer periods, continual research into methods of protection was necessary. The numbing effects of cold, even when actual frostbite

* Protanomalous (deuteranomalous):—Having a defect in the first (second) constituent, essential for colour vision, as in red (green) blindness.

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did not occur, resulted in lowered physiological efficiency with a corresponding increase in the risk of operational failure; with aircrews operating in outside temperatures sometimes as low as minus 40° C. and the duration of flights anything up to ten hours, the problems created were not inconsiderable, especially in the case of air gunners, who were the chief victims of frostbite. Some idea of the numbers of incidents can be gathered from the tables below.

CASES OF FROSTBITE IN BOMBER COMMAND

TABLE I. *Total Number of Cases*

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1942 .		No record				4		No record			3	1(a)
1943 .	7	13(b)	3	3	6(c)	3(d)	3	2(e)	3	78	6	27
1944 .	15(f)	68(g)	No record	14	8	1	nil	1	1	11	18	17
1945 .	31(h)	8	2	1(i)	nil	–	–	–	–	–	–	–

Notes: (*a*) 2,077 sorties carried out but temperature conditions not too severe;
(*b*) 4,150 sorties at considerable heights but temperatures not too severe;
(*c*) 2 cases in Halifax aircraft on operational flights at maximum altitudes of 22,000 ft., 4 cases in Lancaster aircraft at 25,000 ft. (temperatures February to May between minus 20° C. and minus 35° C.);
(*d*) 6,000 sorties;
(*e*) 7,072 sorties; (from June to November 1943 the operational effort was increasing; the sharp rise in October was on account of increased altitudes and very cold weather);
(*f*) Temperatures down to minus 43° C.;
(*g*) Very low temperatures;
(*h*) 16 cases on operational flights, 15 on non-operational flights;
(*i*) Mosquito aircraft flying at 25,000 ft., minus 46° C.

TABLE II. *Causes*

	Anoxia	Heating Failure	Electric Failure	Clothing deficiency	Removal of part of clothing	Lack of adequate heating, clothing or oxygen	Excessive draught	Not known	Totals
June 1942 .	—	—	—	—	—	4	—	—	4
November 1942	—	—	—	1	—	—	—	2	3
October 1943 .	42	—	12	—	—	—	—	24	78
December 1943	7	—	7	5	2	—	—	6	27
January 1945 .	7	6	5	10	—	—	2	1	31
February 1945 .	1	—	—	1	3	—	—	3	8
March 1945 .	—	—	—	1	1	—	—	—	2
April 1945 .	—	—	—	1	—	—	—	—	1

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PARTS OF THE BODY AFFECTED AND CAUSES OF FROSTBITE

The parts of the body most affected were those areas of the face in contact with metal buttons or studs from the helmet; fingers and hands; toes and feet. Frostbite was usually found to be due to cabin heating deficiency, failure of the electrical heating apparatus in flying clothing, lack of oxygen or carelessness on the part of the aircrew member—for example, removing gloves to select bomb keys or manipulate switches or failing to wear the special underwear provided. Frequent sources of trouble with the feet and toes were the wearing of damp socks and the tendency of all aircrews to wear flying boots about the camp, resulting in sweating immediately prior to operational flying.

PREVENTIVE MEASURES

Protection against frostbite was provided by a combination of special insulated flying clothing and cabin heating. Later the clothing was electrically heated, but even so, considerable thought and scientific experiment were involved in the production of a scale of clothing which would afford sufficient protection in the event of electrically heated equipment failing. The interior heating of the new types of aircraft at the beginning of the war was far from satisfactory, particularly in the isolated gunners' positions where the cold was most felt, and the technical staffs were constantly seeking methods of improvement. The following is a brief description of the heating systems adopted and the aircraft in which they were used:

CABIN HEATING SYSTEM IN BOMBER AIRCRAFT

The fundamental principle of the heating system of all bomber aircraft was the supply of a current of hot air to the cabin and this was achieved in four main ways:

(*i*) *Direct Heating*, in which the air passed either through a pipe running through the engine exhaust system or through a muff surrounding an exhaust pipe. This system appeared adequate and reliable, but was not used extensively for fear of carbon-monoxide poisoning, although no trouble from this source was experienced in the Hudson or Oxford aircraft, which employed this method.

(*ii*) *Engine Coolant Heating*, in which some of the coolant was by-passed through an air cooling unit. This system proved uniformly satisfactory and reliable but could not be applied to aircraft with air cooled engines.

(*iii*) *Boiler Systems*, in which the air passed through a heater unit, the latter being heated by steam or hot water supplied by a boiler fitted to an exhaust pipe. This system had a number of disadvantages:

(*a*) Boilers did not stand up to their work for long—the Gallay boiler, for example, was renewed every 160 hours;

(*b*) systems had to be drained in winter when not in use to prevent freezing;

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(*c*) in spite of all precautions, such as filling with hot water, systems sometimes froze before the engines could be started or even when taxi-ing. Anti-freeze compounds for use in the boiler systems were unsatisfactory and ethylene glycol in particular was unsuitable as it decomposed at temperatures encountered in the boiler and clogged the system.

(*iv*) *The Stewart Warner* (*American*) *System*, in which a number of heater units were fed with a petrol/air mixture either from a two-stroke engine or from one of the aircraft engine superchargers. Each unit acted as a small heating stove and had its own exhaust pipe. Hot air was circulated by electric fans.

Summary of Methods of Heating used in Bomber Aircraft

Type of Aircraft	*Method of Heating*
Mosquito	Direct heating. Very satisfactory.
Lancaster Manchester Halifax Whitley Wellington	Engine coolant. Most adequate and reliable system in bomber aircraft.
Blenheim	Heated by a Bristol boiler system which was made more satisfactory after modification.
Hampden	Gallay boiler system; this was considered the most inefficient heating system as the water and steam were at atmospheric pressure. It was found impossible to apply pressure to the system owing to the distortion of the boiler at the increased temperature. No major modifications were attempted because of the obsolescence of the aircraft.
Wellington IC	Heated by Gallay boiler.
Stirling	Boiler with water circulation by electric pump. The steam pressure of the system was raised in order to increase the amount of heat supplied and so prevent loss of water, which had been a serious shortcoming of the system. Further improvement was effected by the piecemeal exclusion of draughts. In addition to the drawbacks mentioned, the system was difficult to drain and as the modifications described were apt to render the cabin too warm in summer, a spill valve was introduced. Direct air heating eventually superseded this system in Stirling I, IB and succeeding models.
Boston	American Boiler. Satisfactory.

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PLATE XVIII: Aircrew being transferred from Briefing to Aircraft Dispersals. The Crews were thus saved the Danger of Sweating which would have occurred if they had attempted to walk the Distance in Flying Clothes

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Fortress I	American boiler. Satisfactory for pilot and observer but useless for gunners and wireless telegraphy operators with gun-posts opened.
Liberator I and II	Stewart Warner system.
All later models of large American aircraft	Stewart Warner system.

In all later type British bombers, boiler systems were avoided if possible, heating by the coolant system being employed in aircraft with liquid cooled engines and direct exhaust heated air in those with air cooled engines.

Memoranda on Frostbite. During the war years Command medical staff kept a watching brief on frostbite by issuing memoranda at intervals and studying returns from the stations. In January 1940 a medical memorandum on frostbite was distributed to all stations, and this summarised the simple steps to combat the disability, as follows:

COMFORT OF AIRCREWS—PREVENTION AGAINST THE EFFECTS OF COLD AND AVOIDANCE OF FROSTBITE

Cold

1. Very cold conditions are found at low altitudes in the winter and at great heights at any time of the year.

The effects of cold depend on three factors, i.e. temperature, wind and moisture, and it is against these three factors separately or in combination that protective measures are necessary.

2. Protection against the effects of cold is necessary for the maintenance of physical and mental efficiency on flying duty and becomes increasingly so in proportion to the duration of the exposure, and the degree of coldness.

The immediate effects of severe cold, if protective measures are not taken or if these are neglected, are discomfort progressing to pain, and a general numbing of the physical and mental faculties, and finally, a general prostration and an uncontrollable desire for sleep; there is, also, always the danger of frostbite affecting those portions of the body which are exposed to or liable to be directly attacked by cold (i.e. fingers, toes, face).

Protective Measures

3. *Primary* protection is provided by closed aircraft and by flying clothing designed to conserve body heat and exclude wind.

4. *Secondary* protection is afforded by artificial heating of the aircraft or clothing, and the use of non-conducting material (e.g. plastic) in the construction of contact surfaces (e.g. controls, rudder bar, etc.).

5. *Personal.* The protective measures referred to above are not, and can never be, perfected in any but a completely closed (i.e. pressure-tight) aircraft; the personal factor, therefore, is a most important one in successfully guarding against the dangers of extremes of cold, for it is only by a combination of common sense and attention to detail that these dangers can be avoided or mitigated.

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In the following paragraph is given a general summary of most of those simple personal precautions which fall within the direct control of the individual and which, if neglected, will lead to personal suffering or inefficiency.

Personal Precautions

6. (*a*) *Flying clothing*. This must be loose and free from any tightness that might interfere with the circulation. Flying boots must be roomy enough to allow two pairs of socks to be worn comfortably.

(*b*) *Personal clothing*. Socks which have shrunk and become tight must not be worn. Several thin layers of loose-fitting, loose-woven clothing are much warmer than is one garment of similar material and combined weight.

(*c*) *Dry clothing. The importance of dry clothing cannot be overstated and is insisted upon*. It is obvious that clothing which is damp inside or outside provides moisture which may freeze in lowered temperatures. Clothing while in use is *continuously* absorbing sweat; any member of a crew who values his comfort and efficiency will remove his flying clothing after a flight, and personally see to it that it is placed in circumstances favourable for drying; particularly does this apply to gloves and fleecy lined boots.

No article of flying clothing ought to be worn for longer than is necessary.

Personal clothing must be dry before donning and before a flight; any excessive exertion which induces sweating is to be avoided when dressed for a flight.

Flying clothing ought to be used only for flying; it becomes wet or damp from the elements or from sweat if used for general purposes, and in this condition its protective value is lost.

(*d*) *The skin*. The skin, particularly of the hands and feet, must be dried before dressing for a flight, and socks and underclothing changed if necessary. Regular games and appropriate exercises, with cold showers and towel friction, will provide a healthy resistant skin and a well-toned cardio-vascular system adapted to combat cold.

(*e*) *Food and drink*. A hot meal taken before a long flight, and hot drinks to taste during flight, will help to ward off the effects of cold. A suitable scale of dietary for consumption during long flights has been issued; sugary substances are the main ingredients of this and should be consumed at regular intervals.

Alcohol gives a false sense of warmth, lessens resistance to cold, and increases the need for oxygen. Nevertheless, in the form of rum or brandy, it will temporarily restore a man who has reached the limits of endurance.

(*f*) *Oxygen*. Oxygen is not a drug, and an excessive supply can do no harm. If properly used, there is not the least physiological risk in high flying (apart from cold). Under conditions of extreme cold, oxygen is useful in maintaining the normal level of the heat exchanges of the body. A member of a crew who becomes a war casualty or is incapacitated by cold during flight, should be given oxygen at heights when its use is, normally, not indicated. It may be freely given on return to the base, and should be given to all cases of actual or suspected frostbite.

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7. Frostbite commonly affects those parts of the body directly exposed to the air (i.e. face) or the extremities (i.e. fingers and toes), where free circulation of the blood is likely to be interfered with. Stamping the feet and clapping arms and hands will help to maintain or restore the circulation and, therefore, the warmth in feet and hands.

The importance of drying clothing has been emphasised in paragraph 6(*c*). Damp flying boots or gloves will cause frostbite of toes and fingers which would not have occurred if these garments were dry; similarly, damp socks and feet or hands will result in frostbite.

Tight boots and gloves will increase the risk of frostbite. *To wear tight and damp foot or hand wear is simply asking for trouble.*

8. *Prevention of frostbite.* There is no direct or practical application which, applied to the skin, will prevent frostbite. Oils and greases have some effect in preventing frostbite when applied to surfaces directly exposed to the air. If applied to the hands and feet, they soil the linings of gloves and boots, with the result that linings are no longer able to absorb natural sweat, and therefore more harm than good is done. The prevention of frostbite is largely a personal responsibility, and is dependent on the observance of the general principles outlined above.

9. *Minor degrees of frostbite.* These, if neglected, may develop into severe frostbite some days after exposure. Numbed and whitened fingers must not be held in front of a fire; gentle friction with snow (if available) or under a cold tap until the circulation is restored is the correct immediate treatment. Every member of a crew suspected of suffering from frostbite, or threatened frostbite, should report at once to the station duty medical officer on return.

Ever-hot Bags. In spite of the cold experienced in the early phases of the war, very few cases of disabling frostbite occurred and this was attributed largely to the issue of 'ever-hot bags' on a generous scale; this, however, was only an interim measure until further investigations and improvements could be made.

Flying Clothing. The necessity for wearing the correct clothing was stressed continually and generally appreciated by the crews; sometimes, however, ground temperatures were such that the thoughtless would not look far enough ahead in making preparations. A knowledge of the heating available at each crew position under varying operational requirements would help to determine the choice of clothing for individual members of crew. A systematic procedure for each particular duty would limit the necessity to remove gloves when using bomb sights, W/T sets and sextants, launching flares or handling guns and ammunition.

It was essential to ensure that all flying clothing was loose fitting and did not restrict circulation and that boots and gloves gave freedom of movement in the small joints of feet and hands. The parachute harness needed to be adjusted according to the clothing worn so that tightness would be avoided. In combating the effects of cold, it was

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considered imperative that crews should start on operational sorties in the most favourable condition possible. Every effort was made to induce personnel to put on their flying boots at the last minute and stress was laid on the importance of clean dry clothing, including socks and oversocks, and avoidance of sweating before take-off. To these ends, during 1942 improved drying rooms for flying clothing were provided at all stations and transport was supplied to convey crews from duty-room to aircraft. (*See* Plate XVIII.) This latter arrangement ensured a dry exterior in inclement weather and a dry interior by avoiding exertion with resultant sweating inside flying clothing*.

Electrically Heated Clothing. Many attempts were made in 1940 and 1941 to warm turrets from the cabin heating systems but in view of the technical difficulties encountered in adapting the current heating systems into rotating turrets it was finally accepted that gunners would need to rely mainly on electrically heated clothing for warmth. Accordingly, in January 1942 the necessary wiring modifications were being carried out and the issue of the 'Taylor' type electrically heated gloves and socks was nearly complete. In October, in view of the approaching winter and longer duration of flights, electric appliances for heated clothing were reviewed and arrangements made for the supply of 1,000 additional electrically heated 'Windak' linings with increased wattage; these were strongly recommended for use in all turret positions.

In January 1944 gunnery leaders attended a two-day course at Farnborough at which a discussion was held with the officers responsible for the design and production of clothing and oxygen equipment; suggestions made included:

(i) the provision of extra heating elements in heated gloves and in the knees and seat of the type 'E' heated lining;

(ii) slight reduction of heating in high-wattage socks;

(iii) production of a new type glove with all the heating elements in the back, to give a better grip and a more positive control over equipment when handled with gloves on. (It must be emphasised that on occasions the handling of small and intricate parts was necessary in flight.)

It was also reported at this discussion that experiments had been made in treating inner silk gloves with latex to give them a rubber coating and so make it possible to handle even small articles with ease. These gloves were given service trials in March and crews using them were unanimous in the opinion that they were a definite improvement on the chamois inner gloves in current use.

* If a member of aircrew entered an aircraft in a sweating condition it was not improbable that this layer of sweat on the skin would be turned into a layer of ice between skin and underclothing if the aircraft encountered low temperatures within a short time of take off. This could have serious consequences if the aircraft was likely to be airborne for a lengthy period.

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At that time, the R.A.F. 'G' type Windak lining was considered the most efficient for all members of crew except the 'ball' gunner who was equipped with 'E' type electrically heated clothing. Complaints were made about the bulk and stiffness of the Taylor buoyancy suit, but the Windak lining proved popular, efficient and reliable; the latter could be worn over aircrew underclothing and under the battledress, making it possible to dispense with the buoyancy suit and thus gain freedom of movement and consequent fighting efficiency while maintaining the necessary warmth.

The type 'H' electrically heated lining with gloves and bootees, which later superseded the type 'G', had a higher wattage and better distribution of elements.

Introduction of Aircrew Cloakrooms and Locker Rooms. Aircrew were inclined to give too little time to the care of their flying clothing and early in 1943 it became evident that adequate attention could only be guaranteed by adopting the method of storage and maintenance whereby clothing would be kept in cloakrooms, issued to crews by the attendants and handed in at the end of each flight. This method would, it was felt, be particularly beneficial at satellite stations, where facilities for sorting and maintaining flying clothing generally were not so good as at parent stations. Towards the end of 1943 it was found that although some stations had made progress with their cloakroom arrangements, the position at others, particularly the satellites, was unsatisfactory. As a result of a conference on the matter, the following requirements were laid down by Bomber Command as a guide to all stations in providing the necessary facilities:

(i) The present crew drying and locker rooms to be redesigned—
 (*a*) 'Aircrew Cloakroom'—to provide for the reception, inspection, daily servicing and drying of flying equipment, i.e. parachutes, Mae Wests, flying suits, helmets and oxygen masks.
 (*b*) 'Locker Room'—to contain lockers for the deposit of personal clothing and other equipment not left in the cloakrooms, and for crews to dress in before flight.

(ii) These rooms to be provided on a squadron basis at operational stations and on a station basis at operational training units.

(iii) The rooms to be adjoining and communicating. Accommodation to be available for setting up the necessary testing panels, oxygen, heating and intercommunication equipment.

(iv) In the locker rooms at operational stations, racks to be provided for cloakroom attendants to set out flying equipment ready for immediate use by crews. The racks to be arranged by the letter of the aircraft, the captain of which to be responsible that members of his crew collected their own equipment and fitted themselves out correctly.

(v) Cloakroom assistants to be designated 'safety equipment assistants' and permanently established. The chief technical officer to be responsible

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for the receipt, issue and servicing of equipment and for the maintenance of the testing panels.

(vi) The squadron commander to be responsible for the locker room and for the proper testing of flying equipment.

(vii) The medical officer and the air sea rescue officer to act in an advisory capacity to the chief technical officer, squadron commander and captains of aircraft in the detail of these duties.

This valeting system was a great step forward in ensuring the correct use and care of flying clothing and equipment, although the co-operation of all concerned was essential to make it a success and staff shortages were apt to decrease its efficiency.

Facial Frostbite. One of the commonest causes of frostbite of the face was eventually eliminated by covering with adhesive chamois leather all metal parts of flying helmets and oxygen masks which were liable to come in contact with the face. Many gunners did not shave for six hours before a flight in order to retain the protective layer of epidermis possibly removed by shaving. Lanolin or other ointments were used for a considerable time but experience showed that any water content increased the risk of frostbite and accordingly, in October 1944, following the issue of new type Balaclava helmets, the Air Ministry gave instructions that the use of grease as a protection was to be discouraged. This Balaclava helmet, which was permanently adopted after several experimental models had been rejected, was a specially loosely knitted helmet to cover head and neck, oxygen mask and tube, leaving a space only for the eyes; it was found to be very satisfactory.

Oxygen. The importance of adequate oxygen supply in preventing the onset of frostbite was stressed at all aircrew lectures and continually brought to the notice of flying personnel. In December 1942 for example, crews were reminded that they should give as much attention to the use of oxygen as the pilot gave to his throttle box. When passing through heavily defended belts at oxygen altitude and when nearing the target area, the oxygen flowmeter was to read 5,000/10,000 ft. above the indicated height. If necessary, oxygen was to be used before landing at home base, irrespective of altitude.

Physical Fitness. Physical fitness would help to overcome cold by building up capacity for resistance. Crews were advised to have a hot meal about two hours before a sortie and were provided with thermos flasks of hot coffee, tea or other beverage for consumption during flight to help ward off the effects of cold. Liability to frostbite was increased by fatigue and it was suggested that this could be avoided to some extent, when practicable, by a systematic crew procedure—e.g. definite periods of relief for the pilot by his assistant, relief of air gunner by wireless operator/air gunner (W.Op./A.G.) after two hours' duty in the turret, and interchange of crew positions—particularly in the case of gunners.

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SOME EXAMPLES OF FROSTBITE

The following are cases of frostbite which occurred in Bomber Command:

(i) A sergeant gunner suffered frostbite of the fingers of the right hand; he was wearing three pairs of gloves and the heated clothing failed. It was felt that the tightness produced by wearing extra gloves was a contributory cause of frostbite.

(ii) The rear gunner in a Lancaster aircraft on a 10-hour sortie at altitudes above 15,000 ft. sustained frostbite of the tips of the middle and ring fingers. He was not wearing electrically heated clothing but was otherwise correctly clothed. In this instance it was found that no electric clothing was available at the station stores and immediate remedial action was taken.

(iii) A sergeant gunner after an operational sortie was found to have frostbite in the toes of his right foot. He was wearing the correct clothing but admitted that his boots were too tight and impeded circulation.

(iv) A second pilot of a Wellington, on a flight of 3½ hours' duration, with an outside temperature of minus 27° C. suffered frostbite of his fingers due to removing his gloves to drop flares through the chute, an action which was difficult when wearing gloves.

(v) A gunner had lost his silk gloves and the top of his right thumb became frostbitten because of a hole in the woollen gloves he was wearing.

Occasionally there was no apparent cause for frostbite, as in the case of the rear gunner in a Lancaster aircraft on a sortie of 10 hours' duration, crossing the Alps at 20,000 ft.; the parts affected were the first and second fingers of the left hand. Full electric clothing was worn and he was otherwise correctly clothed; a full supply of oxygen was maintained.

CONCLUSION

It seems particularly appropriate that during May 1945, when V.E. Day was announced, no cases of frostbite were reported. The foregoing narrative gives a broad picture of the battle against frostbite in Bomber Command. When one considers the weight of operational effort from 1943 onwards, the number of cases was negligible, but this was only achieved by constant vigilance, research and trial of new equipment. As with oxygen and other problems, the battle would be won only to be upset by greater altitudes and flight durations, and the problem would have to be tackled again. One of the greatest continual problems was educating aircrew in the proper use and care of their equipment. Carelessness was frequent and for this reason the Air Officer Commanding, No. 5 Group, made frostbite a self-inflicted injury if carelessness could be proved; after a few members of aircrew had been dealt with in this manner the Group realised the importance of looking after equipment. The other major step forward was the establishment of the

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'valeting' system for flying equipment. It must be stressed that however good the arrangements made, the ultimate responsibility rested on the members of aircrew and constant persuasion, instructions and reminders were necessary to make them realise this responsibility. Before the valeting system was introduced and test-rigs supplied, medical and engineer officers spent many hours in checking for oxygen and heating failures in aircraft only to find that the crew themselves had been careless.

Air Sickness

Before the war air sickness among aircrew was of little consequence owing to the combination of careful selection and the whole-hearted desire to fly shown by the entrants. During the war years, however, with the necessary vast influx of aircrew trainees, air sickness became responsible for a low but continual wastage of flying personnel and a recurrent minor problem for medical officers in contact with aircrew.

In the autumn of 1940 the Medical Directorate, Air Ministry, gave instructions that an inquiry into air sickness was to be held at all operational and operational training units and provided for this purpose a questionnaire to be used by medical officers in interrogating aircrew suffering from air sickness. Authorities in Bomber Command, however, felt that such an investigation at operational stations would serve no useful purpose and might rather have an undesirable psychological effect. These views were made known to Air Ministry and it was finally agreed to limit the investigation to the operational training units of the Command. The results suggested that little true motion sickness existed but that the cases were drawn from personnel in whom the true origin was of a nervous nature. The cases of sickness with nervous causes that survived the elementary training period, but were disclosed under the greater strain of operational training, gave an early indication of the aircrew who were temperamentally or constitutionally unsuitable for operational duties. All such cases were dealt with as they arose through the normal channels for disposal of personnel unfit or unsuitable for flying duties. However, a small number escaped detection at this stage, only to break down under the stress of operational tours.

In December 1940 sufficient cases had occurred for an analysis to be made of the salient factors and this was scrutinised by the consultants in neuropsychiatry and oto-rhino-laryngology and the Director of Hygiene at a conference held at Bomber Command. In none of the cases under review could the indisposition be attributed to an aural defect. In the majority the symptoms pointed to the early onset of flying stress and in others indicated that the individual was unsuitable temperamentally or constitutionally for operational duties, while in a few cases the indis-

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position was caused by nervous strain of a purely temporary nature due either to a transient dietetic upset or to a high sense of duty which refused to acknowledge until too late a temporary unfitness for duty.

From 1941 onwards the supervision and treatment of all cases of air sickness occurring during the stage of elementary flying training was acknowledged as being the most practical method of limiting air sickness at operational training units, where the indisposition of one member would break up a crew and result in serious disorganisation of the training programme.

In May 1943, a further investigation was carried out by the Senior Medical Officer of No. 91 Group to determine the incidence of air sickness still occurring at operational training units. It was noted that air sickness was more frequent among air gunners and flight engineers than in other crew members; this was considered to be due mainly to the fact that the limited flying carried out by these personnel before joining operational training units did not allow sufficient opportunity for the discovery of symptoms in those who either had a tendency to motion sickness or were psychologically unsuitable. The investigations carried out, however, suggested that the wastage rate was trivial in view of the numbers involved and not of sufficient importance to warrant further steps being taken in the matter.

MEDICAL OFFICERS' RESPONSIBILITY

When confronted with cases of true air sickness (motion sickness) medical officers had to give assurances that, with increased air experience, training and confidence, the symptoms would, in all probability, be overcome. Drugs were used as ancillary aids to reassurance, those most commonly used during the war years being gastric sedatives, chloretone, bromides and latterly hyoscine in small doses; this last named drug formed the basis of the celebrated 'Farnborough tablet'.

The few instances of air sickness that occurred during operational flying were found chiefly among wireless operators and navigators on four-engined bombers; those concerned were almost invariably regarded as efficient members of aircrew, and the sickness was considered to be mainly attributable to evasive action, particularly 'corkscrewing' (a corkscrew-like course flown by the aircraft in evading fighters), and to work which required visual concentration or special equipment, the navigator in particular being unprepared for sudden evasive tactics.

On operational flying, cases of air sickness were also reported periodically among flight engineers, and here again the limited flying experience of the engineer, together with the fact that in many instances the crew member was nearly 30 years old before commencing to fly, was thought to be the underlying cause. This was borne out in July 1943, when the air sickness incidence was again under review. At heavy conversion

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units, one or two flight engineers who were crewed up in their operational type aircraft, having had little experience, tended to exhibit air sickness and a certain wastage and breaking up of crews resulted.

A clear picture of the small but continual wastage rate can be seen in the data below for the period January 1, 1943 to December 31, 1943, of personnel who had been either removed from flying duties with a lowered medical category due to air sickness or taken off flying because of a lowering of the medical category, where air sickness was a contributory factor:

	Operational Training Units			Operational Units		
Total flying personnel	34,269			44,985		
Air sickness lowering medical category	135			134		
Percentage incidence	0·39			0·29		
Totals of:		cases	per cent.		cases	per cent.
Pilots	5,997	2 =	0·03	6,700	0 =	0·0
Navigators	6,173	66 =	1·07	6,552	25 =	0·38
W. Op./A.G.	5,935	12 =	0·20	6,636	13 =	0·19
Air bombers	6,459	6 =	0·09	6,370	6 =	0·09
Air gunners	9,705	49 =	0·51	12,243	58 =	0·47
Flight engineers	—	—	—	6,484	32 =	0·5
Totals	34,269	135	0·39	44,985	134	0·29

Flying Stress

The term 'Flying Stress' was generally applied in the instance of aircrew personnel who broke down and became unfit for duty on medical grounds under the strain of flying, and it came to imply a disability where the signs and symptoms were predominantly of a nervous character. At no time during the early phase of the war had it been definitely proved whether physical or mental fatigue was the primary cause of the final nervous disability, but it was considered by most medical officers that the condition arose from a combination of both factors.

Much evidence was accumulated by investigators, the study of whose reports and conclusions were part of the work of the Flying Personnel Research Committee. In this narrative it will suffice to indicate the broad principles governing the problem as it affected Bomber Command and to give some idea of its incidence and the methods employed by medical officers to counteract it. All through the war years 'Flying Stress' was a continual problem among aircrew and a constant cause of wastage of skilled personnel. Some idea of the numbers involved can be gained by scrutiny of the following tables.

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Cases of Flying Stress occurring in No. 5 Group during 1942

	Pilot	Observer	W.T./A.G.	Operational hours				Not exposed to exceptional stress	Exposed to exceptional stress		Temporarily removed from full flying duties	Permanently removed from full flying duties	
				0 to 25	25 to 50	50 to 100	100 to 200		Not injured	Injured		A_pB_p	Limited
January	—	—	—	—	—	—	—	—	—	—	—	—	—
February	—	—	—	—	—	—	—	—	—	—	—	—	—
March	—	—	—	—	—	—	—	—	—	—	—	—	—
April	1	—	1	1	—	1	—	1	1	—	—	2	—
May	—	2	—	1	2	1	—	2	2	—	2	2	—
June	1	—	—	—	1	—	—	1	—	—	—	—	1
July	1	—	—	—	—	1	—	—	1	—	1	—	—
August	1	—	1	1	—	1*	—	1	—	1	1	1	—
September	—	1	2	—	2	1	—	2	1	—	1	2	—
October	1	—	4	2	2	1	—	—	1	4	1	4	—
November	3	1	2	1	2	1*	2	3	—	3	5	1	—
December	—	1	1	—	1	1	—	—	—	2	2	—	—
Totals	8	5	11	6	10	8	2	10	6	10	13	12	1

Notes.—* Second tour.
Average strength of aircrew, 1,167. Incidence per 1,000 per annum, 22·3.

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New cases of 'Flying Stress' occurring in February and July, 1943

Group	Cases	
	February	July
Operational:		
No. 1 . . .	Nil	5
2 . . .	2	Nil
3 . . .	1	7
4 . . .	3	1
5 . . .	5	8
6 . . .	9	2
8 . . .	Nil	Nil
Total operational	20	23
Non-operational:		
No. 91 . . .	14	11
92 . . .	14	13
93 . . .	8	8
Total non-operational	36	32

The view held at Command and Group by the medical staff was that the maintenance of morale was essentially an executive responsibility and that the postponement of the inevitable effects of flying strain depended chiefly on morale and on the methods adopted to sustain this at a high level. It was considered that strain could not be endured indefinitely and that a station medical officer's usefulness in this sphere depended on his practical knowledge of flying personnel and their environmental conditions and on his ability to detect the early onset of strain before this became cumulatively disabling. Thus care was taken, firstly, to avoid obvious intrusion into the environment of operational stations of medical matters and suggestions which would in any way interfere with morale, and, secondly, to avoid attaching any medical significance to the natural reactions of the men when temporarily tired or exhausted by the normal and always severe strain of operational flying. With the onset of operations following the declaration of war, questions of security to some extent barred the medical officer from full contact with the operational side of the station, but later, as the heavy casualties sustained brought the inevitable aftermath of stress and neurosis, medical intrusion into the operational field became essential and indeed was welcomed by the executive.

FACTORS INFLUENCING STRESS

Fatigue on stations was due in the main to a mixture of domestic and operational reasons. Domestic reasons were many and varied, such as

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insufficient undisturbed sleep, inadequate off-duty periods and opportunities for recreation and the lack of attractively prepared meals following operational sorties. The sudden cancellation of sorties, usually due to poor weather, led to considerable difficulty on the catering side of the station and the ingenuity of the catering officer was often taxed to provide attractive meals at very little notice. Living conditions for officers were generally better than for N.C.Os. on the peace-time stations but on war-time stations there was little difference. The question of obtaining sufficient sleep was felt to be to a large extent the responsibility of the individual, but on a 'stand down' night the main objective of the majority of aircrew seemed to be to get as quickly as possible to a neighbouring hostelry. Although revelry was an excellent antidote to strain when indulged in moderately, it was felt that many spent their spare time thus because of a fatalistic attitude 'drink and be merry for tomorrow . . .'; this is not recorded in a spoil-sport attitude, as the desire for entertainment was a feature of the times, but it is considered that over-indulgence did in some instances lead to physical deterioration.

Operational causes of fatigue were many and included sorties cancelled or completed in bad weather, bad crew procedure and the necessity for a high degree of concentration over long periods with little rest, followed by a spell when very little would be required of crews. When a station had operated for, say, eight or nine nights out of fourteen, although no crew was likely to have carried out more than six sorties in that period, some medical officers felt that the crews were becoming tired; however, the situation was often relieved by unfavourable weather conditions or the necessity for overhauls of aircraft. At one station (Marham), for example, there was a period of maximum activity lasting ten days, followed by twenty-eight nights upon which it was impossible to operate owing to unfavourable weather; on many of these occasions, however, squadrons were briefed before sorties were abandoned and it was noticed that the cancellation of a sortie after briefing could be the cause of considerable stress. It should be noted that strain began from the time of briefing and the longer the time between briefing and take-off the greater the strain. On one occasion a sortie was not abandoned until just before the time of take-off, four or five hours after briefing, and the fatigue in those concerned was very noticeable during the period of waiting. Such strain, though not comparable with an actual operation, had to be taken into account in assessing the total stress to which aircrew were subjected during their operational tour.

Bad weather sorties, completed in often 9/10 or 10/10 cloud*, resulted in the target not being pin-pointed and bombs being dropped inaccurately or brought home, causing a sense of frustration or inadequacy

* 10/10 cloud indicates nil visibility.

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among conscientious aircrew. In a rather similar manner the effects of casualties and losses were negatived if it was felt that they were justified by the results obtained, while crashes had a bad effect on morale only when the causes were not known, and for this reason most leaders considered it sound policy to discuss all crashes when they occurred and to point out the lessons to be learnt from them.

It may be fairly considered that the duties of aircrew did not usually cause men to become bodily fatigued and there was no physical reason why a man should not remain in good condition throughout his tour; however, checks from time to time usually indicated that the physical state had deteriorated since the last recorded examination. A high standard of physical health was felt to be medically desirable, though this view could not be correlated with a high survival rate, as many of the fittest aircrew were lost on operations.

That flying stress existed was not admitted by many experienced aircrew. They held that all cases were 'Lack of Moral Fibre'. The majority of personnel who held this view were of a type who did not know or would not recognise danger when they met it, and their imagination could not contemplate anything untoward happening to them. In this measure their operational flying was less of an ordeal than for the majority of aircrew who possessed a higher degree of introspection.

On the other hand many aircrew were equally emphatic that flying stress did exist and was a real problem. In their own experience they had known the effects of marriage, family responsibilities, living-out and the effects of alcohol and other factors on their flying performance. As was pointed out by one experienced bomber pilot, his first tour presented little difficulty, but his second tour, which occurred after his marriage, presented a very different problem and he observed that his pre-operational tension was greatly increased throughout the second tour.

These differing views did not help to simplify the problem and there was also the unfortunate feeling in the General Duties Branch that some slur was attached to flying stress or that the term was synonymous with 'lack of moral fibre'. In any case, it was difficult to draw a line on one side of which a man was condemned as a coward and on the other absolved as being a victim of circumstances beyond his control.

PREVENTION AND TREATMENT

The measures adopted to prevent or treat flying stress were many and varied and included attention to details of all aspects of station life. The full confidence of aircrew in their personal equipment, the reliability of the technical services and aircraft and the efficiency of the medical and rescue services were essential. In this connexion it is interesting to note how few servicing personnel presented themselves as candidates for

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aircrew duties; if they did take up flying, however, they were generally very successful and free from liability to flying stress, and it was felt that if aircrew trainees had had to spend a period on servicing duties there might have been fewer cases of flying stress.

From the days before the war there was an interesting evolution in the part played by the medical officer in the operational side of bomber squadron activities. At some station sick quarters in Bomber Command records existed of the assessment of the standard of physical capabilities of squadron flying personnel with particular reference to their resistance to flying stress. At Mildenhall, for example, such records were made in August 1938, by the squadron medical officer. In September 1939 some of the personnel were still in the squadron and it was interesting to see how their assessment compared with their performance under the stress of combat. In general the assessment proved to be accurate, but in some individuals, where a powerful physique cloaked poor morale, performance fell short of the expected standard.

Shortly after the outbreak of war, authority was delegated to group senior medical officers to hold medical boards under King's Regulations and Air Council Instructions 1432, 1 (*b*) at the discretion of group commanders, in order to provide local facilities for leave, which could not otherwise be obtained. Before this any member of aircrew who became unfit for duty had been automatically struck off the strength of the unit, but such boards made it possible to keep the men in 'home waters', for leave so granted carried no medical stigma of disability. Although this procedure was, in fact, little used, it bridged a gap until other means to effect the same purpose were adopted by group commanders.

When medical officers were finally accepted into the operational field, it was felt that many of them, and particularly those new to the R.A.F., were inadequately prepared for their task; the majority had little or no experience of psychiatry, though this rapidly increased as their knowledge of aircrew broadened. There was at first a tendency to concentrate on the physical aspect of the multiple minor complaints produced by neurotic members of aircrew in an effort to escape their hazardous tasks. For it was to the medical officer that aircrew usually turned in an effort to find an easy way out of the obligations of their flying duties, particularly as by this means it might be possible to avoid the stigma of executive action.

FORMATION OF N.Y.D.N.* CENTRES

In 1940 there was set up at most Royal Air Force Hospitals a department known as the N.Y.D.N. Centre, where a trained neuro-

* N.Y.D.N. = Not yet diagnosed—Neuropsychiatric ?

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psychiatrist was available to advise station commanders and medical officers concerning members of aircrew who were, or were becoming, unsuitable for aircrew duties. To such centres passed three main types of case:

(*a*) Aircrew who had escaped or evaded the vigilance of the station and group executive organisation and were suffering from the effects of genuine operational strain, resulting in lowered physical health and resistance to the physical strain of operational duty.

(*b*) Aircrew of below normal physique and mental constitution, who were unable to withstand the strain arising from normal operational duty as easily as the majority of their comrades.

(*c*) Aircrew who constitutionally were simply lacking in resolution and aggressive attributes and had endured little or no flying strain, but concerning whom the station medical officer was in doubt as to whether a medical factor existed as a cause of failure.

It was possible by close co-operation between medical officers and these centres to sort out the medical and non-medical causes of failure and to deal with them accordingly—by treatment at the centre or other medical establishments, by further investigation or, if the non-existence of a medical factor was proved, by referring back to the unit for executive disposal.

FLYING STRESS RETURN

From April 1, 1940 onwards monthly statistical records were kept at Command Headquarters of all cases of captains and crew who were removed from operational duties on medical grounds as suffering from flying stress. Copies of these records were supplied to the Consultant in Neuropsychiatry who, together with members of his staff, during the war years paid periodic visits to bomber stations, studying crews and conditions, making investigations and advising Command on the normal measures likely to preserve morale. These enquiries were discreetly carried out and the reports made and conclusions reached were part of the work undertaken by the Flying Personnel Research Committee.

The 'Flying Stress Return' made it possible for the senior medical officer to gauge the collective morale and resilience of aircrew personnel and to link the figures with various factors which could be estimated numerically; thus the previous concentration on individual cases of neurotic breakdown gave way to a more general conception of the efficiency of aircrew as a whole. From pre-occupation with purely physical problems of fitness such as oxygen lack, frostbite and differentiation between the disposal of waverers and neurotics, attention was now turned to the supervision of operational activities from the medical psychological viewpoint.

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SUPERVISION OF OPERATIONAL ACTIVITIES

Such supervision was carried out by the senior medical officers of groups in the following ways:

(i) *Contact with Squadron Commanders.* The group senior medical officer, unfettered by considerations of squadron loyalty, was in the most favourable position to assess the temperamental qualities and capacities for leadership of key personnel and this became one of the most vital and fruitful lines of research.

(ii) *Contact with Junior Medical Officers.* It was impossible and in any case undesirable for the group senior medical officer to give individual supervision below squadron commander or at most flight commander level and therefore, when visiting stations, he obtained from his medical subordinates most of the information required concerning the number of cases of neurosis occurring over a period, the number of aircrew reporting sick with trivial complaints, the number of cases of frostbite due to carelessness in flying discipline and the administrative side's record of the numbers of non-effective sick aircrew.

(iii) *Liaison with Air Staff.* One of the most helpful contacts was with the Group Training Instructor and his staff and from the monthly 'Summary of Events' could be obtained figures showing:

(*a*) The number of sorties completed per month per squadron and by the Group as a whole.

(*b*) The monthly total of operational and non-operational flying hours.

(*c*) The influx of new crews.

(*d*) The number of accidents.

(*e*) Analysis of the casualty rate.

The information thus obtained, together with the reports in the Signals and Armament specialist branches, showed the main trend in the Group and revealed any undue increase in the incidence of flying stress in a particular squadron, which was usually considered to be indicative of faulty leadership and poor morale.

RESPONSIBILITY OF STATION MEDICAL OFFICERS

Meanwhile, the investigation of individual operational failures became increasingly the interest of the station medical officer and to ensure close supervision of flying personnel the following system was devised. Records were compiled for each member of aircrew on arrival at his operational station, giving particulars of his previous occupational career, sports interests, family life and responsibilities, medical history before and after joining the Service, an estimate of his mental make-up and an assessment of his proficiency for his particular aircrew duty. When the crew became operational, records were kept of each individual's operational achievements and failures. By reference to these records it was possible to investigate individual or collective recurrent failures rapidly and with a considerable background.

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The part of the medical officer in these 'post-mortems' on failure was very important and it was his responsibility to maintain a balance between the technical and personnel aspects of any recurrent operational failures, for there was a tendency to pay attention to the type of mistake most commonly made, rather than to the individual repeatedly making the mistakes, even though it had been proved in industry that 80 per cent. of the accidents were due to 10 per cent. of the personnel.*

This is well illustrated by one example in a squadron. The Signals Officer was perturbed by a series of unsatisfactory radio 'fixes' obtained by one operator, who was otherwise considered reliable. On investigation it was discovered that the navigator was at fault and that the conflict of personalities caused friction and made full co-operation impossible. Similarly, analysis of 'Bomb Aimers' Errors' from the basis of individual records showed the importance of the 'accident prone' factor in the explanation of bombing failure.

LIMITATION OF THE OPERATIONAL TOUR IN RELATION TO STRESS

In groups in which few sorties were carried out at the beginning of the war it was some time before cases of flying stress developed. For example, in No. 5 Group no sorties were carried out until the invasion of Denmark and Norway, and the crews became accustomed to standing by and were not subject to any particular strain. This also applied to groups doing operational sorties, as the original aircrew were highly trained and of good morale. After the invasion of Norway a considerable amount of daylight bombing was carried out by Hampden aircraft of No. 5 Group, but these aircraft were found to be too lightly armed and towards the end of May 1940 they, together with the Wellingtons of No. 3 Group and the Whitleys of No. 4 Group, were converted into night bombers. The formation of night bomber squadrons meant that, as the bombing was carried out by individual aircraft, each captain of aircraft had virtually the same responsibility for the success of the mission as, in peace-time, it had been assumed would belong to a squadron leader or flight commander. This placed a greater strain on the inexperienced and it was obvious that some limitation would have to be placed on the operational effort demanded of individuals. There were two possible ways of achieving this end:

(*a*) By removing individuals from operational flying when they began to show signs of stress.

(*b*) By limiting the tour of every individual to an amount of operational flying which would be within the capabilities of the average member of aircrew.

* Known technically as 'the accident prone'.

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This question was discussed with the Air Officer Commanding No. 5 Group and it was decided that limiting the tour would be the best method of dealing with the problem. Records indicated that, if aircrew personnel did more than 30 sorties (about 200 hours), they were liable to develop signs of flying stress; this was confirmed by the neuropsychiatrist in charge of the N.Y.D.N. Centre at Royal Air Force Hospital, Rauceby, and at a conference it was decided to adopt the limit of 200 flying hours. The alternative employment of crews after the operational tour was to be at the operational training units on instructional duties for three months. Experience later showed that most individuals could tolerate the 200 hours tour. In this connexion it is worth noting that some medical officers thought that better results would have been obtained if the crews had not had such a long period of alternative employment but had been given shorter tours.

Later in 1941, due to the great increase and expansion of Bomber Command, it was felt that the medical supervision of aircrew in vogue was too diffused and haphazard to be efficient. The anticipation of psycho-neurotic breakdown in any individual by recognition of the grosser signs of nervous fatigue was a hopeless task, if any useful therapeutic result was to be obtained. Thus it was decided that closer attention was to be given to the detail of operational failure from the personal point of view, and correlation between psychological estimate of the neurotic predisposition of an individual and his operational performance was to be carefully watched. It was hoped in this way to concentrate attention on the weak links in the chain, when their defective performance pointed to maladjustment to their part in the squadron effort. Once recognised, encouragement and special training could be expected to bolster up their confidence and morale. In the wider field, this technique of medical supervision of operational efficiency could indicate, as already described, the trend of 'crowd psychology' of the crews and the results in squadron morale both of unit leadership and the higher direction of bombing policy. Further, in the interpretation of operational results and investigation of flying accidents, even more attention than was given at that time to the temperamental qualities of the personnel concerned would be needed to gain an accurate picture from research on the spot.

RÔLE PLAYED BY SQUADRON COMMANDERS AND GUNNERY, BOMBING AND NAVIGATION LEADERS

The part played by squadron and flight commanders and gunnery, bombing and navigation leaders in the prevention of flying stress was of vital importance, for they were in close contact with their crews and therefore in the best position to assess how each man was standing up

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to the operational effort, whereas it was not easy for medical officers, particularly as the numbers of aircrew increased, to know all flying personnel intimately. On a station which was well officered and inspired by the personal example of commanding officer, squadron commanders and flight commanders, a good *esprit de corps* was shared by flying and ground personnel alike. Good leadership contributed greatly to morale, discipline and confidence. A squadron commander who would take his turn of operational flying regardless of the hazard or otherwise of the target was one with his crews, and in such a squadron psychological illness or 'lack of moral fibre' was practically non-existent. Similarly, it was noted that the posting to an operational squadron of a flight commander, often with an excellent training record but without operational experience, would bring about a drop in the confidence of the squadron. For this reason many medical officers when dealing with a case of flying stress would think first of the leadership of the patient's squadron in which might be found the root of the trouble.

RELATIONSHIPS BETWEEN MEDICAL OFFICERS AND NEUROPSYCHIATRISTS

Many medical officers were dubious about the value of sending flying stress cases to a neuropsychiatrist. Their opinion was that before a decision as to disposal could be made, it was necessary to have a full knowledge of the patient's character and background, and that it was impossible for the neuropsychiatrist to be aware of the work and the stresses of an operational bomber station, the inter-play of personalities and the quality of leadership, from which the case had arisen. Added to this was the feeling that the individual would get the wrong impression from being sent to a neuropsychiatrist. On the other hand, these same medical officers admitted their own inability to deal with some of the cases and in practice it was often found that the case was best handled by friendly co-operation between the neuropsychiatrist and the squadron medical officer.

It was furthermore considered by many medical officers that, without operational experience, no doctor was in a position to judge whether a man's refusal or disinclination to fly arose from genuine flying stress or not. In this connexion it is interesting to note the action taken in No. 8 Group in cases of flying stress. The individuals concerned were interviewed by the Air Officer Commanding and the Senior Medical Officer of the Group; the latter stood in special relationship to aircrew, as he had done many operational trips, and it may be that this was a significant factor, for this Group had the lowest record of flying stress in Bomber Command.

A number of medical officers thought it essential, in dealing with cases of flying stress or threatened breakdown, to abstain from showing

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undue sympathy with or understanding of the man's condition. They argued that it was the airman's duty to report any loss of control of his nervous system, and that no blame should be attached to him if he found he could not face up to operational aircrew duties, but rather that his courage in confessing this should be recognised. It was agreed that the attitude of the airman must be kept objective and free from self-analysis and introspection, or his chances of returning to aircrew duties were slight, and these medical officers therefore preferred the cases to be handled by the neuropsychiatrist.

EXECUTIVE ACTION

The problem of dealing with cases of flying stress was fraught with difficulty, executive action being the only alternative to medical treatment. This might mean that the airman would be reduced to the ranks with loss of his flying brevet (a procedure which many medical officers felt to be unjust) in one instance, or re-mustered to another branch while keeping his brevet in another. In fact the executive action taken appeared to vary very considerably from station to station, and furthermore the executive were often loath to accept responsibility and preferred disposal of the case through medical channels whenever possible.

Although medical officers differed in their views on how flying stress cases should be dealt with, they were unanimous in their opinion as to the necessity for speedy disposal of all operational personnel found to be unfit for full flying duties and this opinion was endorsed by group and station commanders. Furthermore, in view of the pressing demand for beds and specialist services in the Royal Air Force Hospitals, it was wasteful to use them for treating ailments, real or imaginary, of personnel inherently unsuitable for aircrew duties but quite fit for full ground duties. Non-effectives were posted to station headquarters and the ideal was for them to be posted away from there as quickly as possible; although on some stations the efficiency of the executive action enabled rapid posting to be achieved, in other instances the men had perforce to frequent the hangars and mess as there was no work for them. This was an unfortunate circumstance for the individual concerned and bad for the morale of the squadron.

CLASSIFICATION OF CASES OF FLYING STRESS

It was difficult to classify cases into hard-and-fast groups, as this type of disease presents itself invariably as a series of individual problems ; however, a classification adopted by the Senior Medical Officer of R.A.F. Station, Waterbeach and accepted broadly by most medical officers is of interest and is given here.* Aircrew who faltered or broke

* Though the classification was evolved primarily for Bomber Command it could be applied to all operational flying Commands.

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down during a tour of operations could generally be divided into two classes—temporary and permanent failures. The temporary failures were divided into those who broke down between the eighth and twelfth trip and those affected from about the twenty-fourth trip onwards; the permanent failures could be subdivided into the essentially unsuitable types and the cases of extreme stress reaction.

Group 1

This group was familiar to all medical officers on operational stations and consisted of aircrew who began to show signs of fatigue from the eighth to the twelfth trip; they were usually both frank and distressed about their reluctance to fly. The medical officer had first to satisfy himself regarding the physical and mental health of the individual and then, once certain of his diagnosis, he would treat the patient himself, on the station, and a complete cure would generally be effected. In dealing with these cases the medical officer's relationship with the aircrews was of the utmost importance, for treatment consisted mainly in sustaining or rekindling the man's resolution and courage by reassurance and sympathetic understanding of the factors contributing to his condition, and the possibility of doing this depended largely on previously established mutual trust and friendship. This treatment was usually supplemented by a mild sedative and a period of leave was sometimes granted at a later date. Efforts to encourage or persuade men to return to flying were not easy or pleasant for the medical officer and he had to realise that their reluctance was based on a perfectly natural fear of death, often linked with a sense of family obligation. He also knew that if the men resumed flying and were subsequently killed, he could not himself escape a sense of partial responsibility.

Example. A sergeant pilot, aged 24 and married, complained of 'nerve beginning to go'. He had done eight trips, including several hazardous ones over well-defended targets. His wife was pregnant and post-mature which added to his worries. A full physical examination revealed nothing abnormal except tachycardia and increased reflexes. Blood pressure was normal, weight was steady but appetite poor. The treatment adopted was encouragement, reassurance and a tonic. He flew again on operations after three days. Leave was arranged so that he could see his wife and he resumed his tour without further trouble.

Group 2

The cases in this group were thought to be true cases of flying stress. They commonly showed both constitutional signs and symptoms of stress manifested by tachycardia, insomnia, exhaustion, depression and anorexia with loss of weight. It was thought that they had become

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fatigued before the end of their tour simply because the accumulated strain of operations had in their case been excessive or because their resistance was adequate but not extreme. Such men required immediate rest, and by a firm decision on the part of the medical officer and the executive this could readily be obtained. The prognosis for a second tour was in most instances good.

Example. A sergeant wireless operator complained of insomnia and return of air sickness, previously mastered at his operational training unit. He had completed twenty-four trips, the last of which had been particularly unnerving, as the plane had crash-landed on return to base after being hit by flak. He had had no appetite after the crash. His previous record was excellent. By executive co-operation an immediate posting to an operational training unit was secured and after this rest he completed his tour with no further difficulty.

Group 3

This was made up of men who broke down in the early stages of their first tour, usually within the first six trips, without having experienced any exceptional strain. They were largely drawn from a small but definite proportion of aircrew, mostly air gunners or engineers, who differed completely from the rest of their colleagues. Their motive for becoming aircrew was usually simply glamour and promotion and they had not considered the risks of flying. They lacked conscientiousness, integrity, responsibility and self-respect, their discipline was bad and they were apt to claim operational successes which they had not achieved. It was felt that the majority of true cases of lack of moral fibre were found in this group.

Such personnel had usually made up their minds, before going to the medical officer, that they would do no more flying and they admitted quite frankly, without constitutional symptoms or marked remorse or distress, their inability to carry on operational flying duties.

The diagnosis in this group had to be made with particular care to ensure correct and fair disposal, but it was clear that almost all these cases required executive and not medical action. Most medical officers felt that there could be no possible doubt about the prognosis—namely, that these cases were absolutely useless from an operational standpoint. Their breakdown was final because their mental make-up was intrinsically poor, and any attempts at encouragement, exhortation or therapy to induce them to return to duty was a waste of time and not in the operational interest.

It was felt that there should be no compromise about their disposal; it had to be immediate and decisive and the first step was their prompt removal from an operational unit—this being the responsibility of the executive.

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Example. A sergeant wireless operator air gunner in a Blenheim squadron, unmarried, refused to fly after six trips. He was sent to the medical officer after refusing to enter the aircraft. He had previously given improbable accounts to the intelligence officer of fighter pursuit through cloud at 11,000 ft. over the North Sea when returning from night operations.

On examination no constitutional signs or symptoms were observed. Immediate executive action was taken.

Group 4

This group comprised cases who broke down after exceptional strain and thus included some of the most worrying with which the medical officer had to deal. Breakdown from exceptional strain could occur at any stage in the tour and might precipitate collapse of morale in otherwise resilient aircrew as well as in any of the types in Groups 1–3 already described. The correct assessment, diagnosis, prognosis and management were frequently complicated, and to make a wise decision in such cases the medical officer required previous knowledge of the man, full understanding of the nature of the strain and, as always, sympathy and imagination. Whether or not the case was considered to be medical, allowance had to be made for the effect of strain on a man's demeanour. A man who had it in him to complete a tour usually showed marked improvement within 48 hours, but a breakdown sufficiently established to necessitate taking the man off all flying for more than two or three days, or referring him for neuropsychiatric advice, suggested a bad prognosis for return to operational flying.

The treatment by the medical officer on the station, directed to an immediate recovery, was on the following lines:

(i) Administration of a sedative immediately following extreme stress before the patient retired to sleep;

(ii) Advice and encouragement to fly again as soon as possible afterwards;

(iii) Recommendation for leave, once the reluctance to fly again had been conquered;

(iv) Continuous and unobtrusive supervision.

Example. A sergeant, aged 28, unmarried, the captain of a Wellington bomber, took off on an operational raid with a 4,000-lb. bomb; one engine began to fail and after circling the aerodrome for some ten to fifteen minutes trying to gain height to reach the sea or an open space to jettison the bomb, the aircraft caught fire and crashed. The crew fought their way out and ran some distance before the 4,000-lb. bomb split and burst. One member of the crew was killed and four seriously injured; the sergeant himself escaped with minor injuries and was treated by a sedative.

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This man had completed twenty trips and was an excellent member of aircrew, but he stated that he could do no more operational flying. On examination, he could not, in all fairness, be considered a medical case, but by co-operation with the executive he was recommended for an instructor's course; this he failed owing to jumpiness at the controls. For disposal purposes he was labelled as an executive case with strong recommendation for leniency in view of the circumstances. The flying prognosis was considered to be very bad.

Flying Personnel Medical Officer

HISTORICAL SURVEY

Among the forerunners of books on aviation medicine were those written on the movements of birds' wings. The first of these, by Borelli, was published in 1680 and the second, by Pettigrew of Edinburgh, on 'The Physiology of Wings' was written in 1870. Results of experiments on atmospheric pressure in relation to life were published in 1878 and 1895. At that time a great interest was being taken in balloons and Glassier ascended to 29,000 ft. in one; at that height he had to stop the ascent because his arms had become paralysed; he pulled the rip cord with his teeth. In 1911 Crutchet and Moulinier produced a book on sickness in aviators.

With the advent of the First World War, more interest was taken in aviation medicine because flying had become increasingly important and a few far-seeing people had already realised its potential in warfare. Between 1914 and 1918 Lucas and Lindemann worked at Farnborough on aviation problems and in 1917 Haldane produced an oxygen mask which employed the 're-breather' principle. It was difficult to persuade aircrews that the use of this mask was necessary and, in fact, the only men who would wear it at that time were the photographic personnel, who found that without its use they did not bring back the required photographs*. Research was also carried out in the Royal Air Force by Flack, Clements, and Birley, and in 1920 Birley published three lectures which constituted the first modern appreciation of the medical problems of flying.

After the War of 1914–18 slow progress was made in aviation medicine owing to the fact that little money could be diverted from the Service estimates for this purpose and because, without the additional spur of a war effort, the development of aircraft and ancillary equipment slowed down to a leisurely peace-time tempo. Abroad, two books of interest were published, one by von Diringshofen and another by Armstrong. The *Manual of Air Tactics*, published in 1935 as a confidential

* This suggests that mild anoxia was common but unrecognised in pilots and gunners.

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document, covered such problems as unassessable bombing errors due to lack of oxygen, cold and its effect on the human factor, the effect of cold on equipment, draughts, fatigue after long flights, the misting of lenses and panels and poor visibility. Information on various war conditions which could increase bombing errors were also recorded, for example:

(*a*) Fatigue might cause the average error to be increased by 30 per cent.
(*b*) Even when targets could be seen and identified at night the average error might be increased by 50 per cent. owing to lack of appreciation of night visual conditions.
(*c*) Difficulty in identifying an objective not contrasting with its surroundings.
(*d*) Poor air to sea contrast when flying below clouds at night.
(*e*) The relative defencelessness of a bomber when held in the beam of a searchlight.

In 1939, with the rapid expansion of the Royal Air Force, the Flying Personnel Research Committee was formed to carry out research in connexion with aviation. After about a year's work on oxygen, blackout, parachute harness and other items of equipment, it became obvious that laboratory and research work was losing touch with the practical side of flying, owing mainly to very rapid development in the latter, and a link was needed between the research side and the squadrons themselves. To provide this link a Flying Personnel Medical Officer (F.P.M.O.) was appointed to each operational Command, on the staff of the Principal Medical Officer.

APPOINTMENT OF A FLYING PERSONNEL MEDICAL OFFICER TO BOMBER COMMAND

Bomber Command were particularly fortunate in their first F.P.M.O. who had been a fighter pilot towards the end of the First World War and then qualified as a doctor. He was in the Auxiliary Air Force for twelve years and became the flight commander of No. 605 A.A.F. Squadron; in 1938 he became the medical officer to the squadron and remained so until the outbreak of war. On mobilisation he was stationed with his squadron at Tangmere in Fighter Command. There, occasionally, bombers made emergency landings, and while inspecting these aircraft he noted various improvements which could be made for the comfort of the crews. He made his views known to the Principal Medical Officer of Bomber Command and was eventually posted to the Headquarters of that Command where he was acquainted with the details of the flying problems known or envisaged at this stage and it was possible to utilise his flying, executive and medical experience in investigating those medical factors which particularly affected the operational efficiency of aircrew.

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Terms of Reference of Flying Personnel Medical Officers. The following terms of reference were laid down for F.P.M.Os.:

(*a*) To investigate and report on factors affecting the functional or operational efficiency of flying personnel from the medical aspect.

(*b*) To inspect and report on equipment used and, so far as it affected the medical and physiological aspects, to make recommendations to meet the varying operational requirements.

(*c*) To study and report on any factors predisposing to non-effectiveness in flying personnel at operational squadrons and operational training units.

(*d*) To maintain liaison with the Physiological Laboratory and the Flying Personnel Research Committee on questions affecting flying personnel and their equipment.

(*e*) To lecture to aircrew personnel as required and to maintain personal contact with crews, giving guidance on all matters pertaining to welfare, use of personal equipment, oxygen, clothing, or other new equipment.

GENERAL APPROACH TO F.P.M.O. DUTIES

The equipment installed in Service aircraft demanded a highly developed sense of sight, hearing and touch and delicate muscular co-ordination in the operator, particularly in the case of the special navigational and radar instruments and the power-operated turrets. Flying personnel therefore required to be mentally alert and to have unrestricted freedom of movement and much experimental work was necessary to evolve a satisfactory oxygen supply and suitable clothing for protection against cold which would not interfere with operational efficiency.

The F.P.M.O. had to be conversant with all the modern equipment used by aircrew and to be aware of strategical and tactical requirements, including engineering and the armament of aircraft. He also needed to keep in constant touch with the men who did the actual flying, fighting and training to ensure that, in planning operational and training requirements, the medical aspect was not overlooked and also that the opinions and suggestions put forward from time to time by aircrew were given careful consideration.

Liaison with Units and other Formations. By this time it was fully appreciated by those concerned that physiological requirements had to be taken into consideration in exactly the same way as armament, navigational and other basic requirements. The F.P.M.O's. opinions therefore, based as they were on a broad knowledge of every aspect of flying, were valuable not only to the R.A.F. Physiological Laboratory, whose work was influenced thereby, but also to Commanders-in-Chief and Heads of Branches, who would often call upon the F.P.M.O. to advise when new types of aircraft or modifications were being considered. Close liaison was also maintained with Bomber Command

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Development Unit, Bomber Operational Training Units, Fighter Command Development Unit (on fighter/bomber problems), the Empire Air Armament School and the Signals Development Unit; the functions of all units such as these were, of course, dependent on Service requirements and modified according to current needs.

Relationship of Flying Personnel Medical Officer to Principal Medical Officer. After a tour of units or a series of meetings, the F.P.M.O. presented to the Principal Medical Officer a draft report on the problems encountered and the investigations made, the various aspects of each subject dealt with being recorded. When agreement had been reached concerning any action which could be taken, branches were informed in order that the decisions might be implemented without delay.

Examples of Investigations carried out by Flying Personnel Medical Officers. Although the terms of reference for their work were clearly laid down, F.P.M.Os. found in practice that they needed to turn their attention to a large number of problems which could not have been foreseen; experience also taught them that, while investigating any specific problem, it was wise to be on the alert for information which might be of value in the consideration of other problems.

In the following pages will be found notes of some of the investigations carried out by the F.P.M.O., the examples quoted having been chosen to illustrate the wide variety of subjects on which he had to give an authoritative opinion:

I. *The Operational requirements of Hampden aircraft in No. 5 Group, 1940.*

In May 1940, the Air Officer Commanding No. 5 Group and the F.P.M.O. reviewed the operational requirements and equipment of the Hampden aircraft of the Group and discussed difficulties peculiar to each crew position. On the night of 9/10 May 1940 the F.P.M.O. accompanied a crew on an operational flight, 'gardening'* in enemy waters; he flew as air gunner in the under turret of a Hampden, and as a result of this experience he made the following observations on the gunner's action station:

(*a*) The very limited space in the under turret resulted in excessive discomfort for the gunner who had sometimes to spend more than six hours in a very cramped position, kneeling on the floor of the turret or sitting with legs crossed or partly extended;

(*b*) The gunner's field of vision was approximately that of the field of fire and he was unable to observe the tactical approach of enemy aircraft over a sufficient distance;

(*c*) Intercommunication: the R/T plug was placed near the oxygen plug point and could be inadvertently disconnected when using the guns, with possible serious consequences;

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* The code and slang name for minelaying.

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(*d*) The excessive draught made goggles essential to comfort, but if oxygen was used (as was frequently necessary) the goggles became misty due to the condensation of expired air and had either to be removed or kept clear by constant wiping.

The combination of such drawbacks as these not only reduced the available fire power but also produced excessive fatigue which could eventually lead to the lowering of operational efficiency.

After examination of the difficulties and conversation with flying personnel of the Group, the F.P.M.O. made the following recommendations:

(i) In new type aircraft an adequate field of vision should be ensured so that full use could be made of available fire power;

(ii) R/T and oxygen plugs should be repositioned;

(iii) An improved oxygen face-piece should be designed which would permit the wearing of goggles at all times without detriment to full operational efficiency and give added protection against draughts.

Although these may appear to be obvious solutions to the difficulties encountered, it was not until the recommendations were made by the F.P.M.O. that remedial action was taken.

II. *Investigation of Armament Failures in No.* 3 *Group*, 1940.

In November 1940, the F.P.M.O. carried out an investigation into armament failures and for this purpose he selected No. 3 Group. Before visiting stations in that Group he interviewed the Air Officer Commanding, who put forward the suggestion that bomb failures were possibly caused by crews using the complicated mechanism of the bombing panel when they were fatigued after long flights and perhaps flurried by enemy action.

Special attention was paid to the following factors in making the investigation:

(*a*) The varying operational requirements and their demands on the personnel.

(*b*) Accidents and failures resulting from factors under the control of the crew members concerned.

(*c*) Accident proneness indicating necessity for better selection of personnel.

(*d*) Fatigue caused on the ground and in the air.

(*e*) Screening of armament personnel and the effect on efficiency.

(*f*) Good lighting, a requirement closely allied with efficiency.

(*g*) Duties involving repetitive processes such as bomb fusing.

Relevant details obtained on stations were recorded on charts and reports and with this information and the results of an examination of bomb aiming procedure on operational trips, the F.P.M.O. was able to make several recommendations.

With regard to armament personnel, the detailing at short notice of targets and bomb loads, necessitated at times by adverse meteorological

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reports, made the final check difficult and it was often necessary to delegate this important task to an armourer below N.C.O. rank. Where armament officers had been able to retain the N.C.Os. and armament personnel on their establishment for some time, they had trained them in the various duties at bomb dumps, fusing points, etc., and had eliminated personnel unsuitable for these tasks; thus when last minute changes of bomb load were required, a duty could confidently be delegated and failures due to maintenance and preparation were reduced to a minimum.

Bombing-up in the dark was a factor which increased bombing failure, particularly in the winter months with the added difficulties caused by inclement weather, and hasty daylight bombing-up needed to be avoided as much as possible. It was also noticed that facilities for work on bombs were often bad; at Newmarket, for instance, fused bombs with lugs covered with mud were seen and it was noticed that the rivets of many tail vanes were loose due to frequent manhandling.

The F.P.M.O. was informed by five crews, who had been recently posted to an operational squadron, that during training at operational training units the bomb aimers had been trained on Wellington 1A and 1C bomb panels, which were not in use in the Hampden aircraft; three of the crews had practised night bombing on only one occasion and the other two crews had practised only twice; oxygen had been used on only one training trip and they had never dropped flares by night. Such preparation for operational duties was considered to be completely inadequate.

It was observed that bombing leaders carried out their duties with enthusiasm and keenness, but in many instances they worked by a definite rule, doing what they were told and only to a small extent using their own initiative when bombing. They did, however, pass on all information they acquired which was of operational importance, and it was considered that, if co-ordinated, this valuable knowledge would greatly assist bombing leaders and also form a basis for standardising the advanced training of bomb aimers.

The F.P.M.O. formed the opinion that bomb aimer/navigators, after a period of operational flying during which they had become proficient and confident in navigating, often interested themselves in astro-navigation; they were invariably ready to discuss this subject but did not generally apply the same serious attention to the factors involved in bombing errors, such as:

(*a*) the study of tactical approach to the target;
(*b*) the use of incendiaries in poor visibility as 'markers';
(*c*) the tactical use of parachute flares;
(*d*) the use of bombing wind;
(*e*) the full tactical use of oxygen.

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When the F.P.M.O. accompanied crews on practice and operational bombing, he observed that a definite systematic procedure was not carried out in the use of the bomb sight and ancillary equipment; this he believed to be the fundamental cause of many bombing failures in the air, and certainly the cause of most bombing errors. Other factors noted and recorded as being subsidiary causes were fatigue, rush take-off, discomfort, anoxaemia and flak.

A number of sample returns compiled by F.P.M.Os. have been included in the Appendices to illustrate the type of information recorded during their investigations and also to show their obvious knowledge of such a technical matter as bombing.

III. *Investigations into the Medical Aspects of the Use of Cathode Ray Equipment* 1943–4.

In early 1944, the F.P.M.O. attended the first meeting of the permanent Radar Training Committee at Command Headquarters. The development of H.2.S., 'Gee', visual 'Monica' and 'Village Inn' (code names for radar and navigational aids involving visual scanning) were discussed and consideration was given to the training problems which arose in connexion with each type of equipment. Special attention was paid to visual problems arising from the use of 'Village Inn', particularly in relation to :

(*a*) the effect of fatigue on accuracy of interpretation of the display;
(*b*) visual standards of selection required for gunners using this equipment to detect ocular muscle imbalance.

The green display of the cathode ray equipment had a considerable effect on visual fatigue and dark adaptation, but although the possibility of using an amber or red filter to overcome this colouration was examined it was found impracticable in view of the high intensity of light required to ensure fine interpretation of the display; in any case, it was decided that operational efficiency would not be reduced to a dangerous level by the use of the green coloured display. The question of visual standards for gunners and navigators was referred to the Consultant in Opthalmology.

The F.P.M.O. reviewed with Bomber Command Development Unit and the group gunnery leaders the development and tactical use of radar equipment from the point of view of physiological requirements, with special reference to the following:

(*a*) Appreciation of the limitation of radar equipment used by gunners and wireless telegraphy operators.
(*b*) The training required to give a high standard of interpretation.
(*c*) Night vision training to develop alertness and improve brain/eye reaction.

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(*d*) Tactical considerations to limit the advantage held by enemy night fighters.

(*e*) Morale of gunners and confidence in equipment.

He was also concerned with the question of the amount of time which should be allotted to training in the use of the latest equipment, and the stage at which such training should be given.

Trials of the new equipment were carried out at Bomber Command Development Unit and the F.P.M.O. maintained close contact with that unit and with all squadrons equipped with the new instruments in order that medical aspects should not be overlooked.

Amendments to the H.2.S. training manual, details of the equipment connected with green display, the high intensity of light necessary to ensure correct interpretation of oscillations and the duration of the observation of the display were all matters connected with radar which were considered from time to time and with which the F.P.M.O. was closely concerned.

LIAISON OF FLYING PERSONNEL MEDICAL OFFICER WITH SISTER SERVICES AND ALLIED MEDICAL BRANCHES

In December 1942 liaison was established with a medical officer of the U.S.A.A.F. regarding the safety of aircrews, with special reference to their crash and ditching stations. Air Ministry diagrams giving the full ditching procedure for various types of aircraft in use in Bomber Command were examined together with diagrams showing the procedure for abandoning aircraft. (*See* Plates XXXI–XXXIII). Arrangements were then made for the American officer to visit Headquarters No. 5 Group, in order that he could see practical demonstrations of the ditching procedure. A meeting with the Deputy Director of Air Sea Rescue at Air Ministry was also arranged.

In January 1943 a naval surgeon commander was attached to Bomber Command for two weeks and accompanied the F.P.M.O. on his visits to stations where the visiting officer was able to discuss with squadron commanders and chief instructors the naval aspects of crew supervision.

These are only two examples of the many ways in which liaison with other Forces and Services was found to be of value to each participant, in providing the opportunity for discussion on points of interest to their respective flying branches.

LECTURES BY FLYING PERSONNEL MEDICAL OFFICERS

Lectures were delivered by F.P.M.Os. at all large aircrew training centres such as the Air Armament School at Manby, Central Gunnery School at Sutton Bridge and the Medical Officers' Course of Flying Physiology at Farnborough, and although the emphasis was naturally placed on the subjects taught at the respective schools, the opportunity

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was taken to give brief reminders on such vital subjects as oxygen, dark adaptation, etc. These lectures were continually revised during the war years and were much appreciated both by trainees and by experienced aircrew on refresher courses.

Although it has only been possible to give an outline of the work undertaken by the F.P.M.O., it is hoped that this brief narrative has shown him to be a valued member of both the medical and flying sides of the Royal Air Force, whose observations not only led to increased safety and comfort for crews but also contributed to the successful prosecution of the war. A study of the Appendices to this section will reveal something of the efficiency and knowledge which lay behind the 'bonhomie' of the F.P.M.O's. approach to aircrew.

APPENDICES

The following appendices have been included to illustrate that although the Flying Personnel Medical Officer's approach to and demeanour among aircrew was in many ways informal (a necessary adjunct if problems were to be aired without restraint), the task in hand was tackled in a systematic manner.

A perusal of the following sample returns will show clearly the attention given to detail and the methodical collation of all data, which, when considered collectively, gave a concise picture of the problem under investigation. F.P.M.Os'. reports normally ran into several pages but, in the interests of brevity, extracts only are given here; these, however, are fairly comprehensive and though not consecutive are at any rate sufficient to indicate the manner in which records were maintained.

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APPENDIX A

Physiological Problems of Long Flight

Standard Method of Recording Information before, during and after Flight by F.P.M.O.

R.A.F. Station Honington. *Date, March* 8, 1940. *Return for September* 3, 1939 *to March* 1, 1940

Squadron	Flying personnel on strength	'Turnover'		Flying hours total	Flying personnel days off duty, sickness and accident	Total Squadron leave in days
		Killed, wounded, missing	Accident, sickness			
No. 9	93	47	3	1,191	—	—

Date, February 1–28.

Name	Duty	Total Flying		Month flying	Days off duty for month			Leave month in days	Off duty days all causes	Notes
		Service	War		Battle action	Accident	Sickness			
	Captain .	1,890·00	50·00	30·00	Nil	Nil	Nil	6	6	Squadron with 12 operational crews. Two reserve crews. Divided into 4 sections with 3 crews per section (one complete section taken for these statistics). One section (viz. 3 crews) away on leave 6 days; after return and interval of two days, the next section proceed on leave.
	2nd Pilot .	636·05	116·05	20·40	Nil	Nil	Nil	6	6	
	Navigator obs.	166·10	105·35	15·00	Nil	Nil	Nil	6	6	
	W/T operator	388·40	116·28	19·20	Nil	Nil	Nil	6	6	
	Rear gunner .	—	—	—	Log book not available—away sick			—	—	
	Centre gunner	58·00	56·00	14·00	Nil	Nil	Nil	6	6	
	Captain .	684·00	86·40	19·35	Nil	Nil	Nil	6	6	
	2nd Pilot .	411·25	82·15	8·05	Nil	Nil	Nil	6	6	
	Navigator obs.	238·15	76·20	18·15	Nil	Nil	Nil	6	6	
	W/T operator	221·30	105·40	13·55	Nil	Nil	Nil	6	6	This ensures flying personnel have 12–14 days' leave per 3 months, and the O.C. always has 9 complete operational crews available.
	Rear gunner .	138·22	70·00	7·40	Nil	Nil	Nil	6+3 (special)	9	
	Centre gunner	113·10	82·55	12·15	Nil	Nil	Nil	6	6	
	Captain .	719·00	104·45	17·45	Nil	Nil	Nil	6	6	
	2nd Pilot .	538·20	104·20	18·45	Nil	Nil	Nil	6	6	
	Navigator obs.	123·10	67·50	16·05	Nil	Nil	Nil	6	6	
	W/T operator	155·45	40·10	15·10	Nil	Nil	Nil	6	6	A reference to the important duties of gunners in these crews, together with the amount of flying carried out, suggests additional flying pay to [illegible]
	Rear gunner .	195·20	103·25	14·50	Nil	Nil	7 (cold)	6	13	
	Centre gunner	167·15	118·25	12·35	Nil	Nil	10 (Rubella)	6	16	

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Consideration on Station

General environment	Non-flying duties	Accommodation: Quarters	Accommodation: Crew room	Messing: Time	Messing: Variety	Messing: Service	Utilisation of sport, recreational facilities
New permanent station part completed. Officers' mess and quarters hutments.	Carried out in rotation by flying personnel.	Hutments	Standard C type hangar		Good		An outlying station—facilities for travelling away or collecting visiting teams not available.
Other ranks—dispersal points, barrack blocks and hutments.		*Note on temperatures, March* 8, 1940 Outside ground level . 33° F. In hangar . . . 35° F.					Regular teams not re-formed; heavy casualties and the necessity for training up new crews has deprived flying personnel of time for the organisation of adequate sports facilities.
Squadron equipped with Wellington 1A and 1C aircraft, previously engaged on day duty, now engaged on day and night duty.		Hangar offices Locker rooms Crew rooms } . 55°–60° F.					A permanent sports officer would overcome this factor. The station W.A.A.F. officer, an exponent of 'Health and Beauty', arranged mixed hockey with success.
Aircraft dispersed—dispersal points and hangars in proportion of 50 per cent.		The establishment of flying personnel in Wellington squadrons does not permit the placing of *all* flying clothing lockers in locker rooms. A number of flying clothing lockers are necessarily placed in the hangar. *A maximum of 37 lockers can be placed in one locker room.* *A practical working number of lockers per room would be 27 lockers.*					
Frostbites reported Chilblains Bodyweight Crew who do not feel cold		Heating, ventilation: Mess Fires	Heating, ventilation: Hangar Central	Menu Good	Tobacco, alcohol Very moderate		Squash Court book: Yes Football teams: Occasional Tennis book: Fixtures, sport: Inter-section only Sports officer: Yes, flying personnel

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Observations before flight, *February* 28, 1940 — *Dressing*

General observations Training sweep	Transport facilities	Messing: Time	Messing: Variety	Messing: Service	Dressing (inner) Socks, pants, vests, cardigans	Flying (outer) clothing and equipment Inspection, preparation, helmets, goggles, associated equipment, clothing, boots, gloves	Collection check disposal of rations, etc.
C.O. 'brief' of crews, 0700 hours February 28, 1940—sweep of North Sea Enemy shipping—800 miles—duration approximately 4½ hours. Action to be taken 1. Submarine shipping 2. Enemy aircraft 3. Weather 4. Clouds Testing of guns Testing of aircraft after action with enemy Testing of slots and flaps Setting of altimeter W/T details Recognition signals, etc. Air-gunners warned to use their eyes Photography Importance of area where shipping must not be attacked, i.e. N. of, etc. The importance of good 'briefing' is a factor in prevention of fatigue Briefing should take only 20 minutes Time: 1600 hours, February 27, 1940 Operation orders issued by C.O. Squadron, 1800 hours Intensity of operational effort: see above Special tasks: see above Special instructions: see above		0630	Good	Good	Variety of underclothing. Dressing commenced approximately 0740 hours, completed 0755 hours, when crews moved to aircraft, carrying gloves and helmets, parachutes and instruments, etc. Grenville cloth, and flying suiting supplied to Long-range Development Flight worn by one member of crew. Issued by Air Ministry, 1937. For Long-range Development Flight Training. Method of dressing: Flight Office, Crew Room and locker room. 'Dodge': Silk gloves and woollen mitts.	Variety	0800 hours placed in aircraft, packet for each member of crew, and some crews carried tins of glucose sweets or fruit drops. Air drill

Type of aircraft, long-nosed Blenheim

Resistance enemy affecting crew	Fatigue observed in crew or individual member of crew	Failure of equipment	Oxygen flow meter reading	Rations stimulants	Notes
Nil	Nil Two and a half hours of close formation flying at sea level in bad weather—fog. Involves some physical strain on pilots. But the duration of this flight was comparatively short.	*Pilot*: Restriction of movement due to clothing and associated equipment. Frequent lifting of microphone facepiece which he kept on lap and held to mouth when giving orders. Navigator same procedure. During rain, water entered through perspex joints in front cockpit. Draught mid-turret round A.G's. shoulders. † Oxygen mask pushed on one side for sighting 'K' gun. Inter-comm. Oxygen	Test on ground for state of bottles	Sandwiches and tin of fruit drops No drink taken	*W/T A.G.* Wore silk regulation gloves and woollen mitts. * Effect of noise. Firing of own guns not heard. Hence danger of surprise. Freeing of all possible flying clothing to increase capacity for performing the duty which requires: (1) Mobility, (2) Alertness.

* Importance of mobility endorsed.

† It is possible 'K' gun will be replaced by two Browning guns. The oxygen mask will then not interfere with fire power.

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Observations during flight, February 28, 1940

General observations Sweep—North Sea: Time	Height	Temperature	Altitude effect on operation	Weather affecting task	Special tactical consideration
0815 hours	–	+9° C. (mercury)			
Front cockpit— Pilot, outer sidcot Navigator, outer sidcot			Warm—pilot and navigator removed gloves.	Sea fog and low cloud necessitated low flying in close squadron formation. Banks of fog necessitated individual action in flight formation.	0915 hours. Testing of guns.
0915 hours	500 ft.	+10° C. (mercury)	Personally wearing thermally-heated suiting—sweating.	Returned to base independent flight action on order being given.	
1000 hours	200 ft.	+8° C.			
1015 hours	100 ft.	+9° C.	Height, 1,000–1,100 ft.		A.G. states the controls feel cold at height. On low-altitude flight of this type, draught is the factor for A.G.
1025 hours	20 ft.	+10° C.			
Returning to base—fog Landed 1100 hours Cold site in aircraft : mid-turret Cold duty in aircraft : W/T A.G. Temperature of cold spot to be recorded			200 ft.—sea level.	Visibility: bad Clouds: 10/10 + + Rain: little Blind flying: one hour	Result of handling guns and equipment.

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Observations on landing after flight, 1100 *hours*, *February* 28, 1940

Extent of exposure–stress	Condition of crew physiological, psychological	Speed of recovery	Use of available equipment	Notes
Squadron formation Nine Blenheims Bad weather Squadron and Flight formation 2½ hours at low altitude, mainly cloud flying. Returned to base without completing 'sweep'	No evidence of stress or strain	—	Aircraft equipment 100 per cent. All personnel had evolved the details of clothing best suited for their particular duty and discarded all equipment which interfered with the requirements of duty Flying clothing returned to locker room and locked up for future use, after letters and valuables had been collected. Hence damp.	Crews wore flying helmet with chin strap unfastened, oxygen face-piece attached on one side only. Holding to face each time R/T was used. A.Gs. pulled down or moved to one side oxygen mask when actually firing. Impossible properly to sight a 'K' gun with mask and microphone in position, without interference from the face-piece. Parachute harness was left unfastened by some pilots and navigators, but was ready loosely lying on shoulders if required. The A.Gs. are compelled to wear or completely discard. Hence, they wear their harness.
Cold spots in aircraft: mid-turret Cold duty: W/Op. A.G. Noise: Firing of own guns not heard				D.R. navigation, beacons, searchlights assisting. D.F. fixes Astro

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APPENDIX B

Operational Sorties taken part in by F.P.M.O. Bomber Command

Date	Squadron and Aircraft	Captain of aircraft	Time hr.	Time min.	Target and duty
February, 1940	No. 107 Squadron, Blenheim (Short nose)			30	(Day). B. Sea: Sweep—returned early—bad weather. 100 ft.
February, 1940	No. 107 Squadron, Blenheim (Short nose)		3	0	(Day). N. Sea: sweep, 500–1,000 ft.
March 14, 1940	No. 9 Squadron, Wellington 1A		6	0	(Day). N. Sea shipping search. 1,000 ft.
March 20, 1940	No. 9 Squadron, Wellington 1A		6	30	(Night). Reconnaissance. River *Weser*, 1,000 ft., and *Bremen*, 13,000 ft. Nickelling *
May 10, 1940	No. 44 Squadron, Hampden		6	30	(Night). Gardening.† *Lübeck Bay*, 500 ft. Passed Kiel 16,000 ft.
October 26/27, 1940	No. 149 Squadron, Wellington 1C		6	30	(Night). Bombing *Merseburg* (near Leipzig) (oil refinery). 13,000 ft.
January 24, 1941	Blenheim (Long nose)		2	30	(Day). Attack Benghazi Aerodrome, 12,000 ft. (Middle East). Returned on one engine
September 22, 1941	Whitley		6	0	(Day). Dinghy search off coast—Ushant, 200 ft. Beaufighter escort
January 27, 1943	No. 218 Squadron, Stirling		6	45	(Night). Mining. *Baltic* via Denmark, 500–1,000 ft.
February 2, 1943	No. 156 Squadron, Lancaster		4	40	(Night). *Cologne*. P.F.F. 18,000 ft.
February 4, 1943	No. 83 Squadron, Lancaster		6	45	(Night). *Turin*. P.F.F. (Primary marker, first on target), 18,000 ft.
March 8, 1943	No. 156 Squadron, Lancaster		7	15	(Night). *Nuremberg*. P.F.F., 18,000 ft. (Primary marker, two runs over target)
March, 1943	No. 218 Squadron, Stirling		7	20	(Night). *Bordeaux*. Mining—ran over flak battery at 500 ft.
March, 1943	American Fortress		5	0	(Night). Nickelling* over France, 25,000 ft.
March 30, 1943	No. 218 Squadron, Stirling		7	50	(Night). *Berlin*. 13,000 ft. (Ten minutes in target area before run in). Severe icing on track out

* 'Nickelling' = leaflet raid.

† 'Gardening' = laying of sea mines.

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APPENDIX B (*cont.*)

Date	Squadron and aircraft	Captain of aircraft	Time hr.	Time min.	Target and duty
April 1, 1943	No. 218 Squadron, Stirling		7	0	(Night. Full moon). *Stuttgart*. Flew at 100 ft. on track out and home. Climbed to 13,000 ft. for bombing
July 27, 1943	No. 83 Squadron, Lancaster III		5	30	(Night). *Hamburg*, 18,000 ft. P.F.F. 'Window'* used effectively
October 6, 1943	No. 83 Squadron, Lancaster		6	50	(Night). *Stuttgart*, 19,000 ft. P.F.F. (Backer-up)
November 23, 1943	No. 83 Squadron, Lancaster		6	50	(Night). *Berlin*, 19,000 ft. P.F.F. Attacked by fighters on the bombing run
July 12, 1944	No. 192 Squadron, Halifax			20	(Night). Returned early. Starboard outer engine failed. Overshoot. Belly landing
1944	No. 83 Squadron, Lancaster		4	0	(Night). *Caen area*. Armour concentration. 14,000 ft. D. Master B. Five runs over target marking
July 5, 1944	No. 460 Squadron, Lancaster		4	0	Normandy. Bomb launching site. Daylight. 18,000 ft.
July 5, 1944	No. 460 Squadron, Lancaster		4	20	*Le Havre*. (Daylight). 18,000 ft.
September 27, 1944	No. 460 Squadron, Lancaster		4	30	*Calais*. (Daylight). 18,000 ft.
November 22, 1944	No. 582 Squadron, Lancaster		5	30	(Night). *Aschallenburg*. P.F.F. Backers-up. 16,000 ft.
November 28, 1944	No. 192 Squadron		5	0	(Night). *Essen*. 100 Group Special Duty. 20,000 ft.
November 30, 1944	No. 582 Squadron, Lancaster		5	30	(Night). *Duisburg*, *B.S.M.* P.F.F. 18,000 ft.
January 6, 1945	No. 90 Squadron, Lancaster		6	0	(Day). *Ludwigshafen*, *G.H.* Formation bombing. 18,500 ft. Aircraft damaged by flak. Credited destroyed enemy fighter shot down by M. U. G.
March 13, 1945	No. 582 Squadron, Lancaster		4	30	(Night). *Dahlbrusch*. 16,500 ft. Bombing red T.I. supporter

*** Metallised paper strips dropped to disrupt enemy radar system.**

APPENDIX C

Standard Method used by F.P.M.Os. for Recording Information *Bomb Loading Routine*

Observations before flight, R.A.F. Station, Mildenhall, October 20/21, 1940—Armament

General observations	Personnel detailed time taken	A Bomb dump procedure	B Fusing point procedure	C Bombing-up procedure at aircraft	Final check before take-off
1155 hours. Group Ops.—Station. Details of night operations. Target to be confirmed at 1400 hours. 1205 hours. Station Ops. M.S.I. 466–477. Allocated to Squadrons. 1405 hours. Group Ops.—Station. *Targets confirmed. S.A.P. to be bombed-up.* 1520 hours. Group broadcast to Met. Office. Weather broadcast. 1515–1545 hours. Crews briefed and left for tea, etc. *Take-off first aircraft* 1800 *hours.* 1620 hours. Group—Station Ops. Weather depends on rate of front coming up—expected to be OK up to midnight. Arrange for only 6 aircraft on D2 target and to be back for midnight. Switch to Target D197 if task cannot be completed by 2400 hours. 1645 hours. Re-briefing of crews. *Time first aircraft take-off*, 1745 *hours.* Operational orders? Intensity of operational effort: Stores, refineries. Special task: Shipping in docks. Special instructions: All aircraft return Base 2400 hours.	N.C.O. 1 A.C.H. 4	1400–1630 hours:— Returning bomb train 500 G.P. and delivering 500 G.P. and S.A.P. 1620 hours. 30–500 G.P. required to replace 30–500 S.A.P. Bomb strauslers detained at various dispersal points after delivering bombs. Load detailed at 1405 hours. 1620 hours. Cancel S.A.P. on 6 aircraft, change to G.P. (Targets of 9 aircraft changed.) Speed of tractor for towing bomb train, max. 8 m.p.h., usual speed 4–5 m.p.h.	Two A.C.H. on duty assembling S.B.Cs. Supervision N.C.O. i/c, who checks personnel at bomb dump and fusing point. 1630 hours. Fusing of 500 G.P. commenced. The bombs had already been retained at fusing point to meet the possibility of last-minute change of bomb load. Tractor driver (station) delivers bomb train at aircraft. Squadron armourers then complete bombing-up at aircraft. * *Note*: Bombing-up completed four minutes before first aircraft due to take-off.	Squadron Armourers' duties:— 1500–1600 hours:— 1 Corporal, 8 A.C.Hs., 1 Elect. } Attached to each flight for bombing-up duties *Checks*:— Corporal Armourer at time of bombing-up. Corporal Electrician. N.C.O. i/c Squadron Armament Section when possible.	Squadron Sergeant, Armourer, Corporal, Armourer of flight. Safety devices taken out by armourer of aircraft. Handed to B/A. before take-off. On landing, B/A returns to armourer, armourer to N.C.O. i/c. Air Drill

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Bombing in Progress

Type of aircraft, Wellington 1C, *No.* 149 *Squadron*

Resistance enemy affecting crew	Bombing errors Haphazard or systematic	Failure of equipment	Oxygen flow meter reading	Fatigue observed in crew	Notes
	2320 hours. Final check of safety devices not made before entering aircraft.				0040 hours. W/T operator reading 'No Orchids for Miss Blandish'.
0036 hours. Evasion tactics. Enemy searchlight. Aircraft not held.			0215 hours. 1,200 ft. Flow meter reading.	0140 hours. W/T operator not taking oxygen.	0140 hours. W/T operator complaining of cold, stamping feet and beating hands.
	0244 hours. Second Pilot failure to correctly connect lug on 5·5 in. parachute flare to chute. Second flare jammed in chute.		0235 hours. Navigator *not using oxygen.*		
0240 hours. Evasion tactics necessary due to flak fire.	Parachute portion stated by rear-gunner to be flapping in vicinity of rear turret.		0243 hours. Second pilot *not using oxygen* when carrying and launching flares.	0243 hours. Second pilot fatigue evident due to lack of oxygen during launching procedure.	0245 hours. A flare marker (incendiary) over target on arrival would have assisted *bomb accuracy* by giving a longer run up in conditions of poor visibility.
	0245 hours. Inaccurate bombing due to short run up caused by difficulty in locating target owing to haze. Bombs released: one 1,000-lb., two 500-lb. Flash of 1,000-lb. illuminated target (oil refinery ?) half mile away on eastern side of bomb burst.	0340 hours. Frosting over of Astrodome necessitated opening of side panel in pilot's cockpit to take Astro fix.			*Oxygen*. Full tactical use of oxygen not exploited on this sortie. Anoxaemia will give bombing errors.
Anti-aircraft fire Searchlights glare Enemy fighters Balloons		Armament Equipment Instruments W/T. R/T Inter. comm. Oxygen	0500 hours. Oxygen turned off		'Dodges'

Observations during Flight

October 26/27, 1940

General observations — Target—Merseburg Refinery, Leipzig: Time	Height	Temperature	Bombing procedure adopted by crew	Weather affecting task or individual member of crew	Special tactical considerations encountered affecting crew
2323 hours	1,000 ft. S/C. 113° m.	− 2° C.	2320 hours. Captain of aircraft informs O.C. Night flying by TR9 he is ready to taxi out and take off. B/A. asks captain if he has safety devices of bombs. Answer, No. B/A. leaves aircraft to obtain same from armourer.	Stratus-Nimbus 7/10 1–3,000 ft. and 5–6,000 ft. Icing level 4,000 ft., in clouds stratus.	Ice formation airscrew, main planes, perspex. Airscrew de-icers in use operated by second pilot. Ice flying off airscrew tearing fabric of fuselage and cockpit.
2400 hours	6,000 ft.	− 6° C.			
0036 hours	9,000 ft. Dutch coast—Rotterdam	−10° C.			
0145 hours	12,000 ft.	−12° C.	Navigator goes forward. Fuses bombs, sets distributor, selects times, etc.		
0215 hours	12,000 ft.	−12° C.	Captain orders oxygen to be turned on.		
0235 hours	11,000 ft.	−12° C.	Captain instructs Navigator to go forward and level up and prepare for bombing.	Clouds 4/10 4–5,000 ft. Ground haze.	*Navigation assisted by*: A.A. flak fire in target area seen from twenty-five miles away on approaching the target.
0235 hours	11,000 ft.	−12° C.	Second Pilot comes aft to prepare *three parachute flares*, 5·5 *in.*		
0243 hours	10,000 ft.	−12° C.	Captain orders first flare to be released from chute followed by No. 2 and No. 3.		
0245 hours	10,000 ft.	−12° C.	Bombs released over target area, very short run up due to bad visibility, haze and smoke.	Clouds 3–4/10 stratus. Ground haze. Moon not fully up.	0245 hours. Haze and smoke caused bad visibility over target area.
0246 hours	10,000 ft. S/C Hock	−12° C.			
0348 hours	10,000 ft.	−12° C.			0348 hours. Navigator Pos. line Astro Pole Star 51°, 36 N.

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Observations after Flight

October 20/21, 1940, 0100 *hours*

Extent of exposure-stress	Condition of crew physiological, psychological	Report on bombing procedure	Report on bombing results and equipment	Notes
Average	Good	Procedure laid down by Bombing Leader followed by all B/As in this squadron. Procedure: 1. Before take-off. 2. On crossing English coast, etc.	Bombs of all 11 aircraft dropped. B/As generally had difficulty in detection of target due to ground haze. Some B/As confident bombs went across target; other B/As thought bombs were in target area. But no hits observed. Note: The use of a flare marker on target would assist the bombing run-up when visibility is poor.	From information of Captain on landing:— Bomb aimers and crews did not adopt a systematic procedure in the use of oxygen: Indicated height flown . . Oxygen flow-meter reading 15,000 ft. . . Nil . . . . X 14,000 ft. . . 19,000 ft. . 14,000 ft. . . 14,000 ft. . . . X 14,000 ft. . . 20,000 ft. . . 13,000 ft. . . 15,000 ft. . . . X 11,000 ft. . . Nil . . . X 11,000 ft. . . Nil . . . X Varying height of remaining four aircraft 8,000 ft. to 11,000 ft. — Oxygen flow-meter used at indicated height or not used at all. Status of Captain: Proneness: Errors (*a*) Haphazard (*b*) Systematic

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CHAPTER 2

FIGHTER COMMAND

GENERAL HISTORY 1918–1939

THE history of the air defence organisation fell sharply into two phases. The first covered the period up to April 1936 when defence was organised into a system of zones, which were clearly defined areas in which the various defensive weapons were used. One of the most important determinants of the size and position of these areas was the time consumed in obtaining intelligence of the approach of hostile aircraft. Warning was provided mainly by the 18 observer groups, created shortly after 1924. The Observer Corps was placed wholly under the control of Air Ministry in 1929, and a system of air raid intelligence was organised whereby information was transmitted rapidly to Headquarters, Air Defence of Great Britain, *via* Observer Sector Headquarters, Fighter Sector Headquarters and Fighting Area Headquarters. The drawback to this otherwise excellent system was the over-burdening of Fighting Area Headquarters with detailed raid intelligence. This method was made out of date by the development of radar to a point when in 1936 it became possible to locate hostile aircraft as far as sixty miles off the coast of Great Britain; this had a most profound effect upon the existing defence plans, and later turned out to be one of the factors which helped to decide the outcome of the Battle of Britain.

At the time of the Munich crisis, Fighter Command was singularly ill-equipped for war, despite the numerous efforts made in the preceding years. Only 5 of the 29 squadrons of the two groups, numbers 11 and 12, were equipped with Hurricane aircraft, although three more were soon to be re-equipped. The Hurricane had been hastened through to production, and was still not entirely free from teething troubles. In consequence, fighter defence depended to a great extent on Gladiator and Gauntlet aircraft.

No. 13 Group was formed at Hucknall in November 1938 as new aircraft became available, but, because insufficient fighter aircraft could be produced by April 1939, Blenheim aircraft were modified for fighter duties and 17 squadrons were equipped in this way. Action was taken also to obtain an immediate reserve of 150 pilots by June 1939. There was an urgent need for aircrews in all commands, but, because a defensive policy had been adopted, Fighter Command reaped what benefit there was to be obtained from the situation. It was also apparent that some

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form of intermediate training between flying training schools and operational squadrons would be necessary, and two Group Pools, numbers 11 and 12, were formed. Number 11 Group Pool formed at Andover in March 1939, and moved to St. Athan in June, and Number 12 Group Pool formed at Aston Down in June 1939, but only started to function after war was declared. These two new training schools were the forerunners of the Operational Training Units.

There were still gaps in the fabric of defence when war began and no purpose would be served by enumerating the deficiencies. Sufficient information has been given to portray the general unpreparedness, which could not be fully rectified in time to avert many of the problems encountered in the first two years of the war.

It can be seen from the above account that the expansion had begun so late that it had to take place in a great hurry, and that ordered methods proven by the test of time could not be employed. In such circumstances it was inevitable that until all the armaments, airfields and buildings needed were manufactured or built, conditions would not be of the best. This factor, as much as any other, presented the Medical Service with problems, in addition to the task of preventing disease and maintaining the health of the large numbers of men and women who found themselves in the Service under conditions to which they were unaccustomed. Apart from this, preparation had to be made to deal with the many casualties expected from bombing.

It was fortunate indeed that a period of inactivity in which to hasten and complete the work, occurred between the declaration of war and the Battles of France and Britain.

ORGANISATION AND ADMINISTRATION

GENERAL

When war began the total strength of Fighter Command, including Dominion and W.A.A.F. personnel, was about 22,000. There were four Groups, Nos. 11, 12, and 13 which had definite defence areas, and No. 22 which was responsible for the Army Co-operation squadrons located at airfields within these areas. General administration was carried out through the usual Service channels with most of the authority retained at Command level. The operational control of aircraft was effected through a system of operations rooms at Command and group headquarters and sector stations. Each sector station controlled the operational aircraft at its own and other airfields within its sector.

The expansion of the Command, begun before the war, received an added impetus with mobilisation. It was soon apparent that the expansion could not be administered effectively without some decentralisation

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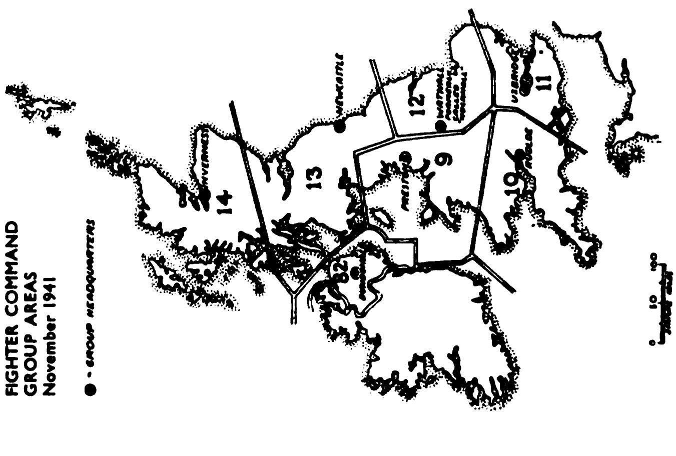
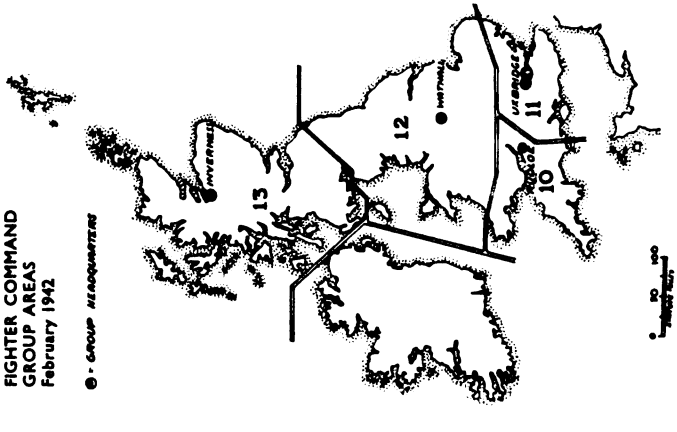
Map 1. Fighter Command Group Areas. August 1940.



Map 2. Fighter Command Group Areas. November 1941.



Map 3. Fighter Command Group Areas. February 1942.

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of authority, and on September 30, 1939, groups were given independent establishments and were authorised to undertake the more routine administration of stations and units in their areas, and the preparation of certain returns hitherto prepared at Command headquarters.

The expansion and reorganisation of the Command and the formation of new groups will not be described in detail because, once the medical organisation had been placed on a war-time basis, it was adapted as the need arose without difficulty. After the collapse of France group areas were extended to cover the whole country and in August 1940, November 1941 and February 1942, were as shown in Maps 1, 2 and 3.

In the summer of 1943, No. 2 Bomber Group was transferred to Fighter Command and, with the elements of Army Co-operation Command which had been disbanded in June, started to form the 2nd Tactical Air Force. No. 38 Group was formed in the same year for glider operations and had its own training units. The maximum strength of the Command was attained on June 25, 1943, with 172,600 R.A.F., Dominion, Allied and W.A.A.F. personnel. In November 1943, on the formation of the Allied Expeditionary Air Force, the name of the Command was changed to the Air Defence of Great Britain (A.D.G.B.). The medical history of A.D.G.B. will be described with that of the Allied Expeditionary Air Force in a narrative on the invasion of Normandy and the liberation of Europe.* In November 1944, Fighter Command was re-formed and consisted of seven groups, Nos. 10, 11, 12, 13, 38, 60 and a new group, No. 70, concerned with target towing and target practice.

The Command therefore was responsible during the war for the day and night defence of the country, the administration and control of Radar stations, the training of fighter aircrew at the operational training unit stage and the administration and training of many units of the 2nd Tactical Air Force. Each of these duties had particular medical aspects which were separate from those arising from the normal medical administration of any home command during the war.

MEDICAL

In September 1939 medical organisation was based on a system whereby the administration of groups was undertaken at Command level by the P.M.O. and his staff. The immediate pre-war medical establishment at Command Headquarters was an air commodore (Principal Medical Officer), a group captain (Deputy Principal Medical Officer), two wing commanders and a flight lieutenant. The clerical staff consisted of two nursing orderlies, a sergeant, a corporal, an airman clerk

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* Volume III of this History.

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and two civilian clerks. The medical strength of the Command on August 1, 1939, was 27 medical officers and 143 medical airmen. The two wing commanders and the flight lieutenant undertook the administration of the various groups under the personal supervision of the P.M.O. and were not group senior medical officers with their own establishments. The increase in Command strength which had occurred just before the war did not seriously affect the smooth running of the medical administration because the medical branch was highly organised and stations and units had been established for some time on the comparatively luxurious standards of peace-time. Medical attention at units was provided either by a Service medical officer or a civilian medical practitioner under contract. Officers and men were of peace-time quality and, although the sickness rate was not substantially different from that of war-time, there were few of the problems which arose later with the rapid expansion of the Command.

The work of the P.M.O. increased considerably on mobilisation and with the expansion of the Command he was unable to exercise the same degree of immediate supervision as hitherto; in consequence the administration of groups was delegated more and more to members of his staff. When much of the work of the Command was decentralised on September 30, 1939, the medical organisation was altered by the introduction of independent medical establishments for group headquarters. The three wing commanders then at Command headquarters and one other wing commander were posted on November 1, 1939, to Nos. 11, 12, 13 and 22 Groups to fill the new establishments of Senior Medical Officer (S.M.O.) at each Group. Each S.M.O. had a staff of one flight lieutenant, a corporal, two nursing orderlies and an airman clerk.

The medical administration of the Command continued to be the responsibility of the P.M.O. but the routine medical administration of groups was undertaken by the S.M.Os. Medical returns were submitted by groups and not by the Command, in accordance with the new procedure required by the Medical Statistical Office. Postings of medical and dental officers remained the responsibility of Air Ministry but the P.M.O. could arrange attachments within his Command. The postings of medical and dental airmen were effected as before by the Officer-in-charge, R.A.F. Record Office, and the Officer Commanding, Medical Training Establishment and Depot (M.T.E. & D.) and attachments of airmen to units within the Command could only be made after consultation with these authorities. (*See* also Volume I, Chapter 2—'Medical Manning: Nursing Orderlies'.)

Station Medical Establishments. The immediate pre-war medical establishment of stations in Fighter Command with two or three operational squadrons was a flight lieutenant medical officer, a sergeant, a corporal and three airman nursing orderlies. A station with one

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squadron had only two nursing orderlies and stations on which Auxiliary Air Force squadrons were based had no establishment for a medical officer as the squadrons had their own. The rapid increase in the strength of stations and the opening of satellite airfields made the posting of extra medical staff essential. Newly joined medical officers were posted or attached to the larger stations without alteration of the existing establishments and were fully employed during the period of expansion and mobilisation. Establishments were amended subsequently from time to time but there was a shortage of medical officers with administrative experience.

On June 11, 1940, an establishment of three flight lieutenants or flying officers, a sergeant, three corporals, nine airman nursing orderlies and one airman clerk, was approved for stations with three squadrons and two satellite airfields. There was at first a considerable disparity between the rank (flight lieutenant) of the station medical officer of sector stations and that of the station commander who was often a group captain, but on June 3, 1940, the establishment of the station medical officer at Northolt was amended to the rank of squadron leader. No. 11 Group then requested similar amendments to the establishments of Biggin Hill, Kenley and Hornchurch. Approval was given on August 28 of the same year and subsequently the establishments of other stations of the same size and importance were similarly amended.

The P.M.O. of the Command recommended in January 1940 the creation of the post of squadron medical officer for operational squadrons. This question had been considered by Air Ministry but had not been implemented, although field force squadrons were so staffed. When squadron medical officer posts were approved in November 1940 the establishment for station medical officers at operational training units was raised to the rank of squadron leader. It has been argued that the establishment of the squadron medical officer was authorised too late to be of value during the Battle of Britain, but it is unlikely, even had they been established, that sufficient medical officers with experience in aviation medicine would have been available. Officers without such experience would have been obliged to rely on the experience of station medical officers during the period of intensive fighting. Medical officers were posted to operational squadrons during the winter of 1940 and their establishments remained in force until the last few months of the war. However, as the general shortage of medical officers increased it became policy to leave certain establishments unfilled and to work with a reduced strength at units and stations where the operational necessity for full establishments was not so pressing.

The approximate strengths of medical officers and nursing orderlies in Fighter Command between 1939 and 1944 were as follows:

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Date	Medical officers	Nursing Orderlies	
		Airmen	Airwomen
August 1, 1939 . .	27	143	—
November 1, 1940 .	102	493	—
September 1, 1941 .	193	1,027	—
September 1, 1942 .	229	1,144	632
September 1, 1943 .	238	1,300	720
September 1, 1944 .	193	1,232	417

TYPES OF STATION

There were many kinds of unit on which medical officers and staff were established but they could be divided broadly into three types: permanent peace-time stations, most of which were complete before the war; semi-permanent stations constructed during the immediate pre-war expansion period, and those which were built after the war began.* Peace-time stations were very well built and were designed on a compact plan in which all barracks, messes, administrative offices and workshops were placed centrally within easy walking distance of each other. Married quarters, recreation halls and gardens were also provided and the whole station was connected by wide concrete or macadam roads and paths. Semi-permanent stations were built on a similar plan to a less lavish scale. Central buildings and workshops were of brick but many of the other offices and sleeping quarters were of wood; these buildings were erected when there was no shortage of suitable timber or skilled labour. The stations built after the war began were of two kinds: those which were constructed on a pre-war general plan, but with materials of lower quality, and those which were built after the adoption of the policy of dispersal. The medical problems which arose from the use of these stations will be discussed later in the narrative, because in 1939 and 1940 the main problem was the disparity between the accommodation available and that which was required. This state of affairs persisted until the methods of construction could keep pace with the increase in the size of the R.A.F. as a whole.

The medical facilities varied on each of the three types of station. Peace-time and semi-permanent stations had one or two-storey, double-walled, brick self-contained sick quarters with wards, offices, kitchen and dispensary. War-time stations had a central medical inspection room consisting of the usual offices, and in most cases a crash room, and separate wards in a barrack block, a nearby hut or a requisitioned house. These buildings were either built to a standard war-time design of one brick thickness or constructed in the various types of prefabricated hutting used throughout the R.A.F. at home.

* Details of these types of stations can be obtained from Volume I, Chapter 7 of this History.

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Specialists' opinions and hospital treatment were available by arrangement with the nearest hospital, civil or Service. Aircrews were admitted to R.A.F. hospitals direct or transferred to them from other hospitals when they were fit to travel.

STATION DEFENCE ORGANISATION

Standing orders existed for the defence of all units against land, air and gas attacks and were amended where necessary after the war began. The military defence of airfields was an Army responsibility until the formation of the R.A.F. Regiment (*see* Chapter 12, R.A.F. Regiment) and Army troops were stationed on or near airfields for this purpose. Air Force personnel were relegated to passive defence duties and because many were employed on the maintenance, refuelling and rearming of aircraft, could not be considered as whole-time defence troops. Medical plans for defence against attack were divided into two parts, the collection and treatment of casualties on the station and their evacuation to hospital. First-aid posts were sited at strategic points on all units and medical stores were dispersed. The usual arrangement was that casualties would be collected by non-medical stretcher bearers trained in elementary first aid, while the medical officer and most of his staff would remain at sick quarters and there treat and hold patients until they could be returned to duty or evacuated to hospital. This medical plan was entirely an R.A.F. responsibility but the evacuation of casualties depended upon the local geography, the defence plans of the local Army commander, the liaison with the local authorities, and the distance to the nearest or most suitable hospitals.

Defence against gas was provided by the special decontamination buildings and, on peace-time stations, by an additional gas annexe to the sick quarters. At all other units where no special buildings existed gas centres were improvised.

These plans were designed to meet any form of heavy or sustained attack but in addition there was the normal everyday organisation for collecting and treating casualties from aircraft crashes.*

MEDICAL PROBLEMS OF MOBILISATION

GENERAL

The medical problems of mobilisation and expansion of the R.A.F. in the first six months of the war were common to all commands and will be described only briefly in this account. It was realised that the task of maintaining the health of the Service would be complicated by factors outside the control of the medical branch, and that until conditions could be stabilised a greater degree of medical supervision would

* *See* Chapter 1, Bomber Command, First Aid.

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have to be exercised than ever before. The relevant factors were the shortage of medical officers with administrative experience, the lack of accommodation and facilities to house and feed the mobilised personnel, the introduction of the blackout, the unbalanced hours of work, the complete absence of facilities at aircrew dispersals, the forecast of an epidemic of cerebro-spinal meningitis for the winter of 1939/40, and the many unforeseen problems arising from the medical examination and remustering of Class E reservists.*

The increased incidence of cerebro-spinal meningitis in Great Britain in 1938 was significant enough for a forecast to be made of an epidemic of this disease in the winter of 1939–40. It was recognised that mobilisation resulted in exactly those communities of unconditioned personnel who were most susceptible, but that, provided the standard of living conditions could be maintained at a high level, the outbreak of the disease might be avoided.† Unfortunately, a legacy of the belated expansion of the R.A.F. was inherited on mobilisation, so that although administrative machinery existed to call up, equip and medically examine incoming men, accommodation and living facilities were often of an improvised nature. The only safeguard was increased medical supervision but, until the decentralisation of medical authority from Command to groups, as already described, it was difficult to carry this out satisfactorily.

During the first two months of the war the strengths of most of the ordinary Fighter Command stations had more than doubled. A certain increase had been foreseen and allowed for in the war-time establishments, but buildings and their facilities had not always been constructed to accommodate and serve as sudden an influx of men as that which occurred.

The difficulties confronting Fighter Command in regard to accommodation, sanitation, catering, anti-gas precautions and, last but by no means least, the blackout, as the R.A.F. expanded, were not materially different from those already described in Chapter 1 (Bomber Command).

The work of administering the expansion was mainly the responsibility of the headquarters staffs at Command and groups. The hours of duty adopted were long and were based on hours worked during the yearly peace-time exercises: during the emergency in 1938 equally long hours had been enforced with added precautions for the staffs of the operations rooms. Before the end of September 1939 signs of fatigue appeared; it was the opinion of all the more senior medical officers that such fatigue could be avoided if the hours of work were reorganised on

* Certain of these difficulties are described fully in the 1939–40 French Campaign in Volume III, Chapter 1 and will not be discussed here.

† *See* 'Notifiable Diseases' section of this chapter.

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the lines of the proven principles already used in industry, where provision was made for regular days off duty and time for recreation; at that time, however, it was difficult to get this idea accepted. Nevertheless certain improvements were made after experience, for instance, in the operations rooms at Command and No. 11 Group headquarters, by altering hours of shifts and making temporary arrangements for rest rooms and isolating the sleeping quarters of those on night duty. The circumstances changed for the better as soon as officers and men became more accustomed to war-time routine. However, a new difficulty soon appeared when women began to work in operations rooms because no provision had been made in the original design for separate rest rooms or lavatories.

LIVING CONDITIONS: AIRCREW

The dispersal of aircraft and their protection by blast bays had been an established policy for some time. The care of flying personnel, however, spending most of their time on duty on the airfield, had not received such detailed attention. Aircrews had to be near their aircraft when at readiness and at first no shelter other than tents was provided for them. This was no hardship in the fine autumn of 1939 but as the winter approached conditions deteriorated. As soon as the building programme allowed, temporary huts were built at dispersal points, but they were small, unfurnished, had no paths to them and were without electricity or running water.

When war began, air attacks were expected at any moment and a state of extreme emergency existed, but to conserve every available aircraft the amount of practice flying authorised was severely curtailed. To provide relaxation between the hours of dawn and dusk during the phase of inactivity between the outbreak of war and the onset of air warfare, one squadron was to be at readiness, one available and one released on three-squadron stations. Special arrangements were made for one-squadron stations. The suggested period of release was three hours, but skeleton crews had to man important operational sectors even during that period. The staff of the operations rooms had to be capable of working at full pressure within two minutes of an alert. Between dusk and dawn, one squadron of the three-and two-squadron stations was detailed for night operations under sector control, and because of the possibility of attacks at dawn and dusk all squadrons had to stand to for half-an-hour each side of these times and operations rooms had to be fully manned. Subject to these states being maintained, commanders of sector stations could release flights or squadrons without application to group control.

These states of readiness were maintained throughout the winter with perhaps greater strictness than was laid down, because controllers were as yet untried in warfare and were loath to release squadrons when there

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was any possibility of attack. Flying consisted mainly of routine and shipping patrols and an occasional interception of reconnaissance aircraft. Boredom set in and strenuous attempts were made to provide more comfort for aircrews at dispersal points. In order that hot drinks would be available at dispersals even when the latter were far from the station messes, field kitchens were often built, but these were not very satisfactory until running water was supplied and better foundations and paths laid because the ground soon became a morass of mud during the winter. Dawn to dusk readiness was not a great hardship in the winter months, but during the summer the days were long and the hours of sleep were curtailed. Conversely, night duty was long in the winter. The only source of lighting in dispersal huts was hurricane lamps and with the blackout and reduced ventilation, the overcrowding (ground and aircrews had to use the same huts on many stations), the primitive heating arrangements and the lack of paths did not add to the efficiency of squadrons during this period. In addition, night flying in total blackout without the efficient airfield lighting system so commonplace now, required great skill and much concentration. The aircraft most commonly used at night were Blenheims and Hurricanes and often more than one patrol was flown. No provision was made for hot meals after a night patrol other than that which could be provided *ex judice* by the station commander.

BATTLE OF FRANCE

After the conquest of Poland the enemy was content to consolidate his gains and conserve his air forces for future operations. As it was no part of Allied strategy at that time to precipitate air warfare upon a large scale, the expansion of home commands continued according to plan without interruption until the invasion of Norway on April 8, 1940. The Norwegian campaign* ended with the withdrawal of our troops on June 8, 1940, but before that date heavy fighting broke out on the Continent with the invasion of France and the Low Countries on May 10. Fighter Command was not seriously involved in the fighting in Norway because of geographical difficulties and the lack of airfields in that country, but during the Battle of France the Command was committed to providing air support during the withdrawals, yet conserving sufficient fighter strength in the United Kingdom to repel an invasion. To meet this contingency the fighter defence organisation had to be extended and strengthened in the north, west and south-west areas of Great Britain to counter the threat of air attack from airfields situated along the occupied coastlines of Norway and north-west France. During the period April 8 to June 18, 1940, when the last organised forces left the Continent, there was extensive air warfare, but, because most of the

* *See* Volume III.

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fighting occurred outside Great Britain, the medical organisation and administration of all home commands was singularly unaffected. It was during this phase, however, that medical officers at home, particularly those in Fighter Command, had the opportunity to observe, without the distractions of warfare in the field, the mental and physical effect of aerial combat on flying personnel.

It was from these early observations, with those of squadron medical officers who served in France, that the present medical concepts of the maintenance of health and efficiency among flying personnel were developed. Hitherto the only aspect of operational flying which had received much medical attention, other than certain specific problems of aviation medicine, was that of 'flying stress'*, most of the knowledge of which was based on the experience of a few specialists of the War of 1914–18.

It was possible later in the war to investigate the psychological factors which were related to the duties and the length of operational tours of aircrews but until the formation on February 4, 1941 of an Air Ministry Committee to investigate the duties of a squadron medical officer, and the establishment of specialist officers to the posts of Flying Personnel Medical Officer (F.P.M.O.) at commands on March 7, 1941, the medical care of flying personnel followed general principles which were empirical in character. For this reason it is impossible to assess the degree of effort made during the operations at Dunkirk and later in the Battle of Britain, but the manner in which these operations were carried out is recorded to emphasise the varying conditions under which pilots fought.

During the evacuation from Dunkirk first patrols were flown off at about 0430 hours each day and the last patrol landed at about 2130 hours, with variations of about fifteen minutes on either side of these times. The heavy fighting in France and the demands for the defence of Great Britain reduced the available strength of the Command considerably and during the six days of intensive air warfare from May 27 to June 1,† an average of only 16 or 17‡ squadrons was available for operations each day. Further squadrons were not available because they were either re-forming or too far away to participate in the fighting. The average daily number of squadron patrols flown during the six days was 30 and the average number of patrols per squadron per day 1·84. Only 7 of the available squadrons operated for the whole of the six days and, of the others, 4 operated for five days, 5 for four days and the remainder for periods up to three days. Two squadrons flew an average of 2 squadron patrols per day for the

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* *See* Chapter 1, Bomber Command, Aviation Medicine Section.

† The evacuation from Dunkirk lasted from May 24 to June 4.

‡ Including the remnants of the fighter squadrons of the Air Component which were withdrawn from France on May 21–22 and absorbed into the Command.

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six day period with averages of 9 and 8 aircraft respectively per squadron patrol and 6 squadrons flew three patrols for one day and one for two days. The average length of each squadron* patrol was 108 minutes. The longest patrol was of 165 minutes duration and the shortest 65 minutes.† Between May 25 and June 4, Fighter Command flew 1,793 sorties in the Dunkirk area, an average of 163 sorties per day for a loss of 106 aircraft. The average daily number of sorties flown by the whole air force on protection patrols over Dunkirk and its sea approaches was 267. From May 10 to June 18, 280 pilots of the Command were killed, missing or made prisoners-of-war and 60 injured,‡ and the total strength of pilots was reduced to 20 per cent. below establishment.

Medical officers who served with operational units considered that the strain of fighting during this period was influenced by two broad groups of factors, one of which assisted in the maintenance of efficiency while the other added materially to the normal anxiety associated with operational flying. It was observed that although the hours of duty were long, patrols were flown at predetermined times and any fatigue resulting from the day's fighting could be relieved by sleep which was uninterrupted because there were no night raids on the country. On the other hand squadrons were handicapped by having to operate outside the normal defence organisation of Great Britain. This meant that pilots, when on patrol over the Dunkirk beaches, were out of R/T touch with controllers in operations rooms and could not be informed of the approach or size of enemy air forces. The length of patrol and the time occupied in flying from and to home bases resulted in aircraft operating to the limits of fuel endurance. Should pilots be unfortunate enough to be shot down, their rescue from the sea depended upon their being located by high speed launches operating within 20 miles of the coast or being spotted by special Lysander aircraft carrying dinghies. The only flotation gear available for pilots was the Mae West life jacket which was of such a design that it would not guarantee keeping the mouth of an unconscious man above the water. Finally, fighter aircraft were not universally fitted with self-sealing petrol tanks.

THE BATTLE OF BRITAIN

The strength of the Command had been reduced considerably during the Battle of France. All but 3 squadrons had been engaged in the fighting and, of the remainder, 12 had had to be withdrawn and re-formed. It was estimated that it would take about a month for all the

* Hurricane and Spitfire aircraft together.

† The estimated endurance of the Hurricane I and the Spitfire II with a combat allowance of 15 minutes was 155 minutes and 104 minutes respectively.

‡ 'Fighter Command and the Battles in the Low Countries and in France' Section ix, Para. 'Some effects of the French Campaign on Fighter Command', sub. para. 5. (Published by Air Historical Branch, Air Ministry.)

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squadrons to be ready for operations. During this period of intense reorganisation of the defence of the country, the medical service was not seriously affected beyond the necessary checking and testing of the existing medical plans for the defence of Royal Air Force stations.

Air attacks on shipping round the east and south-east coasts began to increase in number and weight during the first week of July. It is difficult to fix a date for the beginning of the Battle of Britain, but it is universally accepted that on July 10 the enemy made his heaviest attack to date and from then on continued to employ large numbers of aircraft against each series of objectives in turn. For similar reasons it is difficult to decide when the Battle of Britain finished, because the type and method of attack altered and the degree of effort made by the enemy decreased gradually, but for historical purposes it may be considered to have ceased on October 31.

The period between July 10 and October 31 has been divided in dispatches and operational histories into several phases. The division of the battle into these phases, which are related to changes in tactics and strategy, is not suitable from a purely medical aspect to demonstrate the direct and indirect effects on the medical services of the Command. For example, Phase 1 of the operational history covers the period between July 10 and August 25, during which attacks were made on convoys, coastal airfields and radar stations; apart, however, from some attacks on airfields on July 31, the medical services were not directly affected until August 12, when radar stations were attacked, because the earlier fighting had occurred mainly over the sea.

PHASES

The phases chosen for this account are diagrammatically represented on the following page:

Phase 1. July 10 to August 12. Attacks on convoys, shipping, ports and naval and military objectives on the coast.

Phase 2. August 12 to August 26. Attacks on radar stations, some airfields and shipping.

Phase 3. August 26 to September 7. Heavy and almost continuous attacks on airfields, mainly of No. 11 Group, and subsidiary attacks on shipping, harbours and oil storage installations, particularly those in the Thames estuary and the Port of London on September 7.

Phase 4. September 7 to October 9. Attacks on London and subsidiary attacks on harbour towns. By this time the enemy's losses had been so severe that he was forced to use more and more fighters to protect his bombers until the last and final phase.

Phase 5. October 9 to October 31. During this phase most of the attacks were carried out by fighter bombers operating at great height.

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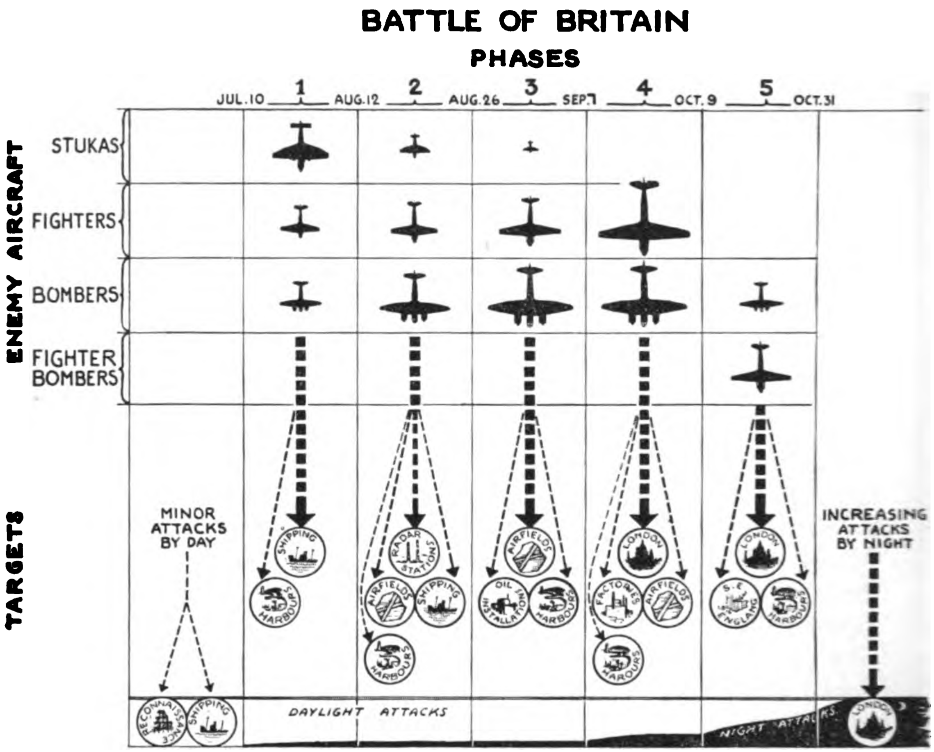

FIG. 1. Diagram showing phases in the Battle of Britain.

Attacks were directed against London and other objectives in Southern England.

Night bombing by the enemy occurred throughout the Battle of Britain and in the earlier phases was undertaken by relatively small forces, but as the enemy losses in daylight operations increased, a greater proportion of his bomber strength was directed to night raiding.

MEDICAL ASPECTS OF THE BATTLE OF BRITAIN

Phase 1. During this phase fighting occurred almost entirely off the coast. Flying personnel who had been shot down into the sea and were rescued received first-aid attention from nursing orderlies on the rescue launches if they were wounded and were transferred direct to hospital from landing places along the coast. The notification of these casualties was often delayed and sometimes medical officers had to attempt to identify bodies from which identification discs were missing or from which all clothing had been torn.

The responsibility for air sea rescue was at that time divided between the R.A.F. and the Navy and had yet to be developed into a

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comprehensive unified service under the control of Air Ministry.* The Germans, however, had provided an air sea rescue service with boats of special design moored at intervals along the channel. Some R.A.F. pilots who were forced to bale out near the enemy coast were able to reach these boats and obtain shelter, but their subsequent fate depended upon whether a R.A.F. or a German launch rescued them. As it was difficult to find pilots in the sea even though they were wearing yellow Mae West life jackets, they were issued, in August, with packets of fluorescene powder capable of colouring a large area of the surrounding sea an iridescent green which was easily discernible from searching aircraft.

Phase 2. The second phase began on August 12 with attacks on airfields and radar stations† on the south-east coast in an effort to dislocate the warning system before the major assault began. Five coast stations were attacked by Stuka dive-bombers and the station buildings and sick quarters damaged. No raid warning was received of the impending attack and personnel were not under cover when it began, except at one where, as might be expected, casualties were fewer than on the other stations.

The administrative problems of supplying medical attention to these stations are described in Chapter 11 (No. 60 Group), and will only be repeated here to explain that it had been very difficult to organise medical services for so many small stations scattered throughout the country. Local practitioners visited these stations daily if medical attention could not be provided by a nearby Service medical officer. Sick parades were held in a small medical inspection room and medicines and treatment were dispensed by a nursing orderly on the station establishment.

After the attacks referred to above first-aid treatment was given from these M.I. rooms except at two which had been seriously damaged by blast. At one station a local doctor arrived within ten minutes of the attack; at another the telephone lines were damaged and communication had to be maintained by despatch rider, but within twenty minutes five local doctors and six ambulances arrived without having received a call for assistance. The total casualties on these five stations in the first raids were two killed, four seriously injured and twenty-four wounded.

It was fortunate that the main attacks on airfields did not start at once, because in these early raids it was revealed that deficiencies existed which could be corrected and which also applied to larger stations. The degree of damage caused by blast had been considerable and it was

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* The Directorate of Air Sea Rescue was formed in February 1941 and was incorporated in September 1941 into the Directorate of Aircraft Safety when the Air Ministry took over control of the service. (*See* Volume I, Chapter 11.)

† In 1940 radar stations were called Air Ministry Experimental Stations (A.M.E.S.).

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realised that the M.I. rooms needed more protection. The building of blast walls around all those that were still unprotected or were not of strong construction was ordered. Earth and sandbag ramparts were made where there was no necessity for brick blast walls or where it would be some time before local labour would be available for their erection. It was also found that the provision of stand-by sanitation had been neglected on some stations and on others, though plans and equipment existed, it was not ready for immediate use. Similarly, adequate preparation had not been made for emergency water supplies. Alternative lines of communication were also necessary because reliance could not be placed on the fortuitous arrival of extra medical help. However, it was not possible to implement all these recommendations fully on every station before further attacks occurred.

Phases 3, 4 and 5. No good purpose will be served by describing the attacks in detail, because, apart from incidents peculiar to certain raids, the main effect of the bombing was to dislocate Service life and routine rather than to cause a large number of casualties. Ten station sick quarters were damaged or hit by bombs, but the total casualties were only one person killed, one moderately and one slightly injured. Between August 26 and September 9 attacks against airfields, in particular of No. 11 Group, were almost continuous. There were often several attacks a day on individual stations and, even when airfields were not being bombed, air activity was incessant with many alerts as hostile aircraft approached or passed over on their way to and from other objectives. In addition to these daylight attacks there were raids on London almost every night.

CARE OF PATIENTS DURING RAIDS

During the attacks in the second and third phases sufficient warning was nearly always given to move patients out of immediate danger. It became customary at sick quarters which had gas annexes to move patients into them during a raid, because they provided protection against all but direct hits and near misses. At sick quarters which had no annexe, patients who were fit to move were sent to nearby deep shelters if the attack seemed imminent, but otherwise they were moved to strong points in the building and the normal precautions against blast taken.

In the opinion of many medical officers the annexes justified their existence if only on the grounds of providing protection during air raids. Nevertheless, several annexes were damaged, and after the Battle the P.M.O. recommended that the building of other annexes should cease, because in his opinion they resembled from the air some form of operations room and were not marked with red crosses.

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COLLECTION OF CASUALTIES

The first casualties usually arrived at sick quarters within five minutes of the end of the attack. The careful plans made for their collection by trained stretcher bearers were almost invariably disregarded after a raid. No doubt the scheme would have worked well in a ground assault on airfields, but in an air attack the nearest person rendered first aid to any casualty and then organised a stretcher party to convey the injured man to the first aid post or sick quarters. The number of casualties was never large enough to make these arrangements inefficient. The average airman's initiative in such circumstances was high and the wounded usually arrived for treatment so quickly that it is doubtful if any cut-and-dried plan could have improved upon the speed of collection. Identification of the dead was simplified in this way, because, although many airmen at that time were not wearing their identity discs, the dead man was usually well known to the airmen who brought him in. Ambulances toured the station after an attack and collected casualties from first-aid posts and other sites as the need arose. On admission to sick quarters the dead were placed in a separate room in the care of a nursing orderly; men fit for immediate transfer to hospital were given first-aid treatment. Patients requiring resuscitation were detained until fit to travel. All casualties fit for evacuation were transferred to hospital within an hour, even on stations which had been heavily bombed: for instance at Tangmere 20, and at Biggin Hill 22, patients were evacuated to hospital in 45 and 60 minutes respectively.

At Kenley, Tangmere and Biggin Hill the station ambulances were rendered unserviceable by bomb splinters and the entrances to sick quarters were blocked by bomb craters. Casualties *en route* for hospitals were often delayed by bomb craters in roads and by police diversions into routes unfamiliar to the ambulance drivers.

TYPES OF INJURY

The injuries sustained by casualties were nearly all caused by falling masonry or fragments of different materials dislodged by blast. There were injuries caused by bomb fragments or small arms fire but the number was very small in proportion to other kinds of injuries. Direct hits on shelters often resulted in the death of all the occupants. Medical officers found from experience that a surprisingly large dose of morphia was often required for severely injured conscious patients and in some cases as much as one to one and a half grains was necessary.

The proportion of dead, severely injured, moderately and slightly injured persons was obtained from extracts of the daily sick books of 40 heavily attacked stations in the Command. In this analysis an attempt was made to estimate the weight of the attacks but it was found impossible and an attack has been recorded as one consisting of anything

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from a machine gun attack by a single aircraft up to a heavy raid by 200 bombers. The figures are tabulated below for the months of August, September and October, 1940. Casualties included R.A.F., Dominion, Army, Allied, N.A.A.F.I. and civilian personnel:

Ground Casualties due to Enemy Action on Forty Fighter Command Stations, 1940

Month	No. of Raids	Deaths	Severely injured	Moderately injured	Slightly injured	Severity unknown	Total casualties
August .	43	88	27	69	54	25	263
September .	42	11	7	11	24	4	57
October .	44	—	6	8	17	—	31
	129	99 (28·2 per cent.)	40 (11·4 per cent.)	88 (25·1 per cent.)	95 (27·1 per cent.)	29 (8·2 per cent.)	351

The strengths exposed to risk are unknown.

Note: The method of obtaining the statistics is described in the section on the relation of casualties to the dispersal of stations.

MEDICAL EQUIPMENT AND DRUGS

The normal scales of medical equipment were found to be adequate and satisfactory. On those stations on which the sick quarters were hit or damaged the dispensaries were often destroyed, or made unusable by the breakage of bottles. All stations had an emergency supply of drugs and dressings in an emergency sick quarters but as an immediate precaution medical officers issued tubuonic ampoules of morphia and extra dressings to all nursing orderlies. These orderlies were not normally authorised to give morphia, but at the discretion of medical officers the more experienced were allowed to administer it in certain special circumstances. When sick quarters were damaged, immediate requirements for dressings and drugs were met by the pooling of supplies carried by the nursing orderlies until the emergency sick quarters could be opened.

On the instructions of Air Ministry, complete sets of Z.1 equipment were held at the Medical Equipment Depot at Hartlebury for immediate despatch if required. This plan worked satisfactorily; for instance at Tangmere the sick quarters was bombed in the late afternoon and by 0700 hours the next morning the new equipment had been received, checked and unpacked in the emergency sick quarters in time for the morning sick parade.

LIAISON WITH CIVILIAN MEDICAL AUTHORITIES

Liaison with E.M.S. authorities was excellent and there was no difficulty in admitting patients to hospital. Use was also made of the

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E.M.S. surgical teams: for instance at Biggin Hill when a large shelter had received a direct hit, a team of two surgeons with nurses and ambulances gave invaluable help in extricating buried persons, often by amputation of a trapped limb.

DISPERSAL OF STATION SICK QUARTERS

Many sick quarters in the Command were on, or very close to, the airfield and their proximity normally resulted in the saving of time and transport. When air raids began, however, it became apparent that the holding of patients in these wards did not assist their rapid recovery. This point was emphasised in the third week of August when the P.M.O., visiting Lympne, was forced to spend most of his inspection time in a shelter trench beside the airfield. The sick quarters had been damaged by blast and patients had been unable to get satisfactory rest or uninterrupted sleep because of the frequent attacks and the many alerts. The P.M.O. requested approval from the A.O.C.-in-C., Fighter Command for the removal of bed patients to quieter surroundings in requisitioned houses two or three miles away from airfields. The move was recommended and agreement in principle was obtained from the Directorate of Organisation on August 26. Signals were sent immediately to all stations in the Command requesting that suitable houses be found for dispersed sick quarters.

There were arguments against such a move. The formation of a separate sick quarters for bed patients outside the defence area of the airfield had disadvantages in the event of invasion, which, in the opinion of some, negatived the advantages afforded by the removal of patients from the sick quarters on the airfield. It was also thought that more transport would be needed, but this was denied by the P.M.O. on the grounds that the existing transport was adequate, provided it was used more often. Finally, there was a strong argument against the splitting of the nursing staff because orderlies would have to do more frequent 24-hour duty to man each unit effectively. These arguments were the forerunners of similar objections to the policy of general station dispersal which was introduced in 1941.

FACTORS INFLUENCING EFFICIENCY OF FLYING PERSONNEL

GENERAL

Most of the statistics which have been prepared of various aspects of the Battle of Britain deal with technical rather than personnel data. Separate research on particular problems has not been possible but one unnumbered report prepared by the Operational Research Section of the Command in 1942 contains sufficient information to illustrate the degree of effort made by certain pilots of some of the most actively

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engaged squadrons. Verbal information was also obtainable from station commanders and medical officers of instances of supreme individual effort lasting several days and culminating eventually in gross fatigue. It would have been most satisfactory to include such instances in this narrative but extensive research has failed to reveal any records which could be quoted in an historical account. No more than passing mention can, therefore, be made of those pilots who flew until they were exhausted and had to be lifted from their aircraft and put to bed, where they slept without interruption for periods varying between 12 and 42 hours. There are no medical records of such cases because medical officers considered that the disability, if it may be so called, was a natural phenomenon which could only be overcome by sufficient sleep and rest. Some records were kept in the daily sick book of pilots who were more mentally than physically exhausted, or who had difficulty in getting to sleep after several days of intensive fighting. Simple treatment by sedatives for one night often overcame their distress and as further trouble was seldom encountered these cases were rarely followed up.

Pilots who survived and continued to fight became fatigued sooner or later and when their efficiency became impaired it was customary to withdraw them from operational flying. It was difficult to determine the best time for such action when pilots were flying several sorties a day and a balance had to be struck between operational requirements and individual operational efficiency.

MORALE

There had been a change in the mental outlook of the whole country to the war after the withdrawal from Dunkirk. All the numerous anxieties associated with war had been sublimated to a single purpose: fight or perish. This sentiment served to weld together not only the fighting units but the civilian population. It has been said, with reason, that the general spirit of the country was higher during this phase of the war than at any other time. Experience had shown that R.A.F. equipment operating within the defence organisation was much superior to that of the enemy and the only serious disadvantage was a numerical deficiency of machines. These factors accentuated the comradeship already present among men of fighting units and resulted in very high morale.

READINESS

The main difference between the aerial fighting at Dunkirk and during the Battle of Britain was that in the former, patrols were flown at predetermined times, whereas in the latter, raiders had to be intercepted. Squadrons had to remain at varying states of readiness according to operational requirements throughout the hours of daylight. Often no

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warning could be given of an impending raid and those squadrons at readiness were required to 'scramble' at immediate notice. The normal anxiety experienced before any event requiring a supreme effort was increased because the times of take-off were unknown. The effects of such anxiety were cumulative if a high state of readiness was maintained for any length of time. Orders to scramble were usually conveyed by Klaxon, Tannoy or telephone. The Tannoy system was not limited at first to giving this information and it was used often throughout the day for other purposes. Similarly, the telephone at dispersal points was used for communications necessary for the normal day to day squadron administration. To pilots who were awaiting orders to take off at any moment, each Tannoy or telephone call was expected to convey such orders, and, in consequence, each time they were used, anxiety was heightened and was followed by relaxation to the normal state of preparedness, if the order to scramble was not given. One of the first signs of accumulated anxiety was often a protest made by pilots, who found these numerous interruptions irritating. Station commanders limited the use of the Tannoy as far as possible to operational orders, and squadron and flight commanders arranged various methods by which normal squadron messages and operational calls could be distinguished.

The hours of readiness were long. Stand-to began before dawn and ended after dusk except for those squadrons on night defence, so that for about 100 minutes flying time some 16 hours had to be spent at varying states of readiness at dispersal points. It is impossible to assess the effect of these hours of readiness on operational efficiency, but there is no doubt that it did reduce efficiency to some extent in all aircrews.

Modifications of the states of readiness were made from time to time and, to guard against surprise attacks on the more southern airfields, two or three pilots remained in aircraft which were warmed up at frequent intervals so that, should it be necessary, they could be airborne in less than a minute and provide protection for the take-off of the remainder of the squadron.

Orders were also given that each aircrew was to have one day off duty a week but this order was frequently disregarded by squadron and flight commanders whose sense of duty overcame their sense of discipline.

PHYSICAL FATIGUE

Physical fatigue arising from operational flying is increased by mental anxiety. The degree of anxiety is related to the physical and mental constitution of the individual, the opposition encountered and the length of time spent on operations and at readiness. These factors should be taken into account in any analysis of the effort made by pilots, but,

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because of the different reactions to each factor by each individual pilot, it is possible to consider the physical effort entailed only by analysing the number of sorties flown by certain pilots over a period of seven consecutive days of intensive fighting.

The analysis tabulates the number of sorties and flying times of pilots in six squadrons of the Command in a period of maximum squadron effort between August 1 and September 30. Only those pilots flying a total of nine or more sorties in one week were included in the investigation.

In the six squadrons chosen there were 99 pilots who had flown more than nine sorties in the week, or 693 pilot days. The table below gives the distribution of pilot days according to the number of sorties flown per day:

No. of sorties per day	No. of pilot days
0	113
1	169
2	200
3	132
4	58
5	15
6	5
7	1

It will be observed that there were 113 pilot days on which no sorties were flown. This did not mean, necessarily, that individual pilots had one day off duty during the week, but rather that for one reason or another, such as bad weather or unserviceability of their aircraft, they could not take part in operational sorties. Since there were 99 pilots, it followed that on the average each pilot had a total of 1·13 days on which he did no flying for one of the reasons stated.

The largest number of sorties flown by any pilot on any one day was seven and the total time for these seven sorties was 4 hours 5 minutes, giving an average time per sortie of 35 minutes.

The longest time flown by any pilot on any one day was 5 hours 10 minutes, in which he flew five sorties of an average duration of 1 hour and 2 minutes.

The greatest number of sorties flown by any pilot during the week was 19, and the total time for them was 12 hours 50 minutes, giving an average time of 40 minutes per sortie.

The longest time flown by any pilot during the week was 15 hours 20 minutes, the number of sorties flown in this period being 14, of an average length of 1 hour and 6 minutes.

The total number of sorties flown by pilots was 1,309 with a total time of 1,112 hours, 30 minutes, the average number of sorties per day

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per pilot working out at 1·9. The average time flown per pilot per day was 1 hour 36 minutes, giving an average of 51 minutes per sortie.

Full data are summarised in the tables below:

Squadron	No. of pilots	No. of sorties on day:							Total sorties for week	Average no. of sorties per day per pilot	Average duration of sorties—minutes
		1st.	2nd.	3rd.	4th.	5th.	6th.	7th.			
No. 32	11	7	12	26	20	36	24	19	144	1·9	53
„ 54	19	52	22	37	30	47	38	37	263	2·0	54
„ 56	22	43	42	43	40	36	32	62	298	1·9	55
„ 74	11	23	24	31	19	19	21	5	142	1·8	42
„ 92	14	22	21	35	21	15	16	28	158	1·6	56
„ 602	22	39	43	46	51	42	39	44	304	2·0	45
	99	186	164	218	181	195	170	195	1,309	1·9	51
Average no. of sorties per pilot		1·9	1·6	2·2	1·8	2·0	1·7	2·0	13·2		

Squadron	No. of pilots	Flying time on days:							Total flying time per week (hours and minutes)	Average time per day per pilot (hours and minutes)
		1st	2nd	3rd	4th	5th	6th	7th		
				(hours and minutes)						
No. 32	11	6 : 10	10 : 10	26 : 05	14 : 30	33 : 05	19 : 25	18 : 50	128 : 15	1 : 40
„ 54	19	48 : 10	20 : 00	37 : 10	25 : 00	36 : 30	36 : 05	32 : 45	235 : 40	1 : 46
„ 56	22	45 : 15	33 : 45	43 : 15	40 : 25	32 : 50	26 : 25	50 : 30	272 : 25	1 : 46
„ 74	11	13 : 50	17 : 15	17 : 55	11 : 40	17 : 40	17 : 00	5 : 15	100 : 35	1 : 26
„ 92	14	23 : 05	15 : 05	33 : 10	21 : 20	15 : 50	11 : 50	26 : 10	146 : 30	1 : 30
„ 602	22	30 : 50	35 : 05	36 : 15	41 : 05	28 : 20	31 : 45	25 : 45	229 : 05	1 : 29
	99	167 : 20	131 : 20	193 : 50	154 : 00	164 : 15	142 : 30	159 : 15	1,112 : 30	1 : 36
Average time per pilot . .		1 : 41	1 : 20	1 : 57	1 : 33	1 : 39	1 : 26	1 : 36		

RECREATION

In the early phases of the fighting the general attitude at stations was that there was no time for the simple recreation so necessary, even during intensive effort, to maintain mental and physical well-being. Station commanders and station medical officers viewed with increasing anxiety the onset of fatigue and irritability among aircrews and deplored the amount of alcohol which was consumed on occasion, although they could understand the temporary relief afforded by such indulgence. It was a debatable point whether or not to restrict the consumption of alcohol by aircrews who were so unselfishly employed to the full extent of their ability. In those squadrons which suffered heavy casualties, pilots began to make crude calculations of their chances of survival as their friends one after another failed to return. Morale, however, remained high because the casualties inflicted on the enemy were always

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greatly in excess of squadron losses. Pilots felt the need of some form of relaxation after being at dispersals all day, and parties, consisting sometimes of whole squadrons, would leave the station after release to obtain outside the relaxation they needed, returning to bed at varying hours. It was soon realised that, if organised entertainment could be arranged on the station, it could be terminated at a reasonable hour, so that air-crews could obtain the amount of sleep they needed without interfering with their desire for relaxation. Dances, stage shows and other forms of entertainment were, therefore, organised and the exodus of flying personnel from the station after duty was considerably reduced. The consumption of alcohol fell at the same time to reasonable limits. However, even with these measures some pilots delayed going to bed in messes which were on or near the airfield, because they could not sleep peacefully knowing that they were on a major objective. It is probable that this state of mind was the normal reaction to the heavy fighting during the day and the pilot's inherent dislike of being on the ground during an air raid. Sleeping quarters accommodating about six beds were made available off the stations for any pilots who felt inclined to make use of them, but, once available, they were seldom used except by pilots who had realised that only uninterrupted sleep would overcome their fatigue after several days of intensive fighting.

NOTIFICATION AND TREATMENT OF AIRCREW CASUALTIES

The usual method by which aircrew casualties were notified, collected and treated in the first eleven months of the war is described in Chapter 1. It was possible, then, for medical officers to supervise their collection, on many occasions accompanying the ambulance to the site of the crash or other accident. As soon as attacks on airfields began, there was neither time nor transport available for this because medical officers and ambulances were more urgently required on the airfields. So many aircrew were forced to bale out or make emergency landings away from their home stations that it was very difficult indeed to estimate with any accuracy the number actually missing and the number whose return was delayed for some reason. Pilots had the habit of reporting after a lapse of even two or three days, unhurt and fit for duty, and this gave rise to a feeling of unwarranted optimism that all pilots would return in like manner unless their loss had been witnessed. During intensive air warfare it was quite usual for aircrew believed missing to be found injured in hospitals to which they had been admitted without the knowledge of the station medical officer. Communications were often interrupted and the intact lines were fully occupied with priority operational orders and information; hospitals did not know the R.A.F. units from which the men came and were, in fact, unable in many

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instances to inform any R.A.F. station that they had admitted injured aircrew.

Instructions were issued by the E.M.S. authorities to all E.M.S. hospitals on August 8, detailing the procedure to be followed if such casualties were admitted. The Medical Statistical Office, Ruislip, was to be notified of all such admissions and all orthopaedic cases were to be transferred as soon as possible to R.A.F. general hospitals or to special centres. This procedure was cumbersome and it soon became apparent that a more effective system of control was needed. Fresh difficulties arose daily and when a very seriously burned pilot who had been treated in a local maternity home in Kent with tannic acid was discovered in an advanced condition of sepsis, reorganisation of the system became imperative.

To avoid occurrences of this kind new instructions were issued by the Air Ministry on October 2, 1940 to ensure that all battle casualties, as they were then called, were notified to the Senior Medical Officer, No. 24 Group at Halton. The surgical consultant was placed at the disposal of this Senior Medical Officer and visits to aircrew casualties in civilian hospitals were planned in conjunction with the Medical Statistical Office—agreement having been reached by the Air Ministry with the Ministry of Health that such visits could be made and that the consultant would have authority to arrange transfers where necessary. It was hoped that the slow notification of casualties under the E.M.S. system would be replaced in the near future by another scheme whereby all aircrew casualties would be reported as they occurred to the nearest police station, which in turn would inform the nearest R.A.F. station. Information could then be passed *via* the group in which the station was operating to the S.M.O. of No. 24 Group.

In practice this latter method of notification was not very efficient because the police were too often pre-occupied with their own business and in many instances appeared to take no action. Sporadic notifications were received from the senior medical officers of groups, but it soon became obvious that the new system was not operating satisfactorily. Air Ministry (M.A.2) arranged on October 19, 1940, that they would obtain and transmit notifications received by the casualty section of the Directorate of Personnel to the S.M.O. of No. 24 Group for action. This system gave reasonably satisfactory results and the two sources of information were correlated. In addition, the hospitals themselves, by this time well aware of what was desired of them because of further instructions and the visits made by the surgical consultant, began to notify casualties direct to the S.M.O. of No. 24 Group or to Halton Hospital, from where the information was passed on.

The first group of cases notified by the Medical Statistical Office numbered 124, but they were not all 'battle casualties', some of them

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being cases of ordinary sickness in aircrew not requiring the special attention of the surgical consultant. The latter, during four separate tours of civilian hospitals, mostly in the Kent and Sussex area, between October 4 and October 26 had transferred 48 patients (out of a total of 159) to Royal Air Force Hospitals, all but 3 going to Halton, and 11 others to special centres. Of the remainder, 34 had already been discharged and 23 were allowed to remain, their condition not being of sufficient severity to warrant their transfer. Action had been taken on 43 of these cases by making contact with the hospital or by planning visits, but final disposal and transfer of the patients had not been settled until after the cases had been seen. Visits, by agreement between the Air Ministry and the War Office, were also made to military hospitals and a number of the cases seen were transferred to Halton. As a result of these visits it became widely known in the Kent and Sussex hospitals that the R.A.F. would welcome the transfer of patients, and effective and ready collaboration was achieved.

The transfer of most of the cases was effected by a pool of four ambulances located in No. 24 Group, two stationed at Halton and two at Uxbridge. Later, use was made of American and Red Cross ambulances and an extra ambulance was placed at the disposal of the S.M.O. of No. 16 Group to assist in the work of clearing cases from the south-east of England. Rail transport was used on two occasions to transfer burn cases in the depths of winter, and at times an air ambulance was used when weather conditions were suitable.

The transfer of many severely injured casualties resulted in the overloading of the accommodation at Halton Hospital, despite the fact that some casualties had been allowed to remain at certain Class 1A. E.M.S. hospitals. It was agreed, therefore, that the surgical consultant could use further discretion in the transfer of patients and that those who were allowed to remain in E.M.S. hospitals should be followed up by further visits. Pressure on Halton Hospital was also relieved by fuller use of the officers' hospital at Torquay and of the E.M.S. special centres. Maxillo-facial and burns cases presented a special problem, and after a few weeks' experience every use was made of the E.M.S. special centres for the treatment of such injuries at Hill End Hospital, St. Albans; Park Prewitt Hospital, Basingstoke; and the Queen Victoria Hospital at East Grinstead. Cases requiring treatment at R.A.F. general hospitals were defined as those 'suffering from all types of disabilities in which specialised forms of treatment would expedite recovery', and the definition was to apply particularly to cases of multiple injuries with combinations of orthopaedic, burns and head injuries.

By December 5, 1940, the casualty area visited extended from the south coast to Northumberland. The surgical consultant had paid a hundred visits to various hospitals and had travelled approximately five

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thousand miles in the thirty-six days spent on the road. Two hundred and forty-two cases had been dealt with: 73 had been transferred to R.A.F. general hospitals or special centres; 100 more had been visited but not transferred; 63 were discharged and 6 had died before the consultant visited the hospitals concerned, either because he was delayed by urgent visits to certain other cases, or because the injuries sustained were so severe that the patients died in a very short while. It was considered that the transferred cases had benefited by the move and those who had been left in recognised centres had progressed satisfactorily. Patients not suitable for transfer had been revisited, and useful contacts had been made throughout the E.M.S. However, it was found that the treatment of burns and fractures, except in certain first class hospitals, was not of such a high standard as that provided by R.A.F. hospitals, and rehabilitation facilities were entirely absent except in a few of the largest civilian hospitals. The appointment of an additional surgical consultant was thought desirable, so that the country could be divided into a northern and southern area for the visiting of cases.

An analysis of the distribution of aircrew casualties by various areas was made on January 1, 1941. Of the 734 cases notified in England and Wales, 182 (in 87 hospitals) were in the London, Southern and South Eastern Areas, a proportion of 25 per cent.; 141 (in 50 hospitals) were in the Northern, North Eastern and North Midland Areas, a proportion of 19 per cent.; and 128 (in 28 hospitals) were in the Eastern Defence Area, a proportion of 18 per cent. These areas therefore accounted for 62 per cent. of cases occurring in 165 hospitals.

The administration of the Aircrew Casualty Disposal Scheme was undertaken by a medical officer holding flying officer rank, who had been posted to No. 24 Group for other duties when the scheme began. It was decided in November 1940, when No. 24 Group moved to Gloucester, that this officer should remain at Halton to continue the work and maintain the necessary contacts with the consultants and Halton Hospital, and with the transport required for the movement of casualties. He was, therefore, posted to the Central Medical Establishment. It was possible after an increase of the clerical staff to institute and maintain a card index system, so that information was readily available on every case handled. Scottish cases came under the control of the Department of Health for Scotland and no supervisory or administrative action was taken by the Air Ministry, the notification merely serving for record purposes. An extensive correspondence between the Central Medical Establishment and the civilian hospitals took place in an endeavour to trace, obtain information on, control, and if necessary move, unvisited cases. Brief notes on the condition of the patients were entered on the cards, so that a complete history from admission to discharge was available. It was possible by the end of January to start

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hospital cards, each carrying the serial number of the case admitted, so that it could be shown at any time how many cases were in a given hospital, how many had been discharged, the numbers transferred and details of those who had died.

It was essential for the successful administration of this work to know the standard of treatment available at the many E.M.S. hospitals to which aircrew cases had been admitted, and a private file was opened containing brief information obtained from various sources, all first-hand. The immediate removal of cases from hospitals which provided inadequate or unsatisfactory treatment was effected after notice of admission had been received. By the end of March 1941 special information of this kind was held on 121 out of 316 hospitals, together with a good working knowledge of the standard of treatment which could be expected. Air Ministry provided up-to-date lists of all E.M.S. hospitals with their telephone numbers, and similar lists of the auxiliary hospitals, naval and military hospitals and hospitals administered by the Department of Health for Scotland. In due course it became evident that it was impossible for the consultants to visit all cases and arrangements were made with the commanding officers of certain R.A.F. hospitals, particularly Ely and Rauceby, for their surgical specialists to visit cases when the surgical consultant could not be spared to go to the district in question.

In February 1941 the Disposal Scheme was reorganised by Air Ministry, and the area covered by the surgical consultant was reduced from that of the whole of England and Wales to the Defence Areas 4, 5, 6 and 12, which included East Anglia, Kent and Sussex and a central area extending from Oxfordshire to Hampshire and bounded on the west by Wiltshire. On February 10, a new scheme came into effect by which all cases occurring in regions other than those covered by the surgical consultant were notified by the Central Medical Establishment to the group controlling the R.A.F. hospital nearest to the case. Arrangements were then made for the surgical specialist to visit the patient. It was originally intended to make these notifications to the group in the form of a casualty signal, but during the first two months of the new system the telephone communications *via* the R.A.F. 'Central' exchange were so good that this means of communication was used except in a very few instances.

A feature of the new system was that in the West Country most of the cases gravitated to the Officers' Hospital, Torquay, and as the number of casualties in Devon and Cornwall began to increase during March 1941, the Air Ministry made extra surgical facilities available in that hospital and in addition use was made on occasion of the E.M.S. orthopaedic consultant at Exeter. Assistance was also given by the Royal Naval surgical specialist stationed at Plymouth.

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Reports were submitted monthly by Central Medical Establishment to Air Ministry, in which cases were divided into various groups according to whether they had been transferred to R.A.F. hospitals, special centres, civilian hospitals, or were still awaiting disposal.

Cases recorded between the beginning of the scheme in October, 1940 and March 26, 1941 totalled 1,258, and of this number 165 were still in civilian hospitals awaiting either transfer or discharge. From an analysis of these figures it was found that the groups consisting of multiple injuries, fractures, burns, gunshot wounds and other lacerations, accounted for 47 per cent. of the cases. A quarter of the casualties were cases of ordinary sickness and included a very small number of patients with nervous diseases not attributed specifically to flying, and the remaining quarter of the total consisted of a mixed group of head, face, back and limb injuries, and an unclassified number of minor injuries—the last accounting for 11 per cent. A further analysis was made after excluding the cases of ordinary sickness, by separating the types of injury where details were given in the multiple injuries cases and by regrouping the types of injuries mentioned above. It was found that fractures accounted for 32 per cent. of all injuries, those of the lower extremity representing almost half of these; burns for 13 per cent.; gunshot wounds and lacerations together for 14 per cent; minor injuries for 14 per cent.; concussion and post-concussional states for 7 per cent.; and an unclassified group for 20 per cent.

CASUALTIES 1940

The statistics quoted below were supplied by the Air Ministry Medical Statistical Department:

Deaths and Injuries (non-fatal) R.A.F. and Dominion Personnel, 1940

Month	Deaths*				Injuries			
	E/A (air)	Flying Accidents	Air Raids	Totals	E/A (air)	Flying Accidents	Air Raids	Totals
January	—	16	—	16	—	5	—	5
February	3	8	—	11	1	4	—	5
March	5	17	—	22	1	6	—	7
April	1	16	—	17	1	11	—	12
May	88	21	—	109	30	9	—	39
June	43	23	—	66	15	8	—	23
July	61	17	—	78	15	21	1	37
August	149	15	78	242	114	10	99	223
September	122	24	13	159	119	16	34	169
October	62	44	18	124	46	10	30	86
November	22	28	5	55	20	16	10	46
December	5	30	—	35	4	11	8	23
Totals	561	259	114	934	366	127	182	675

E/A. = Enemy Action. * Includes missing presumed dead.

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The total number of all casualties due to enemy action for the year was 1,223 of which 961 occurred between July 1 and October 31.

Deaths (including missing presumed dead) per thousand operational man sorties. The number of operational sorties flown by each type of aircraft for the months March to December inclusive were obtained from the Central Statistical Branch and the man sorties were calculated by multiplying the number of operational sorties flown by each type of aircraft by the number of aircrew normally carried in the aircraft. The figures for May exclude casualties sustained by the Air Component of the Field Force up to May 21/22 but after that date include any casualties sustained by any formation of that force which was absorbed into Fighter Command and operated from No. 11 Group bases.

Month	Operational man sorties	Deaths* E/A. air	Deaths* E/A. air p. 1,000 op. man sorties
March	7,712	5	·648
April	6,008	1	·166
May	6,809	88	12·9
June	10,194	43	4·22
July	22,769	61	2·68
August	25,490	149	5·84
September	22,788	122	5·35
October	11,710	62	5·30
November	16,457	22	1·33
December	8,531	5	·58
Totals	138,468	558	4·03

E/A. = Enemy Action.

* Includes missing presumed dead.

The high figure in May is understandable when it is remembered that aircraft were operating outside the home defence system, over the Channel and on the Continent. Unfortunately monthly figures of personnel missing presumed dead are not obtainable but the total number of personnel missing presumed dead for the year was 231 of which between 88 and 94 were so posted in May.

Burns. Aircraft were modified as soon as new equipment became available or because experience had shown the necessity for, or advantage in, the introduction of the modifications. Each modification either improved the performance of the aircraft or contributed to the safety of the pilot in air combat. The most important was the introduction of self-sealing petrol tanks in the middle of September 1940. Extra fireproof protection was also supplied during the Battle of Britain. All the tanks in the Hurricanes could be made self-sealing but in the Spitfire the upper fuselage tank could not be so modified at that time without alterations in either the design of the tanks or the lines of the aircraft.

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The effect on the incidence of burns among pilots before and after the introduction of self-sealing tanks has been impossible to determine because of the large numbers of aircrew missing presumed dead in the fighting over the Channel.

The number of types of burns tabulated below includes those cases which were classified as 'multiple injuries and burns' (*see* Burns Section, Chapter 6, Volume I). A large proportion of these were dead when located or died shortly after, and it was not possible to say whether the person was (*a*) killed, and then burnt, or (*b*) burnt, and then died of his injuries, or (*c*) died from the combination of burn and injury. The proportion of deaths occurring among personnel burnt in air action with the enemy was lower than that among those burnt in flying accidents, and this probably reflects the difference between the operational aircraft which had self-sealing tanks and other aircraft which had not, although a number of flying accidents undoubtedly occurred in operational aircraft which were fitted with self-sealing tanks:

Burns				
Month	Total E/A. air	Deaths E/A. air	Total flying accidents	Deaths flying accidents
January . .	—	—	5	5
February . .	—	—	2	2
March . .	3	2	7	6
April . . .	—	—	2	2
May . . .	4	—	6	6
June . . .	3	1	10	10
July . . .	10	9	8	8
August . .	43	18	5	4
September . .	37	11	10	9
October . .	13	9	13	13
November . .	3	1	4	4
December . .	—	—	8	6
Totals	116	51	80	75

Forty-seven of the 103 burns due to enemy air action between July 1 and October 31 were fatal. Thirty-four of the thirty-six burns due to flying accidents during the same period were likewise fatal.

If the casualties classified as 'multiple injuries and burns' are excluded from the above table, the figures for R.A.F. personnel only* are as follows:

* Only one burns case among Dominion personnel had been reported at this stage of the war.

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Number of Cases of Burns and Scalds, 1940

Command	Fighter Command				All Home Commands			
Average strength	40,617				292,688			
Cause	Enemy action		Flying accidents	Other causes†	Enemy action		Flying accidents	Other causes†
	Air	Ground			Air	Ground		
Part affected:								
Generalised	58	1	9	3	59	3	99	43
Head; scalp, ear	1	—	—	—	1	—	—	4
Eye or eyelid; face	7	—	1	9	11	2	6	66
Face and hands	16	—	1	—	18	3	30	1
Hands; fingers, hand and forearm; hand and wrist	2	—	—	19	3	2	7	83
Upper limb, other than hand	—	—	—	2	—	1	1	17
Trunk and parts thereof; including external genitalia	—	—	—	2	—	—	—	10
Lower limb and parts thereof	1	—	—	15	1	2	—	64
Totals	85	1	11	50	93	13	143	288

† The numbers shown under 'Other causes' include scalds. Incidences are not shown in this table as the strength figures do not give a true indication of the population exposed to the separate risks.

APPOINTMENT OF FLYING PERSONNEL MEDICAL OFFICER

On mobilisation there had been a great demand for medical officers with administrative and staff experience to man the newly established more senior medical posts at Command and group headquarters. The medical branch was alive to the need for the posting of such officers who held 'wings' to the operational commands and groups to advise on the problems of aviation medicine, but the pressure of work was considerable and it was found that these officers could only devote time to the supervision of the specific care of flying personnel at the expense of other essential duties. In addition, three-quarters of the medical officers who had entered the Service in the R.A.F.V.R. were inexperienced in aviation medicine and only a few could fly.* The establishment of medical officers at squadrons in the autumn of 1940 was a step towards the acceptance of the need for extra supervision of the care of flying personnel. The Air Ministry Committee which was formed in February 1941 to investigate the duties of the squadron medical officer was concerned with the production of a pamphlet (A.P. 126) for issue to medical officers to assist them in their task of looking after flying personnel. Meanwhile, the P.M.O. of Fighter Command assigned one of his

* i.e. held Pilot's certificate 'A'.

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officers experienced in aviation medicine, who held wings, to watch over the maintenance of health and efficiency of operational aircrews in the Command, and to supervise unit medical officers, until they had obtained by experience a knowledge of the problems of social and aviation medicine affecting flying personnel. The logical outcome of this step was the request by the D.G.M.S. on March 7, 1941, for the official establishment of such specialist posts on the staffs of all operational commands. The duties of these special medical officers were to supervise, and advise on, the care of flying personnel generally; to keep an ever watchful eye on their needs; to teach and guide group and unit medical officers in aviation medicine; to assist and advise on the factors influencing 'flying stress'; and to foster a close liaison between responsible officers at Command headquarters, the Chief Executive Officer of the Flying Personnel Research Committee, and other aviation and research centres such as those at Farnborough, Cambridge and Edinburgh. They were also to undertake supervision of the feeding, accommodation, rest, sleeping and recreational facilities which influenced the health, welfare and efficiency of aircrews. Approval was given for the establishment of these officers in the posts of Flying Personnel Medical Officer (F.P.M.O.) on March 15 and on March 26 the posting of selected medical officers to all operational commands was authorised.

From the medical aspect the establishment of F.P.M.Os. occurred at an opportune moment because the character of the war, so far as Fighter Command was concerned, altered in the spring of 1941. The concentrated defensive fighting of the previous year had given way to a lull in operations without any reduction of the hours of readiness. The excitement had gone and many of the experienced squadron leaders had been lost or were temporarily relieved from operational flying.

It was during this period that more attention was given to the organisation and administration of the hours of duty and times of release, the feeding of aircrews and the improvement of living conditions at dispersals. Hitherto the tempo of the fighting had been so fast that the implementation of plans to improve living conditions, which depended upon the employment of labour, had been delayed, and even when certain recommendations which would have improved comfort and efficiency were made, they were not accepted at first on the grounds of 'operational necessity'. It was argued that aircrews spent more of their time during their waking hours at readiness than in any other way and that it was reasonable on these grounds to improve the facilities at dispersal points even at the expense of some luxury at the main messes. Similarly the advice of the F.P.M.O. was invaluable at a time when there was dissatisfaction over the delay in fixing a recognised length of tour in the Command. A fixed tour of duty had been arranged in Bomber Command and aircrews in Fighter

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Command did not see why a similar policy should not be introduced for them. The establishment of a definite length of tour was extremely important because it fixed a time at which aircrews could expect a respite from operational duty. A corollary to this was the delay in deciding the length of time a tour-expired member of aircrew should spend at operational training units. Many such aircrew personnel had been held at these units for periods well in excess of six months. The result was that while welcoming relief from operational flying at the end of a tour of duty, they were unwilling to undertake training duties at O.T.Us. for indefinite periods because of their fear that they might never return to operational flying or that, when they did return, they would be inexperienced in modern combat fighting and be overlooked for selected promotion.

MEDICAL ASPECTS OF NIGHT FLYING

The study of night vision began in 1927. Early investigations were handicapped by the difficulty of obtaining reliable apparatus which would give constant standards of very low intensities of illumination, and of deciding suitable methods of grading ability to recognise and see specific objects and forms at determined intensities. The history of the development of the study of night vision has already been covered to some extent in the Aviation Medicine Section of Chapter 1 and only those particular aspects relating to the night fighter defence in Fighter Command will be described in this chapter.

Between 1927 and 1939 evidence concerning the physiology of night vision and the factors which influenced the ability to see at night was gradually collected, but, because most of the research was carried out on very low intensities of illumination, and because pre-war night exercises were normally held only in favourable weather when there was a moon, the application of the results of this research to night flying was delayed. However, as soon as the war began, the conditions under which night flying had necessarily to be carried out altered completely and the medical evidence on night vision collected over the previous years became of immense value. Patrols were flown increasingly in weather in which flying would have been prohibited in peace-time, and the imposition of the blackout, with the existing methods of airfield lighting, created new and unfamiliar hazards the surmounting of which, except in conditions of haze and fog, depended mainly upon the ability to see in the dark. Many factors, both inside and outside the cockpit, influenced the degree of dark adaptation and for this reason a brief description of the development of airfield lighting in the early years of the war is necessary.

AIRFIELD LIGHTING

During peace-time pilots on night exercises were assisted by the innumerable street lights and commercial neon signs which provided an

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excellent horizon and assisted night navigation. Flare paths consisted of money flares* laid by hand; additional illumination was provided by a floodlight and obstructions were mounted with red lights. When the blackout was imposed, a higher standard of instrument flying became necessary because there was no horizon provided by civilian lighting. It became customary to send a squad into the country in the direction of take-off to sling lamps in the trees to provide horizon lights for take-off. Experienced pilots had little difficulty in becoming accustomed to the new conditions, but newly trained pilots without much experience of instrument flying were handicapped and there were many accidents. An additional hazard arose because the airfield lights, controlled from an operations room off the station, were often extinguished, for instance if an enemy aircraft was approaching, without reference to the wishes of pilots of aircraft landing or taking-off. The control of flying on the field itself was undertaken by the Control Officer with an Aldis lamp.

The accidents which had occurred during night flying between September 3 and December 15, 1939, were reviewed at Air Ministry on December 19. It was observed that 38 fatal and 117 non-fatal night flying accidents, a total of 155, had occurred in this period. There had been some difficulty in assessing which accidents were due to blackout conditions and which were not, but as far as it had been possible to judge from the information available, 24 were definitely and 9 possibly due to blackout conditions. Of the total, Fighter Command had had 60 night flying accidents, of which 12 definitely and one possibly had been due to blackout conditions. Seventeen of the 31 fatal accidents had occurred at take-off or immediately after take-off. Very few could be considered to be attributable to defective instruments or incorrect cockpit drill.

Night patrols were being flown in Hurricane, Spitfire and Blenheim aircraft. Few of the pilots of single-engine aircraft were experienced in night navigation and, in view of the expected enemy attacks, orders were given on December 28 that these pilots were to be restricted to operating only on moonlit nights, until they had become accustomed to night flying and could be employed on nights on which there was less visibility. The employment of Spitfires at night was also discontinued about the same time, because the aircraft's narrow undercarriage made it unsuitable for night landings except in the hands of very experienced pilots. In the meantime night flying squadrons carried out various experiments with hurricane lamps and car headlights to reduce the difficulties of taking off and landing at night, while lead-in lights were installed at some Fighter Command airfields for about 1½ miles on either

* Consisting of paraffin-soaked tow in a container.

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side of the flare path and were found most useful. It was not, however, until March 11, 1940, that authority was given to reverse the previous policy of extinguishing airfield lights from a separate operations room in the event of an air attack when flying was in progress, and it was decided that the amount of light to be shown on or near airfields was to be that required by pilots for the satisfactory handling of their aircraft and was not to be limited by the possibilities of an air attack. The responsibility was, therefore, transferred to the Control Officer, who was under the direction of the Station Commander, but as yet there was no central system of controlling all the lights on the airfield from one point.

It was realised that until some form of standardised airfield lighting was introduced little progress could be made in increasing the efficiency of night defence squadrons or reducing wastage. At early discussions on this subject Bomber and Coastal Commands were not sympathetically inclined to any standardised system because their station requirements varied from one locality to another. A degree of standardisation was however introduced into Fighter Command by the installation of angle of glide indicators (already used by the Fleet Air Arm) at all night flying stations. Further experiments on airfield lighting from the operational aspect were carried out by Air Ministry at Boscombe Down and in Fighter Command at Drem. After tests held on August 23 and September 9, 1940, the 'Drem' system was accepted in principle and developed into the standard system of airfield lighting throughout the Royal Air Force. Details of this system may be obtained from technical accounts; it is only necessary to explain here that the system incorporated single or double flare-path lights of special construction, single or double perimeter track lights, leading-in, outer circuit, horizon, funnel, obstruction and fog lights. A central system of control was installed in the control tower during 1942 and 1943 by which the flare path could be altered at a turn of the switch if the wind veered. The perimeter and flare path lights were hooded and of blue colour, their intensity being controlled centrally by the Control Officer. The introduction of 'Drem' lighting removed many sources of extraneous and unstandardised forms of illumination on airfields which were capable of reducing the degree of dark adaptation of pilots. Various modifications were introduced from time to time but the basic system remained unaltered in the Command.

NIGHT VISION

Research into night vision* before the war had shown that there was among aircrews a wide variation of ability to see certain test figures and

* *See* also Chapter 1, Bomber Command.

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objects at ground level at low intensities of illumination. The application of this knowledge to the routine night vision testing of pilots and their subsequent grading was resisted by the executive authorities at the beginning of the war on the ground that, if a further limiting standard was adopted, it would reduce seriously the elasticity of the defence. It was appreciated, however, when night raids on this country became regular, that a great responsibility rested on those engaged in night fighting. Anything, therefore, which could increase the efficiency of the defence became of paramount importance. Research into the problems of night vision received an added incentive and in the early part of 1940 it was concluded from experiments carried out at the Physiological Laboratory at Cambridge, that no noticeable improvement in the night visual capacity of pilots resulted from the addition of Vitamins A and C to a normal Service diet. Further experiments carried out under the auspices of the Flying Personnel Research Committee during the autumn showed that if aircrews flew at night above an altitude of 6,000 ft. their visual capacity was reduced by between one-fifth and one-tenth of normal if no oxygen was used. A further reduction took place at increasing altitudes, until a complete temporary night blindness resulted, which could be abolished at once by increasing the supply of oxygen to that required for the altitude. (*See* Plate XIV, Chapter 1.) It was recommended that all aircrew engaged on night flying should use oxygen for the whole time they were airborne. This information was disseminated to commands in the third week of September 1940 with a statement of results of recent experiments in dark adaptation, which had been shown to be very rapid in the first ten minutes, the eye becoming three-quarters dark adapted, and after that to take place at a more moderate rate, being almost complete in half an hour.

This information was available to an Air Ministry Committee which was called on October 25, 1940, to discuss the minimum measures necessary to facilitate the work of night fighter squadrons. The meeting was attended by the Consultant in Ophthalmology and one of the subjects discussed was the testing of the night visual capacity of aircrews by the rotating hexagon. The medical branch was ready to test aircrews at any place selected by Fighter Command and it was suggested that all pilots and air gunners should be tested as soon as possible. This was agreed to by the Command but it was emphasised that the withdrawal of any aircrews who were flying satisfactorily at night could not be considered whatever the findings of the night vision tests. As a long-term policy it was agreed that all aircrews, before being posted to night flying O.T.Us., should be tested to exclude those with poor night vision. Extensive testing was, therefore, carried out in the Command and it was decided subsequently that no pilots with poor night visual scores should be engaged on night fighter defence; the standard was decided upon after

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testing numbers of successful night fighter pilots. Despite the evidence upon which night vision testing was based there remained always among experienced night fighter pilots some doubt as to the advisability of the rigid application of the policy adopted and it was never accepted by the most successful night fighter pilots as being sound, because, in their view, so many other factors determined the ability to fly at night, great ability more than compensating for the supposedly reduced night visual capacity of an experienced pilot as tested on the rotating hexagon. (*See* Plate XVII, Chapter 1.)

The method by which the maximum degree of dark adaptation could be obtained by pilots before take-off was also discussed at the conference. It was stated by the Consultant in Ophthalmology that it would be bad psychologically for aircrews to sit in darkness in dispersals for long periods before take-off and it was recommended that they should wear dark tinted celluloid visors before take-off rather than sit in darkness. It was explained that these visors were similar to the anti-gas shield and that supplies would be ready in three weeks.

Very shortly after the introduction of these visors, an improved type was introduced consisting of two circular dark-green glass lenses made of Chance's protex glass held in a metal frame attached to a leather face piece. An adjustable elastic band held the goggles on to the face. Twenty pairs were issued for Service trials in January 1941 and were intended to be worn by aircrews for fifteen minutes before take-off. The results of the trials were satisfactory except that the glasses became fogged after being worn for a few minutes. This was partially overcome by incorporating into the leather face piece two small light trapped vents, but misting was not abolished entirely unless the goggles were warmed slightly before being worn. Later the green lenses were changed for very dark blue-black lenses, which excluded so much light that pilots wearing them found it difficult to see even in a well-lit dispersal.

Meanwhile it had been shown in America that a considerable degree of dark adaptation could be obtained satisfactorily by using goggles fitted with red monochromatic glass lenses. Samples of these goggles were sent to the United Kingdom where the principle was confirmed. Lenses of a deeper shade of red monochromatic than those used in America were issued and replaced the dark-blue lenses in use. The red lenses enabled aircrews to move about a normally lit dispersal with comparative ease although it was not possible to read in comfort. All recreational games except those using red colours could be played.*

It was soon discovered that if an intense light was seen by a dark-adapted pilot, his dark adaptation was immediately impaired. This was of importance when going from dispersals to aircraft because ground

* Card games could be played if the outlines of the red cards were inked in with black ink.

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crews did not use masked torches and were not particularly careful to keep the light shining upon the ground. A coloured filter material, Dufaychromex orange-red filter, was introduced and was used in special torches for the use of navigators of intruder aircraft in September 1942 and later issued to ground crews in 1943. A further source of discomfort to the eyes was abolished in some dispersals by the installation by squadron medical officers of indirect lighting, so that the sources of illumination in the room were not visible to the eye.

COCKPIT LIGHTING

During the first three years of the war, cockpit instruments were painted with self-luminous paint and accessory lighting was provided by shielded cockpit lights with adjustable apertures. Emergency lighting was provided by the torches carried by aircrew. These forms of illumination were considered satisfactory, until research showed that on dark nights the uneven distribution of luminous paint on the instrument dial markings produced interference with night vision in the peripheral fields of the retina*, which resulted in a phenomenon known as 'instrument dial dance'. It was also shown that it was not the small glare factors which interfered with night vision but the continual presence of some distracting source of light. These phenomena were of greater importance among night fighter and bomber squadrons than among other squadrons of the R.A.F., whose duties did not depend, as far as pilots were concerned, upon the need for the highest degree of dark adaptation. Various methods of improving cockpit lighting were developed. One which showed much promise was the floodlighting of cockpits and instruments by shielded lights incorporating the Dufaychromex orange filter material. This form of lighting was introduced into Bomber Command in addition to other improvements made in the production and marking of instrument dials with self-luminous paint. The most promising method, however, was the illumination by ultra-violet light of instruments painted with fluorescent paint. The first experiments in this form of lighting were carried out in 1941 on a Bolton and Paul gun-turret and were developed for Service use with the introduction of Mosquito aircraft in 1942. The advantages of ultra-violet lighting of instruments were that the source of light was invisible and the intensity of the illumination produced could be adjusted by an iris diaphragm down to any requirement according to the darkness of the night. The use of Dufaychromex filter material was not entirely abandoned as an accessory form of lighting. Research continued in an attempt to obtain a satisfactory fluorescent paint which would transmit an orange or red colour on irradiation with ultra-violet light but although such paints were produced they were found unsatisfactory because of their tendency to flake.

* The retinal area in which the rods are predominant.

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SOCIAL MEDICINE ON NIGHT FLYING STATIONS

During the first year of the war, defence at night was provided by special night fighter squadrons and patrols flown by flights of day fighter squadrons. When in the autumn of 1940 the use of the day fighters for night defence was abandoned, except for the employment of a few Hurricanes, special airfields in strategic positions were allotted the rôle of night flying stations housing only night fighter squadrons. This policy was followed until the later stages of the war when circumstances demanded the establishment of day and night fighter squadrons on certain night flying stations within the Command.

The immediate effect of having separate stations for night fighter squadrons was the simplification of the station organisation and administration. Night fighter squadrons consisted of two flights, each serving alternately two nights on and two nights off duty. Day readiness during overcast weather was usually provided by the flight not on duty at night. Routine readiness began before dusk and finished at dawn or earlier according to circumstances. One half of the maintenance flight remained on duty with the flight and was released when flying finished for the night. In consequence, apart from station headquarters staff, one half of the station personnel were on inverted hours of duty and were not on parade until midday, having slept from the time of release the night before until reporting for lunch. The organisation and administration of such a station had to be adapted to the operational needs and necessitated similar adaptation of the medical facilities and the safeguarding of special arrangements made for the maintenance of efficiency of aircrews.

The hours of duty of medical officers and their staffs had to be arranged to fit in with the requirements. The duties of medical officers on these stations were more arduous than on day fighter stations, the difficulty being not so much that of medical organisation and administration as the personal difficulty of obtaining sufficient sleep. Routine sick parades and normal station duties had to be carried out as on day fighter stations but the hours of duty at night were prolonged. It was only possible to go to bed at normal times at the expense of the most important duty of visiting and staying with aircrews in dispersals during flying. Usually, medical officers remained up until midnight and their time of going to bed depended upon the possibility of bomber diversions; they were frequently called in the small hours of the morning to stand by when aircraft were in difficulty, though more often than not there were no casualties from crash landings and other accidents. The stations most affected were situated in south-east England in No. 11 Group—Bradwell, West Malling, Manston, Ford and Tangmere.

There were other problems to be resolved on night flying stations which were not experienced on day stations. The solution of these

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problems was the responsibility of the executive staff, but because they affected the health and welfare of aircrews, medical officers were intimately associated with the difficulties. These arose over arranging suitable sleeping accommodation in such a way that those who were on night duty were assured of undisturbed sleep. The barrack accommodation did not always permit segregation of the shifts. It was possible to make fairly satisfactory arrangements for ground crews, but in the sergeants' messes it was more difficult, because it meant allocating the section of sleeping accommodation of the mess to night fighter ground and aircrews, a solution not always popular with senior N.C.Os. with many years' service. It was difficult to preserve monastic silence until midday. Conditions for officer aircrews were more favourable and on many stations separate messes were established in requisitioned houses and cooking facilities provided for meals which did not fit in with the normal station routine. It became customary, and then compulsory, for all officers to have their midday meal at the main mess. 'Night flying' suppers were provided in the most suitable and convenient location depending on the distance from dispersal to the officers' and sergeants' messes. If the distance was far, meals were cooked at dispersals in a cookhouse incorporated into the dispersal building. Meals for visiting bomber or other aircrews operating at night were arranged in the sergeants' or officers' messes at first. This policy gained a mixed reception because it meant splitting up a bomber crew on a strange station after an operational sortie, just when they probably benefited from their crew spirit and comradeship, particularly if the opposition encountered had been severe. In 1942 meals for visiting aircrews were provided in the airmen's mess for all ranks. This solution was not dictated by the stated preference of bomber crews or the psychological implications of such a change, but rather because increasing numbers of visiting aircrew, sometimes amounting to 300, had to be catered for at half an hour's notice and the facilities and organisation at the main airmen's messes were more suited to this task. Sleeping accommodation and facilities for ablutions had also to be arranged. In this respect the P.S.I. (President of the Service Institute) Committees and the Red Cross were of assistance in providing such necessary articles as shaving materials and other personal requisites, because it was not customary for bomber crews to carry small kit with them on operations.

The facilities for treating increasing numbers of injured aircrew at stations receiving crippled bomber aircraft were increased in 1942 by the conversion of sick quarters annexes into extra resuscitation and casualty reception wards. Several annexes in the Command were adapted for this use. Three-tier stretcher racks were manufactured locally on the station and installed in the annexes and arrangements were made to provide radiant heat to each stretcher rack. Oxygen was

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piped to each stretcher and fed to the patient through obsolete R.A.F. Class D, or B.L.B. oxygen masks. The source of oxygen was provided via high pressure piping from a bank of aircraft oxygen bottles. The advantage of using oxygen from such a supply was that these bottles could be easily recharged on stations, whereas the cylinders of oxygen normally supplied to station sick quarters could only be replaced after delay.

ACCOMMODATION

The problems of the routine maintenance of health of Service personnel had been overshadowed during the Battle of Britain by the more pressing demands of the actual fighting. Nowhere in the Command had the medical arrangements been inadequate and, apart from minor alterations in establishments, there was no need for any radical changes. However, new aspects of Service life requiring medical attention had arisen.

The immediate threat of invasion had passed but there was no guarantee that raids would not be renewed at a later date on a larger scale. The possibility of extensive damage to stations in future attacks led to a review of the planned and existing designs of airfield accommodation and resulted in 1941 in the official adoption of a policy of extensive dispersal of dormitory and servicing facilities on stations.

DISPERSAL ON STATIONS

Accommodation depended, as in other commands, on the amount of new construction which could be provided with the labour available. On nearly all the sector stations the pre-war expansion programmes had been completed by the end of 1939. Extra accommodation was also provided by reducing the floor area per man from 60 to 45 sq. ft. By the end of 1940 the pre-war expansion programme had been completed at all stations except Kettering, Digby and Wittering, but nowhere had it kept pace with the increasing Command strength. Personnel had often to be accommodated in huts of various kinds even before the sites upon which they stood were finished. Temporarily, therefore, living conditions were of a very low standard. The following extract from the Annual Hygiene Report of the Command for 1940 illustrates these points:

> Barrack huts were sited in isolated spots without water or drainage. They were comfortless and surrounded by mud. There was nowhere for the men to sit, except on beds, and personnel had to wear Wellington boots constantly, pending the completion of perimeter tracks and concrete paths. The huts were heated by one small iron stove which gave out no uniform warmth, and the men were inclined to crowd round it. The coal ration was, in spite of economy, insufficient to last out the week. Ablution facilities were limited. Drying rooms had yet to be provided and there were not sufficient recreation huts. The lighting was poor but was being improved.

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The damage which was inflicted on stations during the summer and autumn materially retarded the provision of new accommodation and made necessary a review of the whole building programme of the Command. A survey of all existing and projected accommodation was made in the late summer of 1940, and on October 21, with the results of enemy air attacks in mind, new proposals were circulated to all station commanders and superintending engineers with the suggestion that their application to existing stations should be considered.

It was proposed that the accommodation provided on main stations should be limited to technical accommodation for three squadrons, domestic accommodation for the personnel of station headquarters, one squadron and a proportion of the maintenance personnel of the squadrons located at satellite airfields, and the Army and Royal Air Force station guards. Stations with one satellite were to have domestic accommodation for two squadrons. The technical accommodation and the sleeping accommodation for the Army and Royal Air Force guards were to be sited on the airfield, and the remainder of the accommodation, including messing and ablution facilities for the guards, was to be dispersed in small groups nearby.

Sleeping accommodation on satellite airfields was to be dispersed in small groups irregularly sited outside and around the airfield. Each group was to house from 100 to 150 personnel, including accommodation for officers and non-commissioned officers. Messing facilities were to be centralised on the dispersed site nearest the airfield, and station sick quarters was to be placed off the airfield but in a position in which it could be reached easily in an emergency. W.A.A.F. accommodation was to be provided in a self-contained site off the airfield, or in a requisitioned house.

Water and waterborne conservancy was to be provided for the airfield, the central messing site and station sick quarters only. Ablution and bathing facilities were to be located centrally on the same site, but the dispersed sites were not to have a water supply or waterborne drainage unless these amenities were already easy of access. The W.A.A.F. site was to be fully provided with water and waterborne conservancy.

Satellite airfields were to be supplied by water-cart only and were to have no waterborne conservancy except at the main satellite messing and ablutions site. Electric lighting was to be provided on all sites on the parent station, but satellite airfields were not normally to be supplied with electric light, and, in any event, only after completion of the station.

These proposals anticipated the policy of general dispersal (*see* Chapter 1 for details) which was confirmed by Air Ministry for all operational commands on May 30, 1941, but before that date preliminary discussions had begun. The policy outlined by Fighter Command was substantially retained.

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The dispersal policy entailed much extra work for station medical officers because there were no amenities for keeping clean at the sites. Most sites eventually had piped water, and officers and non-commissioned officers heated washing water on the hut stoves, but the airmen had to use the communal site. The expansion of the Air Force required the simultaneous construction of many stations and their occupation before they were completed. Paths capable of withstanding the English climate were often one of the later constructions on sites, and until built the cleanliness of barrack huts was difficult to maintain.

The shortage of building material resulted in the erection of several different types of prefabricated hutting on all stations and the soundness of each type varied with its design and construction.*

There seems to be little doubt that the dispersal of stations was basically a sound preventive plan, but from an analysis of enemy air raids and the casualties sustained during these raids, it is clear that the dispersal began after the prime need for it had disappeared. During the later enemy bombing attacks the air defence of the country was so good that dispersal to the extent adopted became an unnecessary precaution.

The rapid recruitment of W.A.A.F., before the completion of the W.A.A.F. sites, made necessary further requisitioning of houses and the modification of some accommodation used previously by the R.A.F.

Sick quarters were dispersed as much as possible and new ones of standard pattern were built on many airfields, but without annexes, pending further decision on their provision. The building of new decontamination centres ceased with the construction of central ablution facilities, because the communal ablution blocks had been re-designed so that they could be used as decontamination centres if necessary.

Temporary overcrowding inevitably occurred during this expansion period, and the regulation 45 sq. ft. per person was infringed in many quarters if the number of beds and the floor space were correlated; in effect, however, the standard was maintained on nearly all stations, because personnel worked in watches and therefore not all the beds were occupied at the same time. Many of the newly constructed huts were put up without damp courses or guttering, and were in consequence difficult to keep dry. Conditions grew worse on stations at which drying rooms had not been provided up to establishment.

In 1942 cleanliness became a pressing hygienic necessity rather than a matter of daily routine. The floor area per man was reduced from 45 to 38 sq. ft. but overcrowding was not so apparent, except at a few

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* *See* Volume I, Chapter 7, Accommodation, Hygiene and Sanitation.

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No. 60 Group stations which were built in isolated districts where billeting had to be used pending the completion of sleeping sites.* All stations in the Command were more or less completed by the end of the year, except for expansion and construction in five, and modifications in another twenty-two, which were to be transferred to the U.S.A.A.F. Combined sick quarters were built on satellite stations for both R.A.F. and W.A.A.F. when the strength exceeded 700, or the satellite was more than five miles from the parent station. The construction of sick annexes to a modified pattern was also begun again in 1942.

In 1943 many organisational changes took place in the Command before the formation of the Allied Expeditionary Air Force in November. The personnel of exercise 'Spartan' formed the nucleus of No. 83 Group, and remained under canvas throughout the summer months. Accommodation in this period was not difficult, but when men had to be moved into winter quarters it was not easy to arrange, because of the shift south of an increasing number of men in preparation for the invasion the following year. The labour available even for maintenance work was curtailed, and temporary hutting began to show signs of deterioration. A further reduction in floor space per person, from 38 to 32 sq. ft., took place during the year and the increased substitution of W.A.A.F. for R.A.F. personnel necessitated modification of existing accommodation. The policy of having combined messing on the 'self-service' cafeteria principle simplified the dining hall and cookhouse arrangements, and in spite of the general shortage of labour, recreational facilities, particularly in the form of station cinemas or entertainment halls, were provided.

CASUALTIES IN RELATION TO DISPERSAL ON STATIONS

There is no doubt that the adoption of the policy of dispersal on stations caused many administrative problems although, in 1941, it was a wise insurance against the dislocation of operations during future attacks. It so happened, however, that there was never an opportunity to assess the merits of the policy because there were no enemy attacks in strength on stations during the rest of the war. From the purely medical aspect of casualties sustained on the ground during air attacks, the efficacy of dispersal was overshadowed by the many problems of hygiene and preventive medicine which arose.

This is illustrated in Fig. 2 on page 204 displaying the total number of casualties sustained by the forty Fighter Command stations in relation to the number of enemy attacks, irrespective of their strength. It will be seen that from June 1941 the number of enemy raids was small and that there were very few casualties.

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* *See* Chapter 11, No. 60 Group.

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Casualties were tabulated in groups: killed; severely injured; moderately injured; slightly injured; and casualties of unknown severity. Moderately injured casualties were considered to be those who, although not seriously injured, were sent to hospital because no facilities were available in the standard R.A.F. sick quarters for their continued treatment. The total casualties include those sustained by other Service and civilian personnel employed or stationed on airfields. The details had to be obtained from the daily sick books held at each station sick quarters because the normal casualty returns did not give any information on personnel other than those in the R.A.F., W.A.A.F. and Dominion forces. *Pro formae* (*see* Appendix) were sent to 100 stations in the Command which had been heavily attacked. The dates of all raids were obtained from records held in the Air Ministry War Room, Whitehall. The results of the *pro formae* were disappointing, because the records of some of the most heavily bombed stations had been destroyed, and in others there were discrepancies between the sources

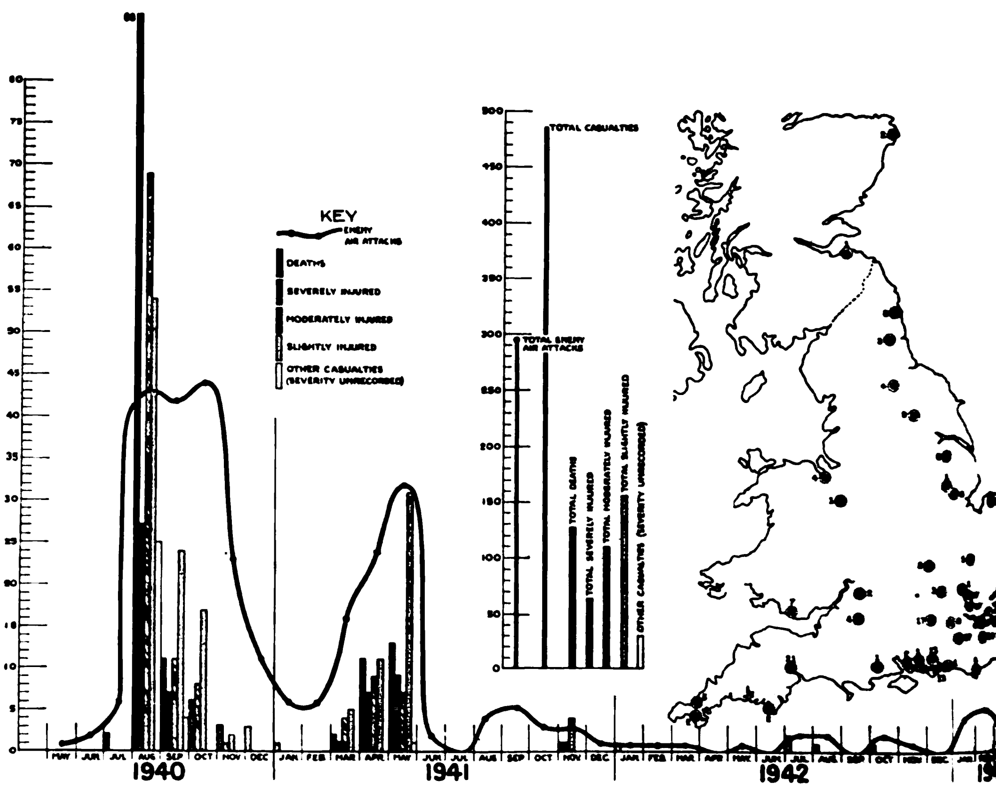

FIG. 2. Graph and Map showing casualties resulting from enemy air attacks on 40 Royal Air Force Stations in Fighter Command from May 1940—April 1943.

of information available. Records were complete from 40 stations and these were analysed and are presented diagrammatically (*see* Fig. 2). The numbers exposed to risk are unknown.

OPERATIONS ROOMS*

Fighter Command was responsible for the collection and distribution of information concerning the position and movements of any aircraft flying within the area covered by the defence system. This information was obtained from radar stations, observer corps posts and other sources, and was displayed on plotting boards in sector, group and Command operations rooms. These rooms formed part of operations blocks which contained the necessary equipment for the rapid collection, display and dissemination of information, and the control of operational aircraft.

There were three types of operations blocks in the Command: permanent underground blocks at Command and group headquarters; permanent above-ground blocks at some sector stations, and temporary blocks at other sector stations or wherever circumstances directed. Each block contained a central operations or plotting room and various adjoining or separate rooms housing the variety of equipment necessary for the collection and display of information, the control of aircraft, and the ventilation and lighting of the building. The complexity of the equipment increased with the size and importance of the operations block and necessitated an establishment consisting of plotters, control and liaison officers, telephone and teleprinter operators, radar and wireless mechanics, engineers, clerks and police. The conditions under which these personnel worked gave rise to several medical problems because work had to be carried out in artificial lighting, in shifts, and in an artificially ventilated atmosphere.

The efficiency of the defence of the country depended upon the full working of all the operations blocks at sectors, groups and Command before war was declared. This had been attempted but not achieved, but the lapse of time between the beginning of the war and the Battle of France enabled most of the system to function even if incomplete. The race against time was one of the factors contributing to the unsatisfactory conditions found in some operations blocks. The most important factor, however, was that there had been too little co-operation between the Works and Medical Directorates before the war. Certain requirements, particularly with regard to ventilation, were overlooked and most of the representations made by both senior and junior medical officers for improving the working conditions could not be followed up, because the changes recommended were too fundamental

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* *See* also Chapter 11 (No. 60 Group).

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to be put into effect in war-time. The increase in technical knowledge, the use of new apparatus and the necessary addition to establishments arising directly from this meant placing more and more personnel into operations blocks, so that without major modification the existing ventilation plants became inadequate to maintain the original standards laid down.

VENTILATION OF UNDERGROUND OPERATIONS BLOCKS

The average ventilation plant consisted of two supply fans, one for normal ventilation and the other for gas filtration; motors; steel trunking with inlet and exhaust grilles; thermostatically controlled air heaters; gas filters; and an extractor fan and motor. The main air inlet to the building was sited approximately ten feet above the ground and air was drawn down to the plant room by the supply fan. After being warmed the air was blown under pressure into the various rooms by air ducts. The vitiated air was extracted through a separate system of ducts and grilles, which were placed at opposite locations in the rooms to the inlet grilles and returned by suction to the plant room by the extractor fan which forced it under pressure to the external atmosphere above ground level.

At some places, for instance at Newcastle, it had been found advisable to incorporate a dry filter in the circuit to cleanse the air, but experience gained from such installations showed that it was necessary to include these filters only in environments in which the air contained large particles of dirt. The average commercial filter had an efficiency of 55 per cent. and was therefore useless for the exclusion of smoke or fog, but it was thought that in foggy weather, provided that the temperature inside the operations block was kept at a high level, the only indication of such outside conditions would be found in the immediate vicinity of the inlet grilles and that any tendency for fog to form inside the building would be eliminated by the temperature of the internal air.

In most plant rooms, for instance at Newcastle, Hucknall and Bentley Priory, only one fan chamber was needed because the supply room was fully protected, but at Uxbridge two plant chambers were provided and one ventilation plant acted as a stand-by to the other, one being served by an alternative source of power.

It was thought that the air of underground buildings had a sufficiently high humidity and that a humidifying apparatus was not necessary. The installation of any such apparatus was also thought inadvisable because excessively high humidities might affect the electrical and signalling equipment.

The air passing through operations buildings was entirely fresh, recirculation being thought hygienically undesirable. Experiments on the recirculation of air had been carried out by leading authorities and

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it had been found that difficulty was experienced in keeping the air free from the exhalations of the occupants. It was also thought inadvisable to economise by recirculation because some of the technical apparatus emitted much heat. It was considered preferable to supply 30 to 40 cu. ft. of air per minute per person and retain a fresher atmosphere, rather than to install a recirculation plant which would probably require a refrigerating apparatus.

OPERATIONS BLOCKS ABOVE GROUND

The system of air circulation in these buildings was similar to that used in the underground structure except that an internal combustion engine was linked to the plant for stand-by purposes. The gas filters in this branch had a limited life. Experiments were made at Debden to prolong their effectiveness by reducing the air flow through them should a high concentration of gas be present in the neighbourhood of the air intake. However, the increase in filtration efficiency obtained was offset by the drowsiness of personnel which resulted from lack of fresh air and the rendering of the building permeable to gas because of a reduced internal air pressure.

Inquiries were made as early as November 1939 about the ventilation of operations rooms. In reply the P.M.O. stated that he considered the ventilation was not satisfactory in any of the three types of operations blocks in use. The headquarters underground blocks and the sector above-ground blocks had no system of air-conditioning but only a forced draught system of ventilation. Alterations had been necessary in the underground blocks because the siting of some of the outlet vents was unsatisfactory and areas of air stagnation were present. Air-conditioning was thought to be essential. In the temporary operations rooms no systems of ventilation had as yet been provided, although the buildings were gas-proofed and in consequence could not be ventilated by natural means.

These purely medical criticisms were replied to by the Directorate of Works on November 16, 1939, in an exhaustive report. It was emphasised that in the designing of operations blocks many factors had to be taken into account, such as heat loss and heat dissipation, protection against gas, the number of persons working underground, the accommodation of the ventilation plants and their stand-by machinery, and the satisfactory arrangement of air ducts so that they would not interfere with electrical and radio apparatus, cables or other technical equipment. The avoidance of noise and air pollution had also to be considered. While certain refinements could have been incorporated into the design, they were not thought to be essential for the efficient functioning of these particular buildings. However, certain modifications were included

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in designs at particular stations where circumstances merited such differences.

The amount of fresh air allocated was determined by the volume of air introduced per minute per person. On the average this worked out at between 30 and 40 cu. ft. of air per minute per person, or three changes of air per hour, the standard adopted at the Porton conference in 1937. The figure of 30 cu. ft. of air per minute per person was considerably higher than that laid down for German air-raid shelters, where the air was circulated at a rate of one cu. ft. per minute per person. The standard for Home Office A.R.P. shelters was 2½ cu. ft. and the L.C.C. standard for new cinemas or theatres was 16 cu. ft. per minute per person. In referring to examples at specific stations it was estimated that at No. 11 Group, Uxbridge, the rate of flow was 2,100 cu. ft. per minute for 60 persons. At Debden the rate was 35 cu. ft. per head for 40 persons and at Bentley Priory 40 cu. ft. per head for 125 persons.

The many problems which arose in operational buildings were investigated by Air Ministry and visits were made to operations blocks to obtain first hand information. At Uxbridge there was overcrowding, but the air seemed fresh. The temperature was 65° F. but there were no baffles over the air vents. Here, as in the other blocks, most of the complaints arose from the necessity for using the buildings before they were completed. However, the employment of women added to these difficulties, because no provision had been made for separate rest rooms or lavatories. The installation of extra lavatories would have required pumping machinery to raise the sewage from deep underground to sewer level, and, because major modifications to the existing structure would be essential to carry out such work, buckets and other receptacles were used as an improvised measure. For similar reasons the addition of rest rooms could not be made except at the expense of the rooms already in use.

The rate of flow of air at Uxbridge when visited was 1,000 cu. ft.—equivalent to the L.C.C. standard for cinemas and other places of entertainment. Whether such a standard was compatible with efficient continuous work had not been proved, but there was no doubt that the reduction of the rate of flow of air from between 30 and 40 cu. ft. per person per minute to about 17 cu. ft. per person per minute gave rise to many subjective complaints, until the whole issue was clouded by the accumulated prejudice of all those who had to work underground. A large psychological element was added by the prejudice transmitted to newcomers by those who had worked underground for some time, and it was maintained by the constant unfavourable talk and comment of officers in front of other members of the establishment.

The operations block at Uxbridge was completed in mid-December 1939, and it was hoped that the Fighter Command block at Bentley

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Priory would be finished in January 1940 and those at Hucknall, Newcastle and Walters Ash during that month. The above-ground operations rooms at Debden, Church Fenton, Tangmere and Wittering had been completed; several others were under construction and were to be brought into use as the stations were occupied.

A further visit was made to Bentley Priory on May 1, 1940, when ventilation and temperature were found to be within reasonable limits. However, personnel who worked in the underground rooms still complained of an increase in temperature. It was considered that this increase was due to three factors—the rise in temperature caused by the heat emission from the overhead lighting; the number of occupants, which was greater than that for which the building was designed; and the low ceiling and large floor area occupied by furniture and other fixtures which interfered with the flow of air.

As an example it was quoted that the original design for the filter room showed one compartment in which twenty-five to thirty-five persons at a maximum were supposed to work, whereas an intermediate mezzanine floor had been provided, giving a compartment with head-room of only 7 ft. 3 in. into which fifty-four people were placed. The modifications found necessary had been decided upon during the building of the blocks, too late for the ventilation and heating plants to be altered, and although adjustments were made to reduce the temperature in the filter room it was still rather high. It was inadvisable to reduce the air temperature by adjusting the thermostatic electric heaters, because the cooler air would then drop by its own density from the high level inlet grilles on to the heads of persons working below them and cause serious draughts, which would be far more objectionable than a raised temperature, but the air movement through the lower and upper filter rooms was increased and the cooler air from the surrounding corridors utilised. Two more powerful fans were installed and the existing fans were disconnected, although they were capable of being recoupled and used as stand-by fans in an emergency.

It was expected that the temperature inside the buildings would rise in the summer months, but that it would not be too high. This forecast was based on the observation that when the outside temperature rose from 47° F. in the morning to 74° F. during the day, the underground temperature did not rise by more than 2° F. The problem of maintaining suitable working conditions became more difficult as the establishments of the operations blocks were increased and more technical equipment was installed.

An independent medical authority was called in by the Director-General of Medical Services in June 1940 because a second opinion was thought desirable. A visit was made to Bentley Priory on June 26, where the conditions were found to be satisfactory, but it must be borne in

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mind that on the day of the visit the air flow had been increased by 25 per cent. At Uxbridge the installation of *punkahs* was recommended, and it was emphasised that the exit grilles should not be obstructed by furniture or other equipment and that the partitioning of rooms should be vigorously resisted. As many more persons were working underground than was estimated in the original plans, it was hoped that further increases in staff would not occur, and recommended that if some reduction was possible, it should be put into effect.

The Directorate of Works was in agreement over the partitioning of rooms but was not favourably inclined to the introduction of *punkahs*, because in their opinion they would agitate the designed air flow and decrease rather than increase the rate of ventilation.

The reports of these visits, with other reports which had been received from time to time, made the true assessment of conditions in operations blocks very difficult, because there were no standard conditions for comparison, all the visits on which the reports were made having taken place at different times of the year under diverse outside humidities and temperatures. In order to correlate the available information a special meeting was held at Air Ministry on July 10, 1940, and was attended by an expert from the London School of Hygiene and Tropical Medicine.

The ventilation of operations blocks in the event of gas attack was discussed and it was agreed that it was desirable to lower the relative humidity if the air flow was reduced to obtain the maximum filter efficiency. In normal circumstances it appeared from the humidity readings, charted at Fighter Command between May 4 and May 24, 1939, that the working conditions were satisfactory, although on certain days during the year the humidity might rise excessively. However, it was not possible to install a humidifying and de-humidifying apparatus because of lack of space. It was thought that the conditions, provided that the air underground was satisfactory before a gas attack, would be tolerable with a reduced air flow even if they would not be conducive to efficient work at the end of a three hour period.

The high temperature and humidity in certain rooms under normal conditions were due to several causes. There had been an increase in the number of persons in the various rooms above that for which they were designed, without the installation of any additional ventilation plant. In certain rooms local alterations to their structure had interfered with the air flow; for instance, at Uxbridge one room had been partitioned so that the air inlet was in one compartment and the exit in another. In addition, the slats over the inlet and exit vents had been altered by personnel on different shifts, so that the optimum settings of the grilles had been changed. It was recommended that the groups concerned should survey their operations rooms establishments, reduce

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them if possible, and that each room should be labelled with the number of occupants compatible with the air flow. It was also recommended that no alterations to the buildings should be made without reference to the heating and ventilation departments in the Directorate of Works, and special emphasis was given to the avoidance of partitioning and the alteration of grille settings. Humidity and temperature readings were to be taken at four pre-determined times each day, so that the efficiency of the ventilation system could be checked. Letters were sent, containing these recommendations, to the various commands by the Air Council, and every effort was made to improve conditions generally. Improvements were made by the installation of larger fans and by increasing the air flow as the numbers underground increased. Unfortunately, it was not possible to reduce the establishments, and in fact there were many operational reasons why they should be increased. At Uxbridge, where the most intensive work was done, it became necessary to increase the numbers from 60 in 1939 to 156 by 1942.

The problem of maintaining a satisfactory atmosphere in which to work underground was only one of many. Difficulties arose at different times over the illumination and associated visual factors, and the loss of man hours caused by upper respiratory infections in persons working in artificial conditions.

The type of lighting* varied between operations blocks in different groups: some had yellow lighting and others banks of daylight fluorescent lighting. The yellow lighting was the more favoured of the two because, although the fluorescent lighting gave an even illumination, many personnel disliked it and made complaints of glare because the fluorescent tubes were unshielded. Eventually, however, fluorescent lighting was installed in all operations rooms and shields were available for all lights if they caused glare.

Complaints were received from Debden in May 1940 where the controllers, although satisfied with the working conditions, found the illumination of the operations room unsatisfactory. It transpired that some of the equipment had been altered and the placing of tables and boards changed so that the lighting was no longer suitable. Readjustment improved the illumination but made the layout of the room less satisfactory from an operational standpoint.

It became impossible, as Fighter Command increased in size and the scope of operations broadened, to display all the desired information on a single plotting board, and a further display system, operated from the back and called the 'tote', was installed on a framework wall behind the plotting table about 3 ft. away from the back wall. The state of readiness and availability of squadrons were displayed on the 'tote' by numerals

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* *See* Chapter 11 (No. 60 Group).

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and letters of various sizes and colours. This further partitioning of the main operations rooms did not improve the ventilation, while working conditions behind the 'tote' were extremely unsatisfactory and accessory electric fans were installed as a palliative measure. In front of the 'tote' controllers had difficulty in reading the information displayed, and were in the habit of using binoculars with a ×2 magnification. The first proposals for an investigation by an expert ophthalmologist came from No. 12 Group, and ocular examinations of all operations rooms workers were carried out at the same time. Minor alterations were recommended, such as the use of black on white instead of red on white for the numerals and letters on the 'tote', with an increase of a third of an inch between adjacent letters or numerals. Refraction tests carried out on personnel gave similar findings to those obtained in a similar investigation among radar operators in No. 60 Group in which no objective cause for complaints could be found. While these tests were in progress it was recommended that colours restful to the eyes should be used on the walls of the rooms, neutral colours, preferably shades of *eau de nil*, being considered the most suitable.

DROPLET INFECTION

Medical officers noticed that upper respiratory infection spread with rapidity underground and it became preferable to remove infective personnel for a few days, even if fit to work in their speciality, because it saved man hours in the long run. The bacterial content and the possibility of disinfecting the air were assessed by the Shenley Military Laboratory. Numerous petri dish counts and air culture counts, using standard techniques, were carried out for various parts of the buildings under normal conditions. The investigation showed that the average count of organisms per dish was 31·9 and that there were 4·2 organisms per litre of air. Disinfection by Aerosol fluids was attempted in a concentration of one part in twenty million without any appreciable difference in the bacterial content. It was estimated that an effective concentration of about one part in five million would be necessary but that it was an impracticable proposition because the cost would be between £4,000 and £5,000 per year, and after consideration the use of Aerosol was not recommended.

DIEPPE

The introduction of 'sweeps' in the spring of 1941 was the beginning of the change-over to the offensive. At first, the numbers of aircraft employed were small, but, when it became policy to wear down the fighter strength of the German Air Force, larger formations were used until several wings were flying at the same time on main and diversionary sweeps. The scale of the offensive was increased in the autumn of 1942 by daylight bombing carried out by squadrons of No. 2 Group. The

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history of the Command during this period followed an ascending curve of effort up to the invasion of Normandy, broken only in one place, August 16, 1942, by the reconnaissance in force at Dieppe. The medical history of the Command, except for this operation, was uneventful because the offensive fighting occurred over areas of the Channel or the enemy occupied coast of Europe within the range of contemporary fighter aircraft.

Air support for the Dieppe reconnaissance was provided by 45 Spitfire, 6 Hurricane, 1 Hurri-Bomber, 4 Mustang and 2 Blenheim squadrons and 1 mixed Lysander and Defiant squadron. Operations began at dawn on August 16 and continued for thirty-six hours. The total number of sorties flown by the 1,087 pilots engaged was 2,365, an average of 2·2 sorties per pilot. Three hundred and thirteen flew a single sortie, 408 two, 229 three, 136 four, and 1 five sorties. Casualties amounted to 51 pilots lost and 13 wounded. Twenty pilots were recovered from the sea, but three of the five air sea rescue* launches were lost in attempting rescues close to the enemy coast.

MEDICAL ARRANGEMENTS

The operation entailed the concentration of squadrons at airfields in No. 11 Group, most of which had a normal station establishment of between 1,000 and 1,500 personnel. Several days before the attack was due to begin stores were moved in and squadrons began to arrive. The operation was postponed for a few days and the visiting squadrons returned to their home airfields, only to be reconcentrated when the new date for the attack had been decided. This unforeseen 'practice mobilisation' of forces enabled improvements to be made in the general organisation of the operation and in the feeding and accommodation of personnel. As the operation was to be of short duration, no elaborate medical plans were made. Existing facilities were used and the men fed in shifts. Extra latrines were provided in tent lines but no other special measures were thought necessary. The postponement of the operation resulted in troops using temporary accommodation, feeding and washing facilities for a longer period than had been planned, with the result that some of the measures taken, which would have been satisfactory for a shorter stay, became a source of anxiety to station medical officers because of their improvised nature.

The supervision of the medical arrangements was the responsibility of the S.M.O. of No. 11 Group. Station medical officers of the host airfields had prepared for counter-attacks by providing new first-aid posts, by the installation of Flint stretcher gear in transport and by a wider distribution of medical supplies. Plans were also made for the

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* *See* 'Air Sea Rescue', Volume 1, Chapter 11.

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manning of these new first-aid posts by other medical officers of the host stations, but many of these officers were attached temporarily to fill vacancies left by squadron medical officers who accompanied their squadrons to the south coast. The degree of co-operation and assistance which visiting medical officers could provide was problematical because they could not be expected to acquire in so short a time knowledge of the local background of the stations to which they came. Nevertheless, they proved so useful that the station medical officer had no extra commitments after the arrangements had been explained. However, if counter-attacks had materialised, their unfamiliarity with the local arrangements would have thrown an extra unnecessary burden upon the station medical officer and complicated, in the event of the visiting medical officer's death or injury, the medical supervision of the station from which he had been detached. It was also demonstrated during the operation that, although visiting squadrons obtained much comfort from being accompanied by their own medical officers, there resulted a gross wastage of medical man-power. Often between five and seven squadrons, each with a medical officer, were located on the same station with the result that such stations had between six and nine medical officers when three or four would have been ample. No counter-attacks were made, however, and the operation was uneventful from a medical aspect.

VARIATION OF CASUALTY RATES WITH OPERATIONAL EXPERIENCE

Flying personnel were selected according to their aptitude and personality for the tasks for which they seemed most suited. As a whole, they had the same basic qualities, which were modified by their training and the operational duties of the commands to which they were posted. The tradition and history of the various squadrons in which they served stamped them further with certain characteristics, which to the trained eye were common among men doing the same duties. The differences of types of duty, age, stress and other variations between day fighter, night fighter and intruder aircrews are summarised in the tables on pages 215 and 216.

Station and squadron medical officers had to be aware of the difference in mental outlook between fighter, night fighter and intruder aircrews to understand the subtleties of their behaviour and to differentiate between the normal and the abnormal. Such medical officers of operational stations, with certain other specialist flying medical officers (i.e. F.P.M.Os.), were the only men in the medical branch who obtained first-hand knowledge of the stresses to which aircrews were subjected in the war, and of their relation to each individual's capacity for completing successfully the tour of operational duty. The very close association between squadron medical officers and members of their squadrons

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	Day fighter	Night fighter	Night fighter (intruder)
Scramble .	Sudden. Times of take-off known a few hours in advance when flying sweeps	Definite roster except during large enemy raids	Depended upon reports of enemy activity on Continent. Destination and time of take-off unknown except for routine patrols
Hazard .	All normal hazards of day combat	Greatest hazard weather because enemy often operated in conditions which grounded all other home aircraft	All dangers of operating singly over enemy territory in face of efficient night defence. Weaving necessary all the time. Greatest danger was flying unintentionally over well defended airfields
Stress .	Moderate to considerable, but depended upon scale of effort and resistance encountered	Little apart from flying in bad weather	Considerable
Sleep .	Normal hours with stand-to at dawn and dusk as necessary	Inverted hours when on duty	Inverted hours when on duty
Age . .	Young men in late 'teens and early 20's. Exuberant and aggressive	Much older than day fighter pilots. Observers often 10 years older than pilots. Operations more leisurely and behaviour more mature	Mixed ages. Squadrons often contained several men with hundreds of hours' instructional or other non-operational experience
Married state .	Few married	Several married with families	Several married with families
Living out .	Not allowed	Allowed if did not interfere with duties	Not allowed

was of the utmost benefit to both, and many medical officers were able to gain most valuable experience in these junior posts.

The maintenance of health and efficiency among flying personnel depended upon the understanding of their duties and their life on stations by both executive and medical authorities. The effectiveness of the liaison between medical and commanding officers is demonstrated in the results of an investigation by the Operational Research Section of the Command which in 1943 calculated the variations in casualty rates among Spitfire and Typhoon squadrons for the year 1942.

The object of the investigation was to discover how the casualty rates of certain day fighter pilots varied with their operational experience. The records examined covered most British and Dominion pilots flying with Fighter Command in 1942, when a period of 200 flying hours constituted a normal tour of duty, although there were many individual variations on each side of this figure. At the beginning of 1942 there were 730 British and Dominion pilots on the strength of the 33 squadrons (30 Spitfire and 3 Typhoon) in the Command and during the year a further 1,203 pilots were posted to them to begin their first operational

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	Day fighter	Night fighter	Night fighter (intruder)
Aircraft .	Gladiator, Hurricane, Spitfire, Typhoon	Blenheim, Defiant, Havoc, Mosquito	Hurricane, Havoc, Mosquito
Type of operation	Defence by attack up to 1941 sweeps	Defensive	Offensive
Territory .	Great Britain and approaches and enemy territory within range	Confined to specified areas. Not allowed over enemy coastline	Vicinity of airfields in enemy territory
Number of aircraft .	Formation of various sizes	Singly	Singly
Length of sortie .	Average of 50 minutes in 1940. As range of aircraft increased, length of sortie increased as well	Average of 2 hours in 1940. Average of 3 hours in 1943	Depended upon range of aircraft, varied from 2 to 6 hours. Average usually 3–4 hours
Control .	Controlled by flight, squadron and wing commanders under direction of control officers at operations rooms	Under G.C.I. control until contact made, then A.I. used	'Free lance' over airfields in certain areas until 1942–3
Readiness .	According to emergency. From 1941 readiness by one flight at a time in normal circumstances. One release day a week	Roster. 48 hours on and 48 hours off except in emergencies	Roster. 48 hours on, 48 hours off except in emergencies
Altitude of operations	Increased during Battle of Britain but seldom over 30,000 ft. Newer aircraft with pressure cabins raised altitude up to 45,000 ft.	Restricted to flying about 3,000 ft. up to ceiling of aircraft used because of ground echoes on A.I. sets. Later sets more satisfactory but no radar altimeters employed	Seldom operated above 4,000 ft. and usually between 2,000–3,000 ft. near enemy airfields

tour. The investigation covered these 1,933 pilots, of whom 279 became casualties, i.e. killed, missing or prisoner-of-war; 1,037 were posted abroad or transferred to non-operational duties and 617 were still attached to squadrons on December 31, 1942.

The number of defensive sorties flown by the pilots concerned in 1942 was 35,724. There were 25 casualties, giving a rate of 0·7 per thousand defensive sorties. Of these 25 casualties, 11 occurred in battle and 14 in flying accidents. Average rates, therefore, at which flying battle casualties and flying accidents occurred per thousand defensive sorties were 0·3 and 0·4 respectively.

It was estimated that the 1,933 pilots completed 17,715 offensive sorties during the year. The total number of casualties was 279, giving a rate from all causes of 15·7 per thousand offensive sorties. The table at the top of page 217 gives the sub-division of this rate into different types of casualty.

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Type of casualty	Number of casualties	Average casualty rate per 1,000 offensive sorties
Battle casualty—offensive sortie	169	9·5
Fatal accident—offensive sortie	18	1·0
Battle casualty—defensive sortie	11	0·6
Fatal accident—defensive sortie	14	0·8
Fatal accident—non-operational flight	67	3·8
	279	15·7

The total number of sorties (both defensive and offensive) flown during the year was 53,439. The average casualty rate per thousand sorties is shown below:

Description of casualties	Number of casualties	Average casualty rate per 1,000 offensive and defensive sorties
Battle casualty—operational sortie	180	3·4
Fatal accident—operational sortie	32	0·6
Fatal accident—non-operational flight	67	1·2
	279	5·2

It was found that the casualty rate fell rapidly during the first five sorties and then remained almost constant.* From about the 9th sortie, curve 'C' has a slight downward slope while curves 'A' and 'B' remain horizontal for all practical purposes. The reason for this difference is the incidence of accidental casualties on non-operational flights over this part of the tour because relatively more of these casualties occurred then than during the latter part.

The initial fall in curve 'C' is much greater than in curves 'A' and 'B'. This again is due to accidental casualties on non-operational sorties. There were 67 of these casualties, of which 13, or 19 per cent., occurred with pilots who had not done any offensive operations and 54, or 81 per cent., with pilots who had done less than 10 offensive sorties. The effect has been that curve 'C' begins at a rate which is very much higher than that of either of curves 'A' or 'B' but falls to a rate which is not very much greater than the limit rate in curve 'A'.

Throughout, the curve 'A' is slightly above curve 'B'. This feature is unexceptional because the 18 accidental casualties which occurred on offensive sorties were distributed fairly uniformly throughout the tour. The almost constant rates in all curves after the ninth sortie demonstrate that the policy of relieving pilots from operational flying duties either

* *See* Fig. 3 on following page.

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on medical grounds or for other reasons was being administered satisfactorily. If the medical and executive authorities had not been relieving flying personnel from operational duty at the end of a tour or because they required a rest the casualty rates would have risen.

The various casualty rates are displayed in the graph below:

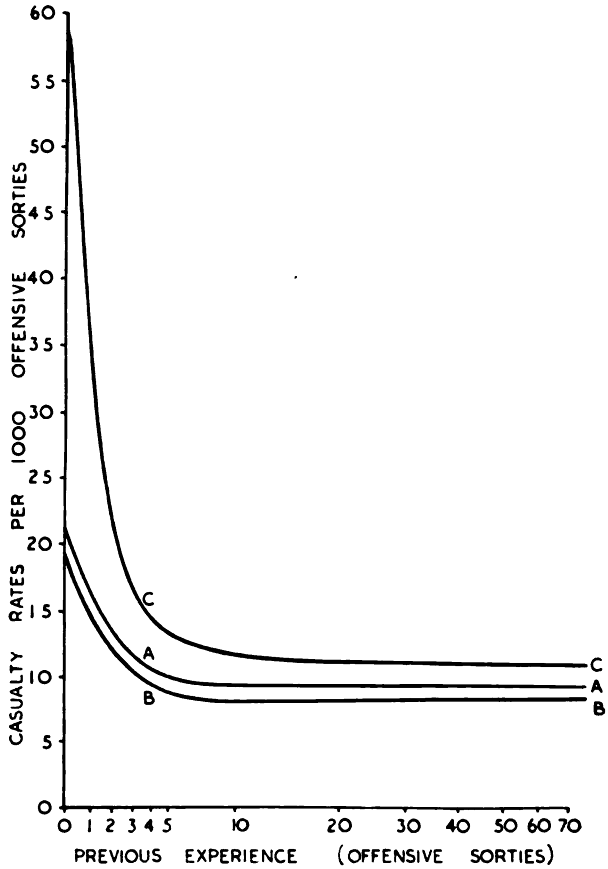

FIG. 3. Variation of Casualty Rates with the Number of Sorties Flown of Spitfire and Typhoon Pilots serving with Fighter Command in 1942.

A = Casualties on Offensive Operations.
B = Battle Casualties.
C = Casualties from all causes.*

* Includes casualties on non-operational flights.

The sharp fall in the curve 'C' has been explained, but the falls in curves 'A' and 'B' could not be explained by the data examined. Two hypotheses were advanced to explain this fall: one suggested that during the first few offensive sorties pilots were inexperienced, nervous, or emotionally keyed up and this resulted in a heavier casualty rate than the subsequent rate when pilots had become more experienced, the

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other suggested that a small proportion of pilots leaving operational training units were subjected to a heavier casualty rate on all offensive sorties than others. Subsequent investigations carried out by the Flying Personnel Research Committee demonstrated that there was a higher casualty rate among a proportion of pilots because they were more 'accident prone'.

Pilots spent four to six weeks on joining their squadrons on non-operational flying and then defensive flying before undertaking their first offensive sortie. During this period 33 per cent.—i.e. 34 out of 99—of the fatal accidents occurred. The amount of non-operational flying decreased as the tour progressed, while the ratio of offensive to defensive flying increased. On the average, 30 per cent. of the pilot's first 50 operational sorties, 40 per cent. of his next 50, and 50 per cent. of his subsequent sorties were on offensive duties. The casualty rate on defensive sorties was consistently low, being about one fifteenth of the offensive casualty rate, and in consequence the composite rate for all operational sorties tended to rise.

HEALTH OF THE COMMAND

STRENGTHS OF R.A.F. AND DOMINION PERSONNEL

On September 29, 1939, the R.A.F. strength of the Command was 21,648. The Command doubled in size before the end of August 1940 and within two and a half years had increased in size no less than 5½ times, attaining at the end of February 1942 a figure of 124,786. The reorganisation of the Command during 1943, with the disbandment of Army Co-operation Command and the formation of the 2nd Tactical Air Force, reduced the strength to below 120,000 by the beginning of 1943, from which date it declined with the building up of the 2nd Tactical Air Force as a separate formation, and later with the formation of the Allied Expeditionary Air Force and the inclusion of the residual command personnel into the Air Defence of Great Britain.

W.A.A.F. PERSONNEL

The W.A.A.F. strength of the Command did not increase as rapidly as the R.A.F. and Dominion strength, because the substitution of airmen by airwomen was not great before the middle of 1941. The total W.A.A.F. strength at the outbreak of war was just under 1,000. A year later the strength was under 5,000, while from September 1941 to September 1942 it rose from 11,318 to nearly 28,000. The maximum strength was attained at the end of July 1943 with the figure of 47,849.

The total strength of the Command was therefore about 22,000 at the outbreak of war, and the maximum strength 172,600 on June 25, 1943. The decrease in R.A.F. and Dominion strengths was offset by the increasing W.A.A.F. substitution. In November 1943, when the A.E.A.F. was formed, the total strength was about 124,000.

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SICK INCIDENCE

The general sick incidence of the Command is presented in three graphs on the following pages and has been divided into sick incidence among R.A.F. and Dominion personnel, and among W.A.A.F. personnel. The rates per 1,000 p.a. for deaths, injuries and venereal disease among R.A.F. and Dominion personnel have been plotted on a separate graph, but no such display has been produced for the W.A.A.F. in the Command, because the rates per 1,000 p.a. in the first two years of the war for such disabilities do not bear fair comparison owing to the low strengths: for instance, there was only one case of venereal disease among the W.A.A.F. for the first nine months of the war, which, if expressed as a ratio per 1,000 p.a., gives a figure of 5·6.

The sick incidence has been divided into the incidence of total disabilities excluding 48-hour cases, and 48-hour cases. The section 'Total Disabilities' includes deaths, all injuries and other forms of sickness for which patients were admitted for a longer period than 48 hours, venereal, and notifiable diseases. The rates per 1,000 p.a. of all notifiable diseases are shown in a finer line at the base of the graph to display any epidemics rather than definite rates. On the sick incidence graph for W.A.A.F. personnel a similar line is included, but has been broken because the ratio of the graph does not allow for any continuous presentation of the rates throughout the years under analysis, and therefore no rates below 20 per 1,000 p.a. are shown.

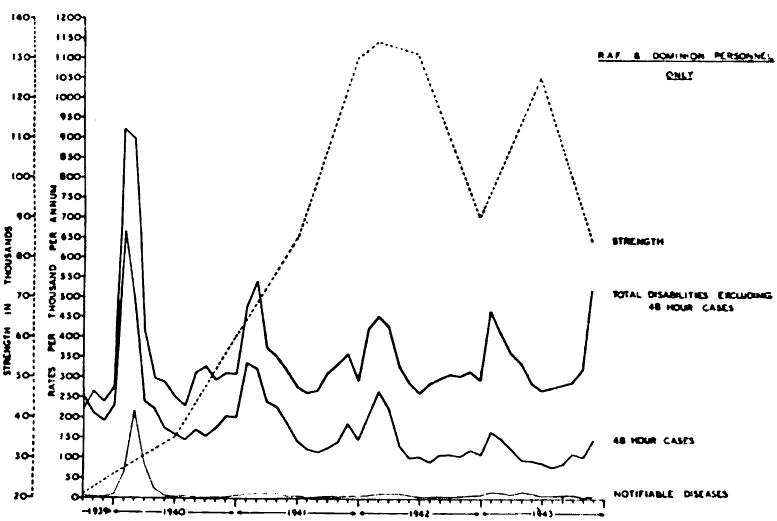

FIG. 4. Graph showing total disabilities—R.A.F. and Dominion Personnel, Fighter Command.

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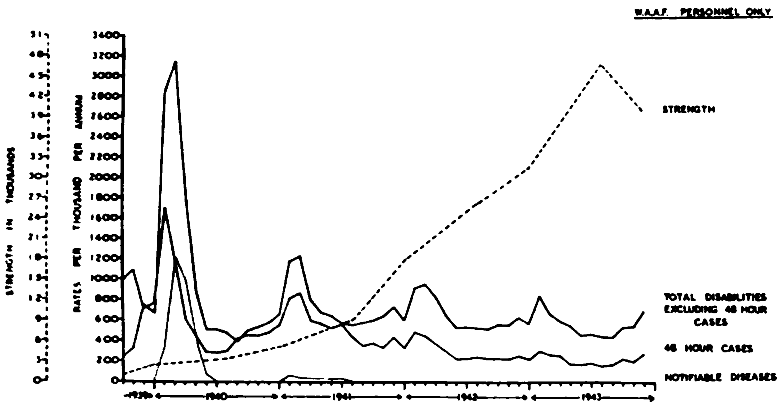

FIG. 5. Graph showing total disabilities—W.A.A.F. Personnel, Fighter Command.

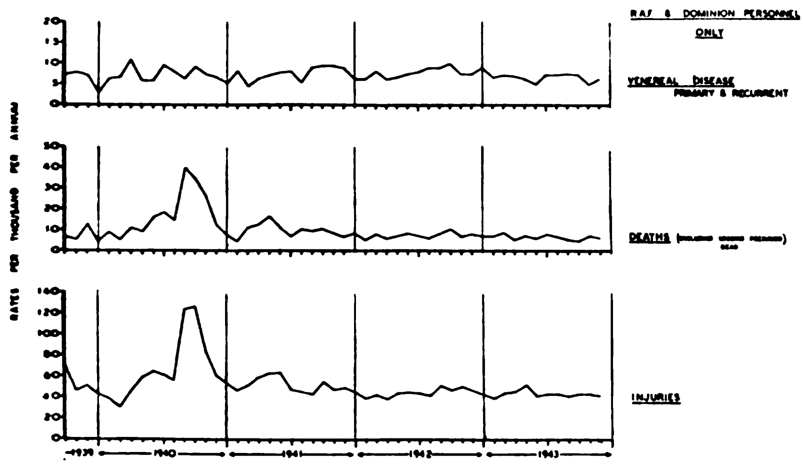

FIG. 6. Graph showing deaths and incidence of injuries and venereal disease among R.A.F. and Dominion Personnel.

TOTAL DISABILITIES

It will be observed from the graphs that among all personnel there was a seasonal increase of disease each winter and spring, but that in the first winter of the war there was more sickness than in any other. Incidence of total disabilities, excluding 48-hour cases, among R.A.F. and Dominion personnel rose to 921·3 per 1,000 p.a. in January 1940, and at the same time the incidence of 48-hour cases rose to 667·7 per 1,000 p.a. In the following winters the incidence of total disabilities, excluding 48-hour cases, did not rise above 541·5 or fall below 450 per 1,000 p.a. However, the maximum incidence of 48-hour cases fell gradually each winter from 336 per 1,000 p.a. in January 1941 to 265 per 1,000 p.a. in January 1942, and 148 per 1,000 p.a. in January 1943.

The sick incidence among W.A.A.F. personnel followed the same general pattern, but at a much higher level. The incidence of total disabilities, excluding 48-hour cases, was as high as 3,150 per 1,000 p.a. in the winter of 1939–40, and the maximum incidence of 48-hour cases was 1,714 per 1,000 p.a., but this figure was reached a month before the maximum incidence of total disabilities excluding 48-hour cases. In later winters there was a gradual decline in the sick incidence among both categories, the maximum rate per 1,000 p.a. of total disabilities, excluding 48-hour cases, being 1,232 in the winter of 1940, 952 in the winter of 1941 and 838 in the winter of 1942. The rates per 1,000 p.a. of 48-hour cases were 867 in February 1941, 483 in January 1942, and 300 in January 1943.

These declines in overall sickness occurred despite the tremendous expansion rate, the increase in strength of all stations and the gradual reduction of floor space per person from 45 sq. ft. to 32 sq. ft. In September 1939 the incidence of 48-hour cases was less than the incidence of total disabilities excluding 48-hour cases among all personnel, but particularly among the W.A.A.F.

Apart from small localised outbreaks of various notifiable diseases there were no epidemics.

DROPLET INFECTION

The winter of 1939 was severe, with temperatures well below normal for that time of year. Upper respiratory infection began to spread through the civilian population and an epidemic of rubella occurred at the same time. Service personnel, many of whom were as yet unaccustomed to community life and living under conditions which were favourable for the spread of droplet infection, were also affected. The peak of the incidence of total sickness among R.A.F. personnel was attained in January 1940, but among W.A.A.F. personnel, the peak incidence of 48-hour cases occurred in January and of all other than 48-hour cases a month later.

It was indeed satisfactory that the health of the Command was maintained despite overcrowding, the reduction of floor space and the imposition of the blackout.

NOTIFIABLE DISEASES

Apart from the outbreak of rubella* in the winter and spring of 1939–

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* The following diseases were notifiable in the R.A.F. in addition to those notifiable by common law: mumps, rubella, infective enteritis, food poisoning, jaundice, leptospiral jaundice, undulant fever, blackwater fever, leishmaniasis, trench fever, yellow fever, tick-bite fever, tetanus, beriberi and scurvy.

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40, there were no major outbreaks of notifiable disease in the Command. The incidence of notifiable disease among R.A.F. and Dominion personnel rose to 218 per 1,000 p.a. in January 1940.*

Cerebro-Spinal Meningitis. The epidemic of cerebro-spinal meningitis forecast for the winter† began among the civilian population in January 1940. The increase in the number of 48-hour cases and under in the Command showed that the transmission by droplet infection of upper respiratory disease was beginning.

Experience had shown that, when such an increase occurred at the same time as an epidemic of a notifiable disease, cases of the latter were to be expected among Service personnel. The medical authorities were well aware of this possibility and felt considerable anxiety, as in the pre-war years the mortality rate among cases of notified cerebro-spinal meningitis was over 50 per cent. The sulphonamide drugs had only just come into general use and their efficacy, with or without convalescent serum, was still under investigation.

The epidemic spread among the civilian population and there were nearly 300 notifications in the first week of February, the number rising to a peak of over 600 a week by the end of that month.‡ In 1939 there had been no cases of cerebro-spinal meningitis in Fighter Command, but during 1940 a total of 35 cases was reported, nine of them in February. There was, however, no epidemic, and apart from five of the February cases which occurred at Biggin Hill and where three personnel from one gunpit were affected, all cases were sporadic.

The five cases reported at Biggin Hill are of interest because the strength of this station varied between 1,000 and 1,100 at that time and contained a high proportion of new entrants. To obtain data of academic interest a large number of naso-pharyngeal swabs were taken. The carrier rates of the various age groups varied between 19 per cent. and 33 per cent. Group 1 Meningococci were responsible for the cases which occurred. The carrier rate on January 19 was 33·4 per cent. and the rate for Group 1 Meningococci 22·5 per cent. A group of 39 soldiers at one gun site were also swabbed on four occasions—January 9 and 23 and February 17 and 28. Of these 39 men, 29 had positive cultures on one or more occasions and 19 belonged to the Group 1 strain. One of these cases came from this site on the first day of swabbing.

The character of the disease was of more interest than the carrier rate, because it was severe, and one fulminating case was observed. This man woke up feeling unwell, dressed and walked 500 yards unaided to

* Caused by 9 cases of cerebro-spinal meningitis, 2 of chickenpox, 3 of mumps, 2 of scarlet fever, 5 of jaundice, 1 of food poisoning, 35 of measles and 414 of rubella.

† *See* 'Medical Problems on Mobilisation' section of this chapter.

‡ Figures obtained from statistics of the Registrar-General.

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station sick quarters, where he died within two hours. The only abnormal post-mortem findings apart from a positive blood culture were massive suprarenal haemorrhages.

During the remaining years of the war there were 38 cases among R.A.F. and Dominion personnel in 1941, 26 in 1942, and 4 in the first eleven months of 1943. The corresponding figures for W.A.A.F. personnel were as follows:

1939	–
1940	2
1941	3
1942	3
1943	4

The decrease in the R.A.F. and Dominion figures for 1943 was possibly due to a larger proportion of men living under canvas during exercise 'Spartan' and the field training of the 2nd Tactical Air Force.

Dysentery. There were a few sporadic outbreaks of *Sonné* dysentery within the Command. Five cases occurred at Biggin Hill and eight among W.A.A.F. personnel at Middle Wallop in April 1942. The disease at Biggin Hill was of a mild character but the W.A.A.F. personnel infected at Middle Wallop had severe diarrhoea, rigors, generalised aches and nausea. Positive stool cultures were obtained but the cause was not discovered.

A further outbreak of a mild nature occurred at Manston in May and June 1943. Fifty cases were confirmed by positive stool culture as *Sonné* dysentery but 47 other cases with diarrhoea had negative cultures. No cause was found for the epidemic.

There was one case of amoebic dysentery in October 1939 and one in November 1943. There were no cases among W.A.A.F. personnel.

Food Poisoning. Isolated cases of food poisoning occurred from time to time in the Command but the only major outbreak was at the Telecommunications Research Establishment at Malvern in June 1942. This establishment consisted mainly of civilians, but there were some personnel, both airmen and airwomen, from No. 76 Wing in No. 60 Group, working on the station. Seventy persons were affected, including 15 airwomen. Symptoms began at 11 a.m. in most cases, and increased in severity during the next two hours. The symptoms were severe and began with abdominal colic, vomiting, diarrhoea, collapse followed by coma, muscular spasms and cyanosis. There was no hyperpyrexia, but most cases had a slight temperature up to 100°. Nine airwomen were admitted to the sick bay of H.M.S. *Duke*, two receiving blood transfusions and the remainder intra-venous glucose-saline. All recovered from their collapse and regained consciousness.

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In all, fifteen airwomen were affected, nine of whom were at Malvern when the symptoms began, the others being on their way to new stations. Two were admitted and two treated as out-patients at the General Hospital, Birmingham; one was admitted to St. James's Hospital, Paddington and another to the Royal West Sussex Hospital, Chichester.

All the patients had had the first breakfast at the canteen. None who took the second breakfast became ill. Egg was served at the first breakfast and bacon at the second but other food was similar at both meals. The egg had been prepared the evening before from egg powder, and was left ready for cooking the next morning. The night had been particularly warm. The symptoms suggested some form of alkaloid poisoning. The egg powder was analysed and found to be free from noxious substances and pathogenic organisms, and the powder in the bin from which the egg had been taken was considered fit for consumption and used without incident thereafter.

Measles. The number of cases each year was as follows:

Year	R.A.F. and Dominion cases	W.A.A.F. cases
September 1, 1939 to December 31, 1940	88 (35 in February)	36 (16 in February)
1941 . . .	126	73
1942 . . .	66	42
1943 . . .	93	152

In the first six months of 1943 the number of cases among W.A.A.F. personnel was as follows:

January	. 17	February	. 25	March	. 29
April .	. 42	May .	. 18	June .	. 9

Rubella. The number of cases of rubella per month among R.A.F. and Dominion personnel was as follows:

1939					
December	. 8				
1940					
January	. 112	February	. 414		
March .	. 174	April .	. 30	May .	. 6
June .	. 2	July .	. 2	August	. 2

There were no more cases in the remaining years reviewed.

The outbreak among W.A.A.F. personnel was more abrupt and of shorter duration, there being 58 cases in January 1940, 197 in February,

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171 in March, 62 in April, 16 in May and three in each of the next two months, after which there were no more cases in the years under review.

Mumps. There was no outbreak, but more cases occurred in the Command in 1942 than in other years. The total number of cases among R.A.F. and Dominion personnel was 555; 290 occurred in 1942, in which there was an average of just over 36 cases a month for the first five months of the year. A similar rise occurred among W.A.A.F. personnel, the total number of cases up to November 1943 being 285, of which 131 occurred in 1942, mostly in the first five months.

Pneumonia. There were three cases of pneumonia among R.A.F. and Dominion personnel in the last four months of 1939; 31 in 1940; 80 in 1941; 103 in 1942 and 76 in 1943. The cases were evenly spread throughout these months. One interesting fact is that five cases occurred in January 1940 but that no cases were notified during February and March, the months in which the sick incidence was higher than at any time during the period under review. Similarly among the W.A.A.F. personnel there was only one case of pneumonia for the first sixteen months of the war; 12 cases in 1941; 25 in 1942 and 12 for the first eleven months of 1943.

Jaundice. The number of cases was as follows:

Date	R.A.F. and Dominion cases	W.A.A.F. cases
September to December 1939	5	Nil
1940 .	36	7
1941 .	113	11
1942 .	259	67
1943 .	349	123
Totals	762	208

The highest number of cases among R.A.F. and Dominion personnel occurred in April 1943, when 56 cases were reported. This represents a maximum rate per 1,000 p.a. of 1·7.

Recurrent Malaria. There were no cases among W.A.A.F. personnel, but among R.A.F. and Dominion personnel the numbers increased as more tour expired personnel returned from overseas. There were 2 cases in 1939; 6 in 1940; 12 in 1941; 34 in 1942 and 50 up to the end of November 1943.

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Other Notifiable Diseases. The incidence is summarised in the table below, with relevant comments:

Disease	R.A.F. and Dominion personnel	W.A.A.F. personnel	Remarks
Typhoid	1	1	—
Paratyphoid	4	2	—
Clinical enteric	2	—	—
Chickenpox	239	145	Even distribution throughout the years
Diphtheria	120	62	Even distribution—maximum number: 12 in April 1941
Encephalitis lethargica	3	1	—
Polioencephalitis	2	1	—
Poliomyelitis	1	—	(January 1943)
Scarlet fever	121	63	Even distribution
Tuberculosis	172	47	Steady small number of cases each month after September, 1940
Whooping cough	9	4	—
Undulant fever	6	—	—
Erysipelas	35	11	—

DEATHS

R.A.F. and Dominion Personnel. The incidence of deaths from all causes, excluding missing presumed dead, among R.A.F. and Dominion personnel was greatest during the Battle of Britain and reached a figure of 39·5 per 1000 p.a. for the whole Command in August 1940. Deaths caused by bombing attacks are included in this figure. The incidence among aircrews in squadrons in the Command was much higher, as is shown in the table on the next page. In 1941 the highest incidence was 16·4 per 1,000 p.a. in March, the following year 10·1 per 1,000 p.a. in September, while in 1943 the incidence never rose above 7·8 per 1,000 p.a.

W.A.A.F. Personnel. The incidence of deaths among W.A.A.F. personnel was very small in all years. There were only two deaths in the first twenty-seven months of the war, and in 1942 the incidence per 1,000 p.a. in any one month never rose above 2·3 and in 1943 above 1·8, the incidence for the whole period under review being ·63 per 1,000 p.a.

INJURIES

R.A.F. and Dominion Personnel. The incidence of injuries from all causes rose, as did the incidence of deaths, during the months of the Battle of Britain. The highest rates were 123·0 and 125·9 per 1,000 p.a. for the two periods of July 26 to August 30 and September 1 to September 27 respectively. Apart from these peak rates the incidence of injuries remained fairly constant with minor fluctuations of about 10 per 1,000 p.a. around an average figure of 50.

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W.A.A.F. Personnel. The incidence of injuries per 1,000 p.a. from the beginning of the war up to December 31, 1940, was 45·5. The total number of injuries in this period was 241, and throughout the period, including all the bombing attacks on Fighter Command stations, only twelve injuries out of this number were due to enemy action. Nine of these occurred at Biggin Hill with one death, the only W.A.A.F. death in Fighter Command caused by enemy action during the Battle of Britain. In 1941 the incidence was 45·35 per 1,000 p.a., in 1942, 48·55, and in the first eleven months of 1943, 38·0.

Incidences of Deaths and Injuries per 1,000 *per annum due to Enemy Action (Air) among Aircrews in Squadrons in Fighter Command July—October*, 1940

1940 (month)	Strengths of aircrews in squadrons*	Deaths due to enemy action (air)	Incidence per 1,000 p.a. of deaths due to enemy action (air)	Non-fatal injuries due to enemy action (air)	Incidence per 1,000 p.a. of non-fatal injuries due to enemy action (air)	Total incidences per 1,000 p.a. of deaths and non-fatal injuries due to enemy action (air)
July . .	1,213	61	603·6	15	148·3	751·9
August .	1,435	149	1,245·6	114	953·3	2,198·9
September	1,423	122	1,022·4	119	1,003·4	2,025·8
October .	1,583	62	470·0	46	348·6	818·6
Averages .	1,413·5	98·5	835·4	73·5	613·4	1,448·8

* Includes missing presumed dead.
Strengths based on reports by Air Ministry D.P.1.(a) were obtained from Air Ministry C.S.B.1.

APPENDIX

Pro forma used to obtain Casualty Statistics

To: Senior Medical Officer
Royal Air Force
From: Air Ministry, Dept. D.G.M.S. (M.A.8.), Kingsway, W.C.2.

Information on casualties resulting from enemy air attacks on R.A.F. stations is required for historical purposes. It has been ascertained from records that attacks took place at R.A.F.,........................on the following dates. Returns should be made to the above address before........

Dates of attacks............

It is suggested that the Daily Sick Books and Sanitary Diaries covering the dates mentioned, with cross references to Forms 38, will show the information. Returns are to be compiled as shown below. Abbreviations may be used.

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Date: August 24th, 1940			Unit	Injury	Severity	Disposal
Number	Rank	Name				
1234569	LAC.	Smith, R.	S.H.Q.	Multiple	Admitted dead	—
7890120	Sgt.	Brown, P.	3066 Ech.	Compound fracture R. femur. Bomb splinter	D.I. (S.I.)	Hospital (Service) (E.M.S.)
187643	S./L.	Jones, L.	905 Sqdn.	Laceration L. ankle	Slight	S.S.Q. (Admitted) Detained
3210124	AC.	Williams, O.	S.H.Q.	Multiple abrasions	Slight	Light duty (L.D.) 8*
98765432	Gnr.	Davies, E.	R.A.	Concussion	Moderate	Hospital (Mil.)
—	Mr.	Hughes, W.	Works	3rd degree burn, L. arm	Severe	Hospital (E.M.S.)

* Number of days before return to full duty.

Care must be observed in recording the cause of injury if known, i.e. gunshot wound, bomb splinter, blast, glass, masonry.

On the reverse side of the return, damage to any buildings or vehicles used by the medical section is to be annotated briefly in columns as shown.

Date	Type of building	Damage	Services interrupted	Was evacuation necessary or not
August 24, 1940	Annexe	Direct hit (Near miss) (Blast) (Fire)	Water (Light) (Telephone) (Conservancy)	Yes: To F.A.P.
	Albion ambulance	Near miss	Unserviceable (U.S.) Serviceable (S.)	

Director-General of Medical Services.

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CHAPTER 3

COASTAL COMMAND

INTRODUCTION

FORMATION OF THE COMMAND

COASTAL Area was formed in December 1919 to control all those land and air units of the Royal Naval Air Service whose administration had been transferred to the Air Ministry on the formation of the Royal Air Force on April 1, 1918. The Headquarters was in London and the two Groups under its command were at Leuchars, Fife and Lee-on-Solent, Hampshire respectively.

The conversion of Coastal Area into Coastal Command was incidental to the reorganisation of the Royal Air Force in 1935–6 and was undertaken mainly to bring the coastal reconnaissance units into line with the general reorganisation. The Director of Organisation's proposals for the organisation of the Command are set out diagrammatically below:

Headquarters Coastal Command

No. 15 Group	No. 16 Group	No. 17 Group	Fleet Air Arm
6 F.B. Squadrons. Marine Craft Experimental Establishment	7 G.R. Squadrons 2 T/B Squadrons	Training Establishments at: Lee-on-Solent Gosport Calshot Thorney Island. Shore training of Fleet Air Arm	All except shore training

There was some doubt as to whether this functional grouping would be preferable to a geographical grouping and the A.O.C. Coastal Area was also hesitant about concentrating the training activities in a special group; nevertheless after considerable discussion, the functional plan was adopted in March 1936. It was later found impossible to form the three groups simultaneously owing to shortage of personnel. The flying boat squadrons were therefore put temporarily into No. 16 Group formed at Lee-on-Solent in December 1936. No. 17 Group also formed at Lee-on-Solent and the new administration came into force in January 1937. The administration and post-F.T.S. training of the

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Fleet Air Arm remained directly under Coastal Command Headquarters as also did the Royal Air Force Detachment at Bermuda.

FINAL DETERMINATION OF THE WAR RÔLE OF COASTAL COMMAND

The issue lay between the reservation of coastal shore-based aircraft solely for naval co-operation and their freedom to participate in the general air plan as strategical considerations dictated. Training and administrative requirements called for an early decision. Admiralty views on the priority of naval claims made support of the second alternative a matter requiring delicate handling.

Following a joint staff enquiry the principle was agreed by the two Services that shore-based aircraft allotted to naval co-operation should only be diverted from that rôle where the serious state of the air defence of the country required it and the aircraft could be released without jeopardy to the overall war plan.

MOBILISATION

Coastal Command was mobilised just before the outbreak of war. Instructions were issued on July 24, 1939, to initiate the movements which would bring the Command into the operational position shown below by August 14, 1939.

Headquarters Coastal Command. Northwood

Headquarters No. 15 Group, Plymouth	Headquarters No. 16 Group, Gillingham	Headquarters No. 17 (Training) Group, Gosport	Headquarters No. 18 Group, Pitreavie
Mountbatten.	Bircham Newton.	Thorney Island.	S.S. Manela
Pembroke Dock.	Thorney Island.	Calshot	Invergordon.
Warmwell.	Detling.		Woodhaven.
Carew Cheriton.	Guernsey Airport		Montrose.
Aldergrove			Leuchars

FUNCTIONS OF THE COMMAND

These were many and varied, and by the end of the war the main duties of the Command comprised anti-submarine patrols, anti-shipping strikes, photographic reconnaissance, meteorological flights and air sea rescue.

(*a*) *Anti-submarine Patrols.* This work was carried out day and night by general reconnaissance squadrons consisting of land planes, amphibians and flying boats and included standing patrols, convoy protection and flights ahead of and around convoys. The aircraft

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principally employed were Liberators and Catalinas and very long range flights of thirteen to twenty hours duration were carried out. Shorter flights of ten to thirteen hours were undertaken by Sunderlands, Wellingtons, Fortresses and Halifaxes. During these flights the altitudes attained varied from 800 to 5,000 ft., but were mostly between 1,500 and 2,000 ft., although when attacking a submarine it was necessary for the aircraft to descend to 50 ft. By night a sea level search was maintained by Wellington aircraft carrying a powerful searchlight known as the Leigh light.

(*b*) *Anti-shipping Strikes.* These were generally carried out by Hampdens and Beaufighters adapted to drop torpedoes, but for long range attacks Beaufighters equipped with rockets were used.

(*c*) *Photographic Reconnaissance.* This was the responsibility of the photographic reconnaissance units, later one of the fixed groups in the Command. Unarmoured Spitfires and Mosquitoes were utilised, the former having an endurance of five hours and operating at 33,000 to 42,000 ft., while the latter aircraft had an endurance of seven hours and operated at 28,000 to 32,000 ft.

(*d*) *Meteorological Flights.* This work was divided into local and long range flying. For local flights of approximately one hour's duration Gladiator and Spitfire aircraft with ceilings of 28,000 and 40,000 ft. respectively were employed, the long range flights of about six to eight hours duration being undertaken by Blenheims and later Hampdens, Halifaxes and Hudsons flying at 18,000 ft.

(*e*) *Air Sea Rescue.* This important work, originally carried out by Lysander aircraft and amphibians, was eventually delegated to Warwick aircraft with their much greater range and endurance. 'Searching' had to be carried out at around 250 ft. as dinghies were very difficult to see from a greater height than this. These low altitudes involved very considerable hazard and demanded continuous concentration with resultant fatigue and eye strain on the part of the pilot and crew.

Functions and Characteristics of the Groups. The functions of each group are given below. In practice the allocations were not rigid, alterations and interchanges being made as the operational situation required :

Function	Groups
Anti-submarine patrols	Nos. 15, 18 and 19
Anti-E boat, anti-shipping patrols and strikes . .	Nos. 16 and 18
Meteorological flights	All groups
Air sea rescue	All groups
Photographic reconnaissance	No. 106
Operational training on Coastal Command aircraft .	No. 17

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GROWTH OF THE COMMAND

On September 3, 1939, Coastal Command administered four Groups (*see* Map 1), one Wing and eight other Stations; this had increased by January 1, 1942, to six Groups, three Wings and thirty-three other Stations. Yearly personnel strengths throughout the war were as follows:

	R.A.F.		W.A.A.F.		Dominion	
	Officers	Airmen	Officers	Airwomen	Officers	Airmen
September 3, 1939	Not available		Nil	Nil	Nil	Nil
January 1, 1940	1,108	10,585	Nil	Nil	Nil	Nil
July 1, 1940	1,631	16,887	68	762	Not available	
January 1, 1941	2,480	30,334	160	1,690	Not available	
July 1, 1941	2,842	37,440	216	3,012	92	228
January 1, 1942	3,500	51,091	338	5,885	329	815
July 1, 1942	3,959	50,366	315	7,133	691	1,888
January 1, 1943	4,593	52,793	384	9,877	898	2,796
July 1, 1943	5,722	57,591	387	13,325	1,470	3,454
January 1, 1944	6,657	56,527	430	13,149	1,680	3,863
July 1, 1944	6,721	57,698	455	12,341	1,701	3,850
January 1, 1945	6,682	63,842	486	13,311	1,874	3,292
July 1, 1945	7,029	54,261	495	12,492	2,181	2,697

Coastal Command units extended all round the coast of the British Isles and the maps show the distribution of stations within their respective Groups; the Command also administered formations in West Africa, Iceland, Gibraltar and the Azores.

Rapid expansion involving overcrowding on established stations and occupation of new units before full completion presented the Command's Medical Administration with problems which were common to the Royal Air Force as a whole at that period. Coastal Command had, however, an unusually large number of units established as a matter of urgency in very isolated positions, where weather conditions were normally inclement. The Outer Hebrides, Shetlands and Faroes may be cited as examples. Supply from the mainland was frequently difficult or even impossible. The stations themselves were built on the dispersed principle, which added to the hardships in severe weather. Buildings suitable for English conditions failed to stand up to the stress of the northern winters. It is interesting to note that in spite of the exposure and other hardships sickness rates compared favourably with those of many stations more comfortably situated. Iceland, in fact, produced the lowest average sickness rate in the Command. It was also noticeable that in these units, which had to depend on themselves for the majority of amenities, morale tended to be higher than on those where outside amusements were readily available.

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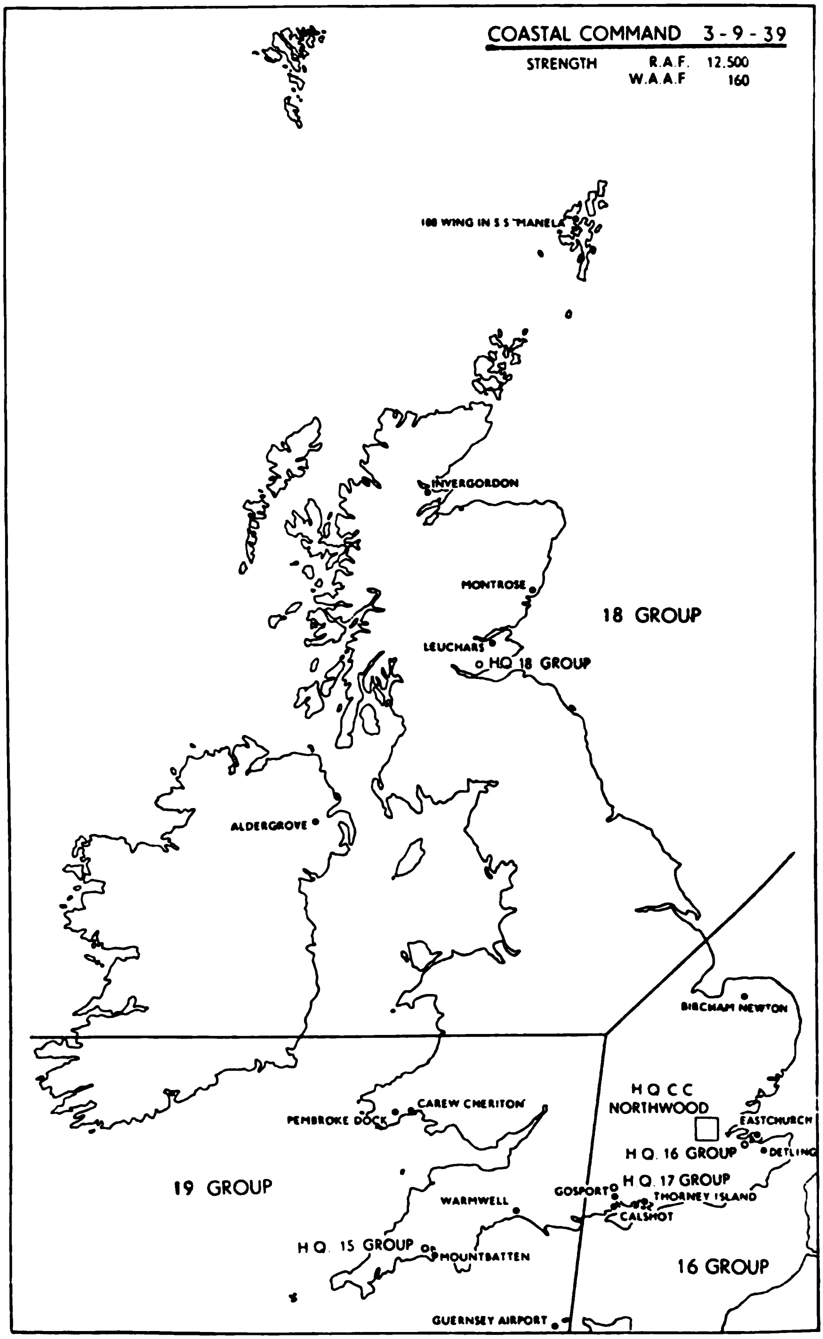

Map 1. Map showing Stations in Coastal Command on September 3, 1939.

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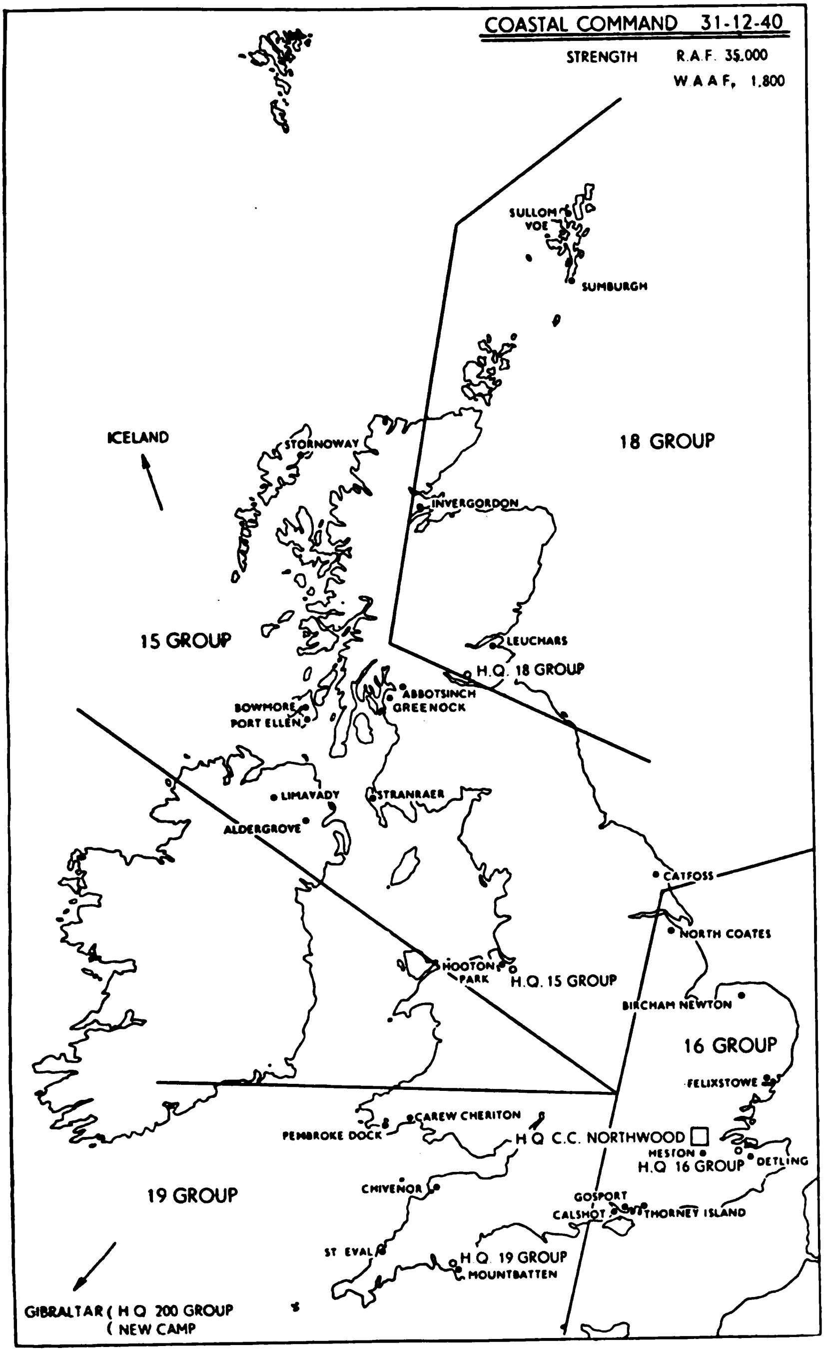
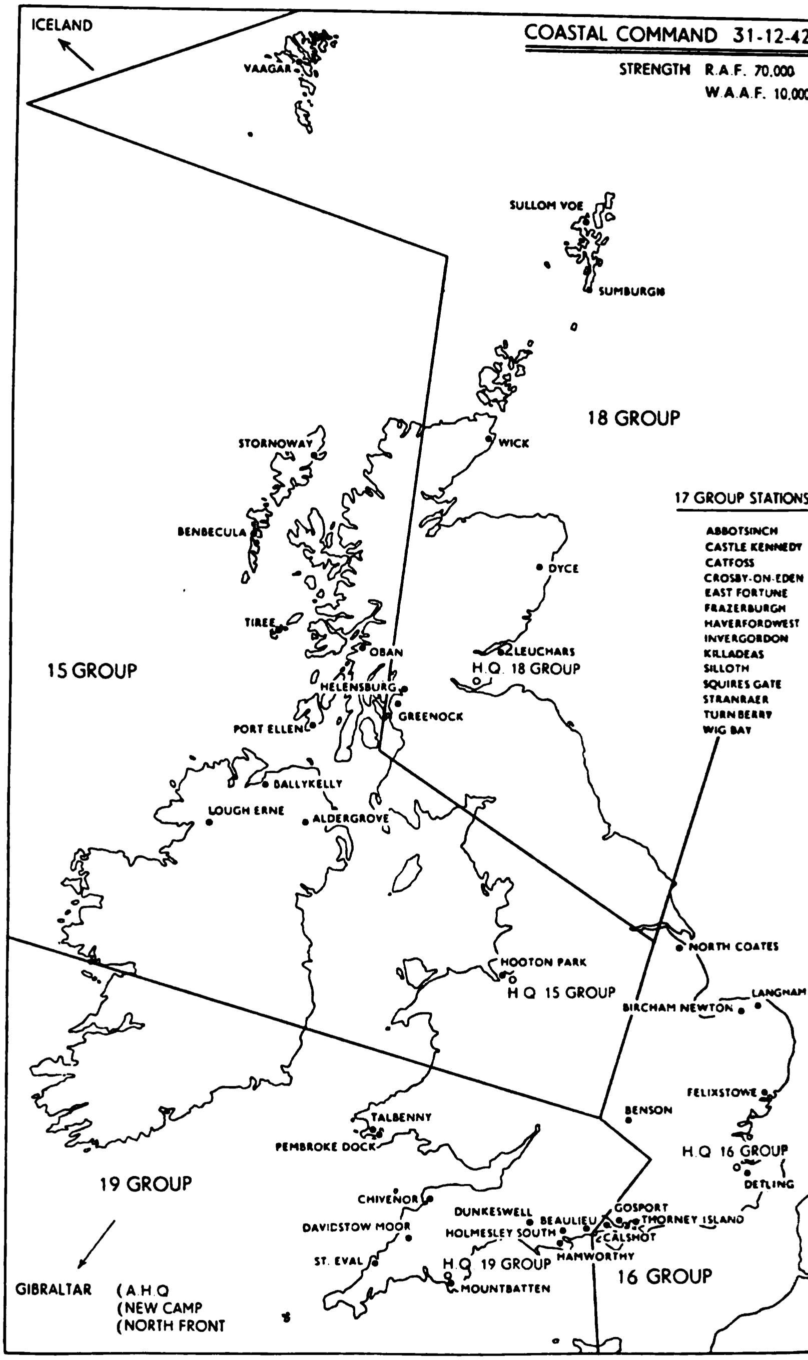


Map 2. Map showing Stations in Coastal Command on December 31, 1940.



MAP 3. Map showing Stations in Coastal Command on December 31, 1942.

MEDICAL ADMINISTRATION AND PERSONNEL

Command Headquarters. On the outbreak of war the Medical Staff at Headquarters Coastal Command comprised one Air Commodore (Principal Medical Officer) and two Wing Commanders (of whom one was Deputy Principal Medical Officer, Hygiene), together with clerical staff.

In early 1940, the increase of W.A.A.F. personnel in the Command necessitated the attachment of a woman medical officer whose duties were mainly confined to lecturing to W.A.A.F. personnel and advising the P.M.O. on health matters appertaining to the W.A.A.F.; this post was finally established in June 1941.

In common with other operational commands, the medical problems of aviation medicine necessitated the appointment of a Flying Personnel Medical Officer in April 1941.

Senior Medical Officers of Groups. The appointment of Senior Medical Officers to Groups and the delegation to them of some of the responsibilities previously undertaken by the Command Headquarters took place more slowly in Coastal Command than in other formations. The following table gives the chronological order of appointment:

Group	Date of appointment of S.M.O.
No. 18 Group . .	September 1939
No. 16 Group . .	November 1939
No. 15 Group . .	December 1939
No. 17 Group . .	January 1940
No. 200 Group . .	November 1940
No. 19 Group . .	January 1941

Note: *See* Map 2.

The value of the scheme was quickly apparent. It provided Group Commanders with an experienced adviser intimately acquainted with the problems of the Group. It relieved Command Headquarters of an increasing volume of routine work and permitted the medical staff to devote their attention to the major requirements of the Command as a whole.

Inspecting Dental Officers. On November 14, 1939, it was possible to post to the strengths of Fighter, Coastal, Bomber and Balloon Commands a flight lieutenant in the position of inspecting dental officer. The improvement in the organisation of dental arrangements was immediately apparent. Later the post was upgraded and a wing commander dental officer posted to each Command Headquarters.

Sanitary Assistants. In September 1940, Air Ministry authorised the posting of a N.C.O. sanitary assistant to each Group Headquarters.

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These N.C.Os., who in civil life were qualified sanitary inspectors, besides carrying out the routine inspections on behalf of the Group Senior Medical Officer, acted in an advisory capacity to stations and gave instruction to airmen in sanitary duties. The introduction of this post was most successful, particularly in the dispersed and incomplete yet occupied stations in the early phase of the expansion of the Command. It was found expedient to post a second sanitary assistant to No. 18 Group for whole-time duties in the Shetlands, where problems relating to sanitation were considerable.

In 1944, a commissioned sanitary assistant was established at Headquarters, Coastal Command, to carry out detailed inspections of stations at which difficulties were being encountered, his reports and recommendations being made direct to the Principal Medical Officer.

Medical Staff Officer for Flying Personnel. The growing importance of aviation medicine and the consequent necessity for supervision and indoctrination of aircrews soon provided a task beyond the power of medical staff officers, who, however keen, had neither the specialised knowledge nor the time necessary for success. The appointment to Command Headquarters of a medical officer with full flying qualifications for this particular task was therefore an immediate success, because, largely by virtue of his being a pilot and not too senior an officer, this F.P.M.O. was able to establish the desired relationship with aircrew in a comparatively short time and achieve much that was of great value to the continued efficiency of aircrew.

Princess Mary's Royal Air Force Nursing Service. In April 1942, nursing sisters were established for duty in connexion with W.A.A.F. personnel, at first at Bircham Newton and Dyce, later at Pembroke Dock and Headquarters No. 19 Group. The policy was successful in its primary object and in addition the presence of skilled nurses on stations enabled medical officers to retain and treat cases which would otherwise have added to the burdens of our hard pressed hospitals.

Medical Routine Orders. War brought many complications to the life of the Service medical officer. In peace-time documentation and amendments to orders were relatively few and carried out by clerks, but in war-time, with the greatly increased amount of secretarial work, the task became impossible for the medical officer new to the Service, with little or no idea of office procedure, and usually only one clerk to assist him. Accordingly Coastal Command, in common with other R.A.F. Commands, introduced in 1942 a system of Medical Routine Orders.

These were numbered serially so that it was easy to keep and amend the Orders in their file. Considerable care was taken in the wording of the M.R.Os., simple everyday terms being used, and the subject was always dealt with as briefly as possible. The introduction of this scheme

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was approved by most medical officers and a considerable saving in office time, both in the compilation and use of the Orders, resulted.

Weekly Sickness Signal. When P.M.Os. in 1940 ceased to receive Forms 38 (Numerical Summary of sickness for each month), their transmission then being *via* Command to Statistical Section, Ruislip, it was found that they lacked any periodical analysis of the state of health at each station. To bridge this gap it was decided that a weekly sickness signal should be sent by each station to the P.M.O., this being put into force in the summer of 1943. The signal was coded and information given from which it was possible to gain a very accurate idea of the health on any one station.

Administration on partially completed stations. One of the most difficult problems which had to be faced by the Group medical authorities was the opening up of partly completed stations. Though it was impossible to adopt any routine procedure, it was found that the situation resolved itself into two phases. The first decision to be made concerned the stage at which a medical officer should be posted to the station. Although hardly justified by the numbers of personnel involved, the presence of a medical officer was often imperative in view of problems of sanitation and hygiene which arose, particularly as much improvisation was necessary owing to the shortage of both materials and labour.

The second difficult period occurred when the station, now further completed, accepted aircraft, for often at this stage the sick quarters was unfinished and the responsibility placed on the medical officer in temporary and usually inadequate accommodation was considerable.

Experience led Coastal Command to adopt the policy of making an apparently over-generous allocation of medical personnel and equipment in the early stages and this proved to be a wise move. Wherever possible the medical officer chosen ultimately to become Station Medical Officer (a squadron leader in operational stations) was posted in at the earliest opportunity, even though the medical commitment at that stage might not, *prima facie*, have justified an officer of that seniority.

NO. 15 GROUP

At the outbreak of war, No. 15 Group Headquarters was at Plymouth and was closely associated with the Naval Command, Western Approaches, being responsible mainly for convoy escort and anti-submarine patrols. The fall of France in 1940 resulted in the enemy's bases for attack being much closer to the south-west coast of England and gave him shore bases on the Atlantic seaboard for U-boats and other craft; the ports in the south-west of England therefore became unusable as far as their original purpose was concerned and the north-western ports took over their functions, so that when the naval Commander-in-Chief, Western Approaches, moved to Liverpool, No. 15 Group was also

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transferred to continue its association. The four stations under the Group—Mountbatten, Pembroke Dock, Carew Cheriton and St. Eval—formed the nucleus of a new Group (No. 19) with headquarters at Mountrose, Plymouth.

No. 15 Group, at its new headquarters, took over Stranraer from No. 17 Group and Oban, Stornoway and Iceland from No. 18 Group, Hooton Park from Fighter Command and Limavady and Aldergrove from Royal Air Force, Northern Ireland, while new stations were opened early in 1941 at Lough Erne, Eglinton, Ballykelly and Nutts Corner in Northern Ireland and Benbecula and Tiree in the Western Isles.

In accordance with instructions from the Director of Organisation, Air Ministry, the medical administration of stations in Northern Ireland was handed over to the Principal Medical Officer, Headquarters, R.A.F. Northern Ireland, on the formation of Northern Ireland Command in October 1942. The P.M.O. undertook the ordinary 'day-to-day' administration and visits of inspection, working in conjunction with the Senior Medical Officer, No. 15 Group, when major proposals for Coastal Command stations were under consideration. Visits and inspections by the medical staff of No. 15 Group or Headquarters Coastal Command took place only after consultation with the Principal Medical Officer, R.A.F. Northern Ireland, who usually accompanied them. (*See* Maps 2 and 3.)

R.A.F. STATIONS IN THE OUTER HEBRIDES

There were four R.A.F. stations in the Western Islands of Scotland; these were:

Port Ellen (Glenegedale the aerodrome and Bowmore, a flying boat base) in the Isle of Islay
Tiree in the Isle of Tiree
Benbecula in South Uist
Stornoway in the Isle of Lewis

Besides the similarity of climate and geography, these stations had several other features in common, all having been built in 1940 and 1941 on the dispersed site plan and occupied before they were fully constructed and all having to face administrative problems arising from the slow rate at which building was completed.

The Outer Hebrides are a trail of islands lying off the north-western coast of Scotland, 50 to 90 miles from the mainland. Apart from the mountains of North Harris the islands are flat and low-lying, few places being more than 200 ft. above sea level; the landscape is practically featureless and consists mostly of moorland and rough pasture with very few trees.

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The islands lie exposed to the North Atlantic Ocean and have a comparatively mild climate with a temperature which rarely rises above 60° F. in summer and only occasionally falls below 30° F. in winter and an evenly distributed rainfall of 40 to 50 in. per annum. There are frequent gales and high winds are unusually prevalent; figures recorded by the meteorological section at Tiree, for instance, show that the incidence of winds there of 25–38 miles per hour is 25 per cent. in January and 4 per cent. in July, making it one of the windiest places in Great Britain, surpassed only by Lerwick and the Butt of Lewis.

Dispersal. It was ruled that these stations were to be constructed on the dispersed site plan designed to lessen vulnerability to hostile attack. It appears open to doubt whether such a decision was in fact wise having regard to the very slight risk of attack and the material increase in hardship to personnel which dispersal in such locations and climate rendered inevitable. The consequence was that some sites were 1½ to 2 miles from the communal centre and personnel walking back to their dormitory sites were frequently soaked to the skin in spite of oilskins and rubber boots; to make matters worse, drying facilities on the sites were usually non-existent. Airwomen, whose site was usually the nearest, could not face the walk to the communal centre in the wet and windy weather which prevailed. The provision of bicycles was of little value, as cycling was very fatiguing in the continual strong winds and impossible during gales.

Recreational Facilities. Opportunities for amusement outside the stations were scanty or absent and the inhabitants of the islands, as a whole, did not welcome the arrival of the R.A.F. and remained aloof from them. In the earlier days recreational facilities had to be improvised by the personnel. Later, cinemas, E.N.S.A. shows and other entertainment from outside became available and the amenities on the camps themselves improved. At the best it was an existence alien to the town-bred men who formed the majority of the personnel. It is all the more creditable and surprising to note the high degree of morale and *ésprit de corps* maintained under the most discouraging conditions.

Medical Organisation. R.A.F. sick quarters were provided at Port Ellen, Tiree and Benbecula. At Port Ellen a large manse was requisitioned and, after installation of a lighting plant driven by a petrol engine, proved satisfactory, while at Tiree and Benbecula, standard sick quarters of temporary construction were provided. The special arrangements made at Stornoway are described in a later paragraph.

The main problem at all these stations was the treatment and disposal of cases requiring immediate hospitalisation, as there were no hospitals on the islands of Islay, Tiree or South Uist and only one in the Isle of Lewis, at Stornoway; this was a civil hospital, but was used for some time by the Royal Navy and the R.A.F.

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To overcome these difficulties to some extent, each sick quarters was issued with additional equipment—a large steriliser, a microscope and ancillary laboratory equipment and a midwifery bag—while in 1942 Port Ellen, Tiree and Benbecula were issued with small X-ray plants, which obviated the necessity for sending personnel on a long and tiring journey to the mainland for radiographs to be taken at the E.M.S. hospitals in Glasgow. These sets were very satisfactory; each took an average of ten films a month and a register was kept of work undertaken, the sets and registers being inspected about once a year by a visiting radiologist. Transfer to hospital, when necessary, was by the air ambulance service to the mainland, and was generally satisfactory; this service is described elsewhere in the narrative.

Psychoneurosis. There was a considerable incidence of psychoneurosis in the islands. Marked depression was common during the first two or three days even among the emotionally stable and instances of airmen trying to commit suicide in the first two days in Tiree were recorded; this particular station was usually referred to as 'this bloody island', sometimes humorously, but often, in cases of maladjustment, in deadly earnest. Several officers showed definite anxiety symptoms after a period in the islands and had to be posted to the mainland on medical grounds—for example, a normally very efficient senior officer broke down after six months, becoming grossly inefficient, forgetful, unsociable and irritable, but he made a good recovery after return to the mainland. Invaliding was necessary in a number of cases of established neurosis. Apart from the more serious cases, there were many of minor degree and airmen on sick parades complaining of 'nerves' were familiar on all stations, but treatment was difficult unless a spell of fine weather materialised.

The majority of all ranks were reasonably happy, although service on these lonely wind-swept islands was calculated to bring to the surface any latent instability. Exclusion was the natural means of preventing psychiatric breakdown, but, as service in the Hebrides counted as home and not overseas service, it was not administratively possible to exclude personnel other than those who had a definite history of psychoneurosis.

Rheumatic and Other Special Conditions. In Benbecula, 6 per cent. of the total personnel reported sick with rheumatic conditions, although the majority were able to remain on duty. Chronic cases of rheumatic conditions, bronchitis or suppurative otitis media were adversely affected by service in the Hebrides, and fibrositis and muscular rheumatism were common among all personnel, practically everyone suffering fleeting joint pains at some time during their service in the islands.

In 1944, however, a full investigation was carried out into the incidence of bronchitis, rheumatism and pulmonary tuberculosis amongst personnel at Port Ellen, Tiree and Benbecula (Stornoway was

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not in Coastal Command at this time); and it was discovered that, with a total population in these three stations of 2,405, the average percentage of personnel invalided or posted away on medical grounds was:

	Invalided	Posted on medical grounds
	per cent.	per cent.
Pulmonary tuberculosis	0·31	0·09
Rheumatism . .	0·42	1·09
Bronchitis . . .	0·36	0·72

The Principal Medical Officer decided that, on the basis of these figures, it was not necessary to make special provision for dealing with such cases, especially as many personnel would be only too willing to advance a medical disability as a pretext for posting away from the islands.

R.A.F. Station Benbecula. Royal Air Force Station, Benbecula was responsible for small transit camps at Loch Boisdale, where, because of the distance from Benbecula, a civilian medical practitioner took the daily sick parade. For the first eight months of R.A.F. occupation of the island, a number of sick and injured airmen were admitted to the Bute hospital and treated without cost to the State, but authority was later given (with retrospective effect) for the payment of ten shillings for the first day and seven shillings a day thereafter in respect of each R.A.F. patient. This arrangement worked satisfactorily and the hospital continued to be used until the Spring of 1943, when the R.A.F. sick quarters at Benbecula was completed and able to accept personnel who required in-patient treatment from Loch Boisdale.

R.A.F. Station Stornoway. R.A.F. Station, Stornoway, in the Isle of Lewis, was situated about two miles outside the town of Stornoway and built on heath and moorland, drainage presenting a continual problem. The station was opened in August 1940, when a detachment of a Whitley squadron moved there from Dyce, but at this time there was no barrack accommodation and all personnel were billeted locally, medical care being provided by the Naval Medical Officer at Stornoway. In April 1941 a dispersed site camp was occupied and a R.A.F. medical officer posted to the unit, but there was no separate R.A.F. sick quarters and cases continued to be accommodated in the naval sick bay at Lewis Castle. This was a large building, in effect a small hospital, with seventy beds and well equipped with operating theatre, X-ray plant, etc.; twenty male and six female beds were available for R.A.F. personnel. Cases which could not be dealt with there were admitted to the Lewis Hospital, Stornoway, which had twenty-four surgical, nineteen medical and five maternity beds.

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R.A.F. Station, Stornoway was transferred to Transport Command in November 1943 but returned to Coastal Command in August 1944. In October 1944 the Admiralty decided to close down the naval sick bay and as the Lewis and Isolation hospitals were unable to accommodate all sick R.A.F. personnel, owing to shortage of beds and staff, there was no alternative but for the Royal Air Force to take over the Lewis Castle sick bay, and this was done on November 15, 1944. Manning a sick quarters of this size presented a considerable problem and an adequate staff was, in fact, never provided, the R.A.F. establishment being a total of 24 in comparison with the previous Royal Navy staff of 37. However, despite difficulties and the fact that all members of the staff were overworked, the sick quarters functioned efficiently. A R.A.F. surgeon with the rank of flight lieutenant was posted in on December 1, 1944, and from that time all surgical work was carried out at Lewis Castle; venereal disease cases were sent to the Military Hospital, Peebles.

After the collapse of Germany in 1945, the squadrons left Stornoway and medical work was greatly reduced; Lewis Castle therefore ceased to be requisitioned and a small sick quarters opened on the station.

AIR AMBULANCE SERVICE IN SCOTLAND AND SCOTTISH ISLANDS

It was recognised that the isolation of many stations in Scotland and particularly of those in the Hebrides would create grave difficulties in transferring cases to hospital and it appeared that the quickest and most economical means of transport would be by an air ambulance service. In the early days of the war and up to October 1941 air transport of sick or injured personnel was effected by:

(a) *Service Aircraft*. The Service aircraft usually employed was the Anson, with which a number of the operational squadrons at Port Ellen were equipped. There was ample room for a stretcher inside the Anson but wireless equipment immediately opposite the door made it almost impossible to move the stretcher in and out of the aircraft; this was partially overcome by the construction of a special stretcher six feet long and two feet wide but even this required tilting to about 90° before it could be loaded on to the aircraft. The Percival Q6 aircraft at Benbecula was easier to load and in due course authority was obtained for its use for air ambulance purposes.

(b) *Civilian Airways*. Civilian airways were always most co-operative and very prompt in supplying aircraft when required. Sometimes the normal run was used, at other times aircraft were specially provided—for example, in July 1941, it was necessary to transfer four patients, two with fractured skulls, one with fractured pelvis and one with a badly fractured humerus; within an hour of the medical officer making the request to the Scottish Airways representative in Islay, two aircraft had landed and were ready to remove the patients.

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(c) *Establishment of Royal Air Force Air Ambulance Service.* In October 1941, two R.A.F. aircraft, specially modified as air ambulances, were established at Abbotsinch and Wick respectively; they were under the control of the Senior Medical Officer, No. 18 Group, although in practice medical officers usually applied direct to the station from which the ambulance was required. During the period immediately after their introduction both air ambulances were unserviceable for about twenty days a month and it was still necessary to use other Service and civilian aircraft. This very high rate of unserviceability in the first year of operation rendered the scheme far from satisfactory, as did also the frequency with which bad weather prevented use of the aircraft; it was for this latter reason that it was proposed to transfer the Abbotsinch aircraft to one of the stations actually in the Hebridean islands (Tiree or Port Ellen) but before this could be effected control of the aircraft passed from Coastal Command. A further disadvantage was that the air ambulance at Abbotsinch was not allowed to take off or land at night. This nearly had disastrous consequences on one occasion in 1943 when it had been requested by Benbecula at 2000 hours one night to transfer an officer with a perforated duodenal ulcer. The air ambulance could not be obtained before 1000 hours next morning; fortunately the emergency operation was successful but the incident drew attention to a serious defect in the air ambulance service.

The Air Ambulance Service in Transport Command. In 1944 it was decided that Transport Command should take over the operation of both air ambulances; accordingly the Abbotsinch ambulance was taken over in February and transferred to Prestwick and the Wick ambulance was taken over in May, remaining at Wick. Medical officers in the Hebrides complained that the change of administration resulted in delay in obtaining an air ambulance when required, for they now had to make their request to Transport Command, who authorised Prestwick to supply the aircraft, whereas it was considered that an efficient service was only possible if the medical officer concerned could make his request direct to the station where the ambulance was based.

The Wick ambulance, after the transfer to Transport Command, was used much less than formerly and then only for local cases, although it had previously been in demand for cases from the whole of Scotland, the Orkneys and the Shetlands.

Example of Use of Air Ambulance. The air ambulance service was used to evacuate civilians as well as Service personnel and although evacuation was normally without especial difficulty, a case which was dealt with by the medical officer of Tiree in 1945 illustrates the kind of problems met in isolated stations.

In March an urgent call was received from Coll requesting medical aid in connexion with a case of eclampsia with alleged pelvic contraction. Attempts had evidently been made to obtain an air ambulance for the

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removal of the patient, but, as there were no suitable landing grounds on Coll, an air ambulance could not undertake the journey, and it was therefore necessary to go over to Coll in a small boat to collect the case. The patient was unfortunately submitted to a rough journey from Arinagour to MacLean's Tomb where she was with difficulty embarked and removed to Tiree on a choppy sea. On arriving at Tiree she was then removed by air ambulance. It was learned later that the mother had since died, but the baby, a male child, was alive and well.

Figures on the use of air ambulances for 1942, 1943, and 1944 are given below:

Abbotsinch air ambulance

	Days u/s.	Flights made	Patients carried
1942			
July	20	7	9
August	20	7	11
September	24	1	2
October	21	3	3
November	30	—	—
December	31	—	—
1943			
January	27	1	1
February	17	3	4
March	3	8	10
April	—	7	11
May	—	10	22
June	3	10	11
July	3	11	14
August	5	13	22
September	3	9	12
October	—	9	12
November	2	7	8
December	7	5	8
1944			
January	—	7	12
February	—	7	10
March, April, May	Ambulance in Transport Command		

Wick air ambulance

	Days u/s.	Flights made	Patients carried
1942			
July	20	6	9
August	20	5	6
September	20	8	15
October	15	6	7
November	30	—	—
December	16	5	12
1943			
January	31	—	—
February	23	2	3
March	12	4	4
April	1	3	3
May	6	4	5
June	—	4	5
July	7	6	9
August	21	1	1
September	15	3	4
October	3	6	6
November	—	3	7
December	—	3	4
1944			
January	8	5	6
February	5	1	1
March	—	3	3
April	—	4	7
May	—	1	1
	Ambulance in Transport Command		

NO. 16 GROUP

No. 16 Group, with Headquarters at Gillingham, Kent, had been formed before the war and controlled Royal Air Force stations Bircham Newton, Thorney Island, Detling and a larger unit at Manston; during 1940 stations at North Coates, Heston and Eastchurch were absorbed

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into the Group. The only stations at which medical arrangements presented difficulty were Detling and North Coates, where there was considerable overcrowding. For example, Detling was a small station designed for one Royal Auxiliary Air Force Squadron and had quarters and a mess for 25 sergeants, but in August 1940, when the extreme pressure of the Dunkirk evacuation had passed, there were 186 sergeants on the station; cooking for these personnel was done out of doors and a tent provided dining room facilities. Water supply was the greatest problem, as the aerodrome was situated at practically the highest point in the locality and the main supply was through a pipe of only 3 in. diameter. Similar difficulties arose in the officers' mess; many officers were living in tents.

At North Coates the airmen's dining room, although designed for 500, could accommodate only 350 at a sitting and was attempting to mess over 1,200.

Sanitation problems on the pre-war permanent stations of Bircham Newton, Thorney Island, Benson and Felixstowe were chiefly due to the increased numbers of personnel for whom the stations had to cater; this resulted in the overloading of sewage plants and an insufficient water supply, but these difficulties were remedied comparatively easily by the co-operation of the Works Department.

At the non-permanent stations, such as Detling, Eastchurch and North Coates the problems were more acute and more difficult of solution; the stations were regarded as temporary and therefore as little money as possible was to be spent on them, but, although the day-to-day policy pursued was understandable, it often resulted in the expenditure of more time, money, labour and material than would have been necessary on a long term basis.

The situation at Detling illustrates this point. Practically every building on the station was either damaged or destroyed in air raids in August and September 1940 and when reconstruction began a policy of dispersal was adopted, huts being erected over a wide area in little communities. Each flight had its own cookhouse and dining room so that with two officers' messes, one sergeants' mess, one W.A.A.F. hostel, one Church Army site, and the M.T. dispersal, there were eleven cookhouses. Although this arrangement had the advantage during the blitz period that it was extremely unlikely that the cooking arrangements for the station would be put entirely out of action, it also had the considerable disadvantage of requiring a much greater staff and entailing more work in the distribution of rations. Unfortunately the huts themselves were not of the best quality and the walls and floors quickly became so damaged through wear and tear, heat and damp that they fell into a state of disrepair and dinginess, staff shortages making matters worse. The experience gained at this station hastened the decision to

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reduce the number of cookhouses generally on stations throughout the Command and to allow airwomen to be messed in the same building as airmen.

HEADQUARTERS UNIT

All personnel at No. 16 Group Headquarters were billeted in Gillingham, R.A.F. regulations concerning floor space being adhered to and not more than two persons being accommodated in one room; the billets were inspected frequently and the standard was found to be satisfactorily high.

Working Conditions. Personnel worked either (*a*) in the Combined Area Headquarters under ground, or (*b*) in wooden huts adjacent to the Combined Area Headquarters.

(*a*) *Combined Area Headquarters.* Constant medical supervision of the R.A.F. section was responsible for the improvement of original conditions by the installation of an additional ventilation system in the teleprinter and traffic rooms, the new plant giving six to ten changes of air per hour as required. Ventilation throughout the headquarters was by means of grilles, air being drawn in from outside through copper-wool filters and then blown into the various rooms; each grille was regulated according to the requirement of the room, having regard to the number of personnel working therein. Originally regular catathermometer readings showed that in many rooms the conditions were not satisfactory, a wet bulb reading being 10 or 11 and the dry bulb reading 3 or 4 as against the minimum acceptable readings of 18 and 5 respectively. There was no exhaust system, exhaust being by means of positive pressure through the ramps and vents. Filters were cleaned once a week by beating and treating with a vacuum cleaner, but this was not completely effective and more frequent cleaning was required than should have been necessary. Lighting in the headquarters was unsatisfactory, and in many rooms the illumination standard was as low as three foot candles. In 1942, however, fluorescent lighting was installed and this was a decided improvement.

(*b*) *The Wooden Huts:* These were of the usual type and on the whole satisfactory as temporary buildings. Heating was by slow combustion stoves and ventilating blackouts of approved Air Ministry design were installed throughout.

Sick quarters. The sick quarters consisted of medical inspection and treatment rooms and a W.A.A.F. sick bay of eight beds. Both the M.I. Room and the treatment room were extremely small and were heated by open coal stoves. Airmen who required admission to sick quarters were sent to Detling while airwomen from Detling were admitted to the sick quarters at Gillingham, an arrangement which worked satisfactorily.

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AIR ATTACKS AND THE EFFICIENCY OF MEDICAL ARRANGEMENTS

A fairly detailed description is included here of air attacks to which R.A.F. Stations Eastchurch, Detling and Thorney Island were subjected in August 1940, in view of the change of policy concerning sick quarters which resulted from these experiences.

On August 13 heavy attacks were made on Eastchurch at 0700 hours and Detling at 1500 hours. At Eastchurch considerable damage was caused to buildings and casualties were:

	R.A.F.	Army
Killed	12	2
Seriously injured	18	10
Slightly injured	15	10

In accordance with arrangements which existed for R.A.F. and civil hospitals to give mutual assistance in an emergency, all casualties were rapidly removed to the local E.M.S. hospital, where they received prompt and efficient attention.

At Detling buildings sustained severe damage and the following casualties resulted:

	R.A.F.	Civilians
Killed	35	2
Seriously injured	10	—
Slightly injured	57	—

Medical aid was requested from Kent County Council authorities and arrived in the form of ambulances, the medical officers from the Council and the sole practitioner from a nearby village. All casualties had been given first-aid treatment and admitted to hospital within an hour of the beginning of the attack.

Interesting points about the attacks on these two stations were as follows:

Eastchurch—air-raid alarm sounded approximately twelve minutes before the attack but many personnel, particularly among the officers, failed to take cover; there were no casualties among those who had sheltered.

Detling—at the time of the attack there was only a yellow warning in operation. The operations room, a modern building of approved Air Ministry design, sustained a direct hit from a heavy bomb, three officers, including the Station Commander, being killed.

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Both Detling and Eastchurch suffered further heavy attacks in the next three weeks and the morale of both stations undoubtedly suffered considerably. There were many cases of psychoneurosis, especially among ground personnel, many of whom had not been long in the Air Force and had not therefore reached the high standard of discipline gained by all personnel passing through initial training wings and recruit training centres. The presence at Eastchurch of a medical officer with experience of psychological disorders was invaluable, as he was able to treat many of the minor cases and enable these personnel to regain their confidence and poise.

Royal Air Force Station, Thorney Island was attacked for the first time on August 16, when bombs were dropped and some damage was caused, although there was only one casualty, an airman who received slight injuries. Another attack was made two days later when five civilians were slightly injured.

There are three points about this attack worthy of mention:

(i) a shelter received a direct hit but the occupants escaped with little injury;

(ii) the station defences reacted well: three Blenheim fighters on the station, which were in the habit of taking off on receipt of a yellow warning, on this occasion engaged the enemy on arrival and shot down two aircraft without loss;

(iii) the ground defences destroyed a further two enemy aircraft with anti-aircraft fire.

Dispersed Sick Quarters. In all the enemy attacks described above the medical services functioned with great efficiency and carried on under difficulties in a highly creditable manner, but after the initial attacks on Detling and Eastchurch it was obvious that on these two stations at least it would be impossible to continue nursing sick personnel within the target area; arrangements were therefore made to take over houses approximately two miles from the stations, where in-patients could be treated in comparative safety and medical services could function in the event of the station sick quarters being severely damaged. It was indeed fortunate that such action was taken, because on the afternoon following the transfer to the dispersed sick quarters at Eastchurch, the station sick quarters received a direct hit, one ward and the dental centre being entirely destroyed.

Shortly after this, dispersed sick quarters were introduced at all other stations in No. 16 Group and in every case this step proved of inestimable value, as not only was the danger from air attack lessened but the premises could be used for recuperation, work in the gardens which were often developed providing a means of rehabilitation for convalescent personnel.

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This dispersal also enabled better use to be made of the sick quarters' buildings on the station.

ROYAL AIR FORCE STATION FELIXSTOWE

At R.A.F. Station Felixstowe, which was a pre-war station operating R.A.F. marine craft, three high speed rescue launches were established, and the unit was closely associated with the naval formation H.M.S. *Beehive*, which operated light coastal forces. Buildings and services were generally satisfactory. The station sick quarters was kept for emergency and a dispersed sick quarters at Trimley Heath came into operation in January 1941, while a naval sick bay under the charge of a naval surgeon was opened in the airmen's married quarters in May of that year. There was close co-operation between the R.A.F. and the R.N. medical authorities, and ratings requiring in-patient treatment who could not be carried up the narrow stairs of the building were treated in the R.A.F. sick quarters.

In 1942 the medical arrangements for the R.A.F. and the R.N. were combined. The dispersed sick quarters at Trimley Lodge was extended and re-arranged to accommodate R.A.F., R.N., W.A.A.F. and W.R.N.S. personnel in the thirty-two beds available and the dispersed W.A.A.F. sick quarters, the W.R.N.S. sick bay and the naval sick bay were closed, with consequent economy of staff and greater efficiency. The station sick quarters at Felixstowe was still retained for emergency purposes and used mainly as an operating room; improved equipment and facilities were installed and surgical and casualty work was undertaken, so that there was no difficulty in dealing with the numerous casualties brought in by the rescue launches or from the light coastal force vessels of the Royal Navy. (*See* Plate XX.)

The dispersed sick quarters at Trimley Lodge was later equipped with an X-ray plant and operating theatre and a surgeon was established in order that it should serve as a central sick quarters and provide hospital facilities for R.A.F. Stations Felixstowe, Trimley Heath, Martlesham Heath, Woodbridge, Ipswich and Bawdsey, No. 25 B.D. Sector and H.M.S. *Beehive*. In the first six months of 1944 there were 388 admissions, 48 major and 51 minor operations were performed and 200 X-ray films taken.

NO. 26 AIR SEA RESCUE UNIT

In 1943 the number of high speed launches was increased and these were formed into No. 26 Air Sea Rescue Unit, an increasing number of survivors being brought in after this date. All boats were fitted with tilting stretchers for Eve's rocking method of resuscitation, and instructions and demonstrations on their use were given to the crews; boats carrying survivors were always met at the dock-side by an ambulance. (*See* Plates XIX and XX.)

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There were 433 attempted rescues in the six months of the winter of 1942–3 of which 131 were successful. (*See* Map 4.)

Method of Disembarking Casualties. In order to remove serious casualties in a horizontal position whatever the state of the tide, the stretcher, which was either the standard or Neil-Robertson type, was placed in a canvas stretcher cot; to this was attached a spreader with two hooks fastening to the cot and a pulley above for attachment to a derrick. The stretcher was then swung directly to the waiting ambulance.

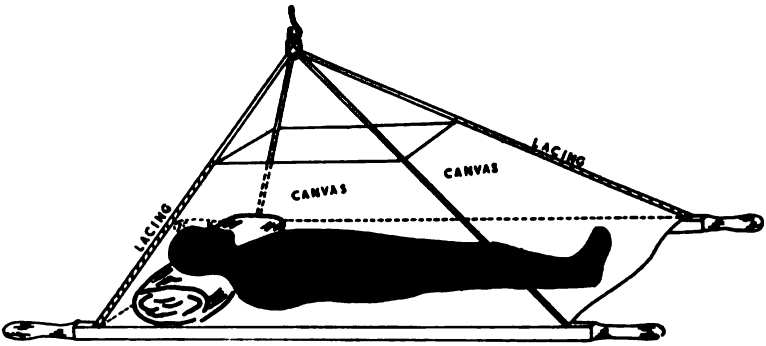

FIG. 1. Diagram of stretcher placed in a canvas stretcher cot.

Treatment of Wounds. The experience of the medical officers at Felixstowe and the central sick quarters at Trimley Heath showed that it was possible to do primary revision and suture of wounds on men who had been immersed in sea water, even if twelve or more hours had passed since the injury had been sustained. The following cases illustrate this point:

(i) An aircrew member rescued after eight hours in a dinghy who had sustained compound fracture of the olecranon. Operation fifteen hours after injury consisted of wound excision, suture and closure without drainage, and application of plaster cast. The wound healed by first intention.

(ii) An aircrew member rescued after four hours in a dinghy with extensive lacerations of the face. These were sutured twelve hours after injury, and sulphanilamide powder applied. Removal of the stitches on the fourth day was followed by perfect healing.

(iii) A member of the crew of a merchant vessel rescued after fifteen minutes in the sea and an hour on a raft. He had a compound fracture of the left humerus and left radius and ulna and the wounds were grossly contaminated with coal and oil. At operation six hours after injury, the wound was excised, loose fragments of bone removed, the fracture set, sulphanilamide powder applied and the wounds closed without drainage. Suitable plaster casts

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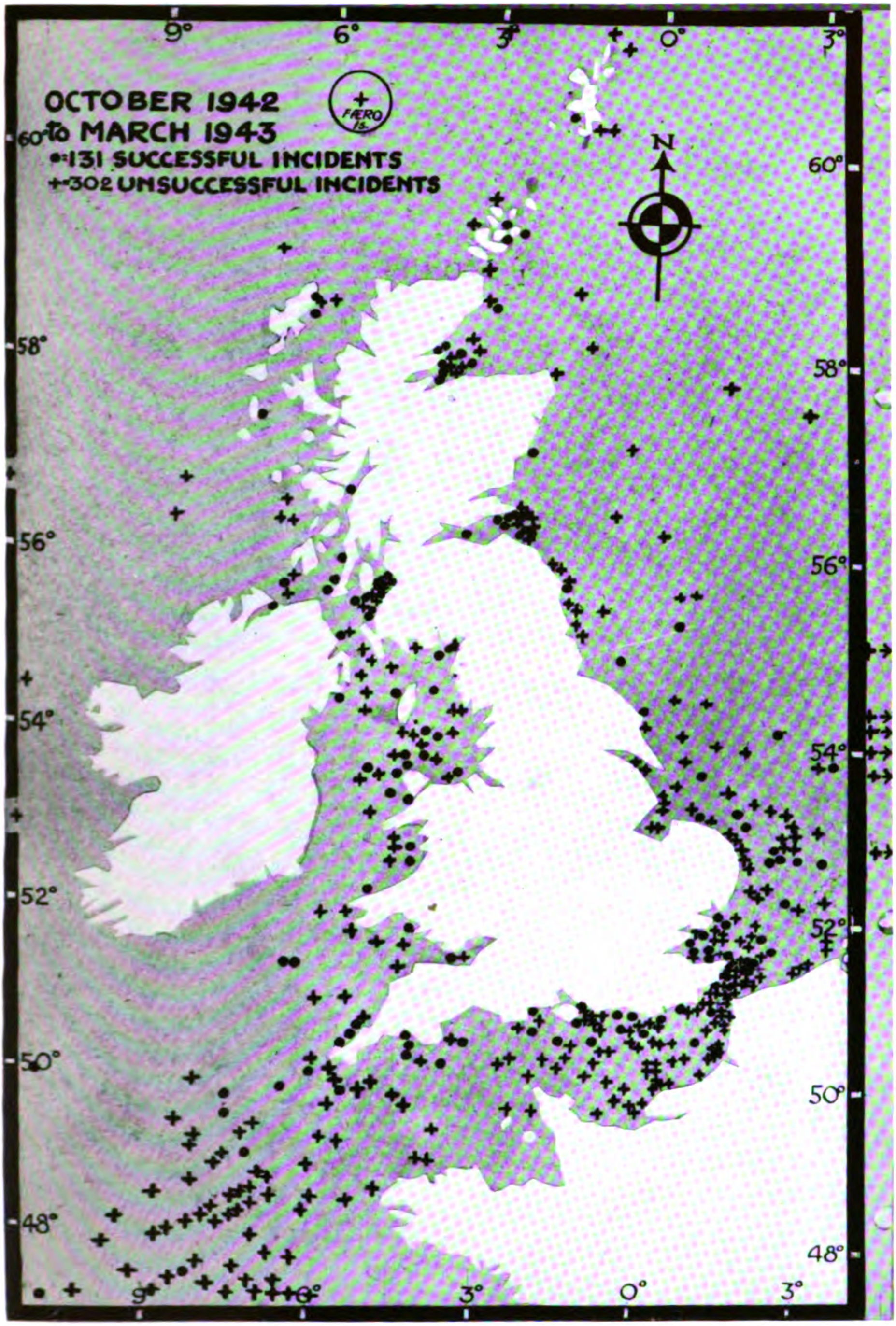

MAP 4: Indication of Positions of 433 Attempted Rescues in Six Months by Rescue Surface Craft and Aircraft

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PLATE XIX: Rescued Aircrew on Deck of High Speed Launch

PLATE XX: R.A.F. 73-ft. High Speed Launch (H.S.L.)

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were applied and on changing the plaster the wounds had healed by first intention.

Clothing of Marine Craft Crews. Three main types of marine craft were used for air sea rescue:

(*a*) high speed launches;
(*b*) pinnaces;
(*c*) sea plane tenders.

Each of these types of craft were wet boats in the mildest of seas and the crew positions extremely exposed. The protective clothing with which they were originally provided was unsatisfactory and N.C.Os. were not able to obtain new uniform more frequently than other airmen in spite of the greater wear and tear, while officers (who were usually of low rank and received correspondingly low pay) were expected to provide new uniform themselves. After strong representation, however, protective clothing was greatly improved and all air sea rescue crews were issued with aircrew clothing.

Medical Personnel at Air Sea Rescue Units. Air Ministry policy did not permit a nursing orderly to be allotted to each high speed launch and consequently situations often arose similar to that at the air sea rescue base at Dover, where there were eight launches and only five nursing orderlies. The number of orderlies available for duty was nearly always reduced to four, owing to sickness and leave, and as it was not unusual for four launches to be out at a time, another going out as each one returned, it was frequently necessary for a nursing orderly to transfer from one launch to another at the harbour bar. These personnel therefore had less off duty time than other members of the crew, although they were exposed to equal strain, fatigue and danger. It was felt strongly that at bases there should have been a nursing orderly as a full member of the crew for each high speed launch.

ROYAL AIR FORCE STATION, BIRCHAM NEWTON

This station, of pre-war construction, operated general reconnaissance squadrons for the first three years of the war and later air sea rescue squadrons. It was at this station that one of the first separate messes for N.C.O. aircrew in Coastal Command was opened.

Aircrew Messes. The dining-rooms and messes were overcrowded but functioned adequately. It had been felt for some time, however, that there was much to recommend the segregation of aircrew N.C.Os. from other senior N.C.Os. The majority of the former were young and their conversation, which was limited to flying and matters connected with flying, soon became boring and even offensive to the older sergeants in ground trades. Furthermore, one of the criticisms frequently levelled at N.C.O. aircrew was that they took no interest in their mess and tended rather to reduce their accommodation to a state of squalid

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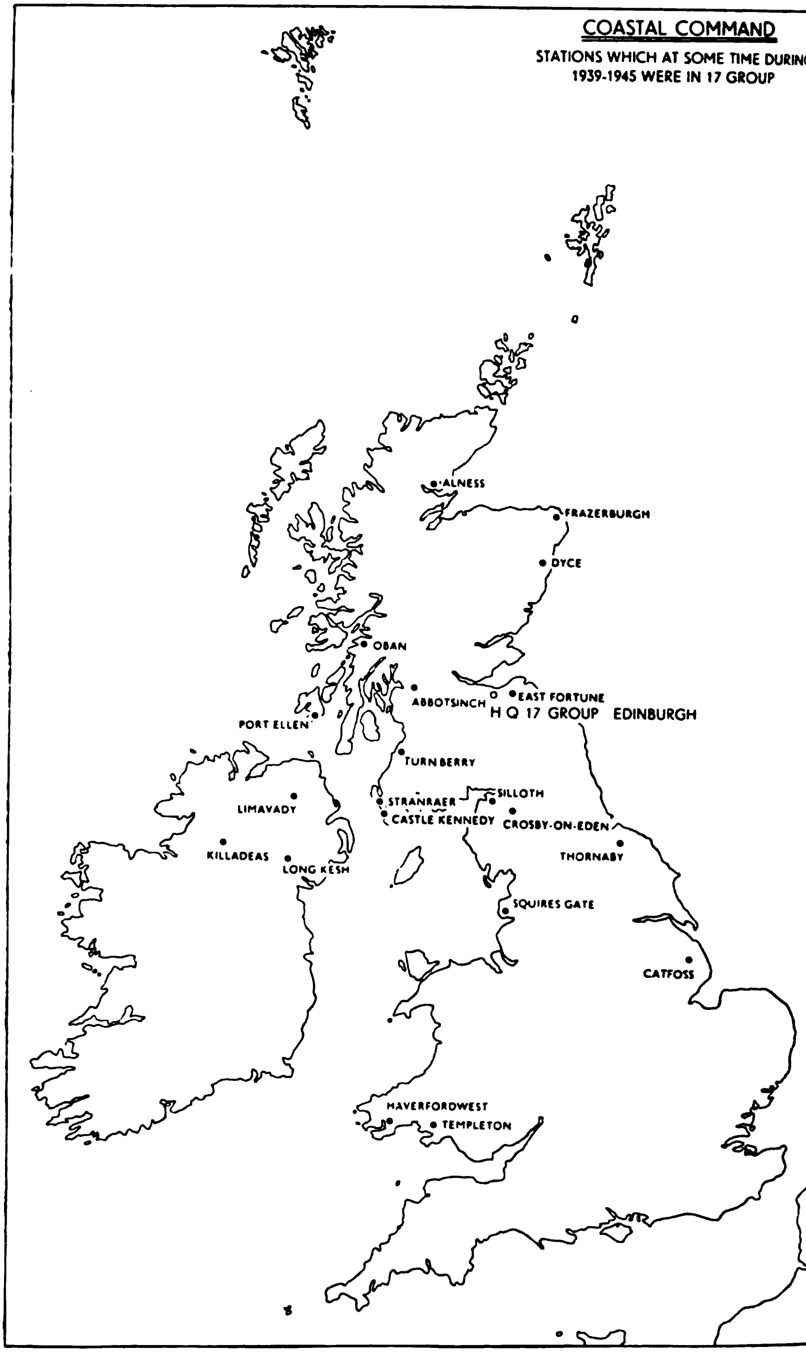

Map 5. Stations which at some time during 1939–45 were in No. 17 Group.

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discomfort, perhaps because they felt that to do their own tidying was beneath them or ill became the toughness of a warrior, or possibly from sheer thoughtlessness. Much of this criticism was justified, for on any station in the Command the N.C.O. aircrews' accommodation tended to be untidy and often dirty. Such criticism could no longer be made at Bircham Newton after the introduction of a separate mess for which the aircrew N.C.Os. were responsible and the innovation was a great success.

NO. 17 GROUP

At the outbreak of war, No. 17 (Training) Group administered three stations—Calshot, Thorney Island and Gosport (*see* Map 1), at which last the Group Headquarters was situated until 1941 when it moved to Edinburgh. The expansion of the Group corresponded to the growth of the Command and with the steadily increasing number of Operational Training Units necessitated by the diversity of aircraft types in use, No. 17 Group became the largest in the Command. (*See* Map 5.)

The growth of the O.T.Us. resulted in acute accommodation problems, which were dealt with in various ways: at Squires Gate, Blackpool, for instance, up to thirty hotels were requisitioned; at Invergordon, S.S. *Batavier* was taken over from No. 15 Group and later, to escape the rigours of winter, the tented camp was struck and the granary of a distillery used as living quarters while a standard dispersed camp was being built. To hasten the completion of this camp, R.A.F. personnel assembled Nissen huts to house the contractor's employees, so that the latter could commence the general camp erection.

Practically all stations in the Group were built on the dispersed site scheme, with all the attendant disadvantages. Sick quarters were widely dispersed and it was found necessary to establish medical inspection rooms at communal sites or near the main centre of activity on the station, in order to avoid the loss of man-hours involved when personnel had to attend the station sick quarters for periodic medical and surgical attention. Originally, Air Ministry policy was that dormitory sites should not be connected with water or sewage disposal, which meant that in some instances men had to make a three mile journey for a bath. This policy was later revised. Brief details are given here of two stations in No. 17 Group which are of particular interest; the first because of a special problem which had to be investigated and the second because of the very nature of its achievements.

R.A.F. STATION, FRASERBURGH

This was in use for a time as a photographic reconnaissance O.T.U. An interesting investigation was carried out at this station into a high incidence of faulty landings, which it had been suggested might be due to the difficulty of assessing height and distance from a low level after

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observing the ground from a high altitude for some hours, or a combination of fatigue and a slight degree of anoxaemia or perhaps of all three factors.

The visual problem was examined by an orthoptist who made no positive findings but discovered that there were no eye muscle defects, or defects in fields of vision after high altitude flying. The experienced pilots—i.e. the instructors—always completed one or two circuits at low altitude before landing in order to re-orientate themselves after a flight at high altitude; this practice was enforced on pupils and with lectures on 'The Human Factors in Aircraft Accidents' the percentage of accidents materially decreased. (The necessity for one or more circuits at low altitude to re-establish height and speed appreciation after long flights was taught in training as far back as 1924.)

R.A.F. STATION, TURNBERRY

This Coastal Command Operational Training Unit on the west coast of Scotland administered an Air Sea Rescue unit at Ayr and a marine craft section at Girvan; although the latter was not established as an Air Sea Rescue base, a pinnace and one of the sea plane tenders were equipped with scale B1 outfits, stretchers and blankets. During the last six months of 1942 the marine craft section, with assistance from local fishing boats, made a number of rescues from aircraft which had crashed close to the shore, 26 out of 49 aircrew personnel involved in thirteen accidents being saved; all those rescued were within three miles of the shore and the majority were supported only by 'Mae Wests', so that there would have been little hope of survival if they had had to wait for rescue by the Air Sea Rescue launch from Troon or Campbelltown, sixteen and thirty miles away respectively. Thus many lives were saved by an efficient marine craft section whose crews had only elementary training in first aid.

It was not considered necessary to have a nursing orderly as a member of the crew of these marine craft, as rescues took place very quickly and it was always possible to have an ambulance with a medical officer and a nursing orderly from R.A.F. Station, Turnberry waiting at Girvan Harbour on the return of the craft concerned.

NO. 18 GROUP

During the war years, Coastal Command stations on the mainland of Scotland and in the Shetlands fell into one of two categories, being either training establishments under the jurisdiction of Headquarters No. 17 Group or operational stations administered by Headquarters No. 18 Group. The medical history of the training stations has been outlined in the section devoted to No. 17 Group and the present

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narrative is therefore devoted to the operational stations; it is the story of a struggle against conditions liable to produce disease rather than against disease itself, and hence of preventive rather than curative medicine.

ADMINISTRATIVE DEVELOPMENTS

At the outbreak of war, No. 18 Group Headquarters was divided into the temporary Operations Room at Royal Naval Air Station, Donibristle, and the administrative section at Pitreavie Castle, where a permanent underground Operations Room was under construction. The medical staff at this time consisted of one civilian medical practitioner and one nursing orderly, with two other civilian medical practitioners who could be called on in emergency. The sick quarters was in part of one of the officers' living huts at Pitreavie Castle and comprised a medical inspection room and a three-bedded ward for airmen.

On September 18, 1939, a wing commander was posted in as Senior Medical Officer to the Group, and the construction of a sick quarters was put in hand at once; this sick quarters was completed in August 1940.

Liaison with local civil authorities was an early and important task for the Senior Medical Officer, and in July 1940 the latter was appointed part-time liaison officer with the Emergency Medical Services in Scotland. This appointment carried no executive authority but was rather a channel for the interchange of information between the Royal Air Force in Scotland and the Scottish Department of Health. Originally, Headquarters No. 18 Group had passed information through the usual Royal Air Force channels to Headquarters Coastal Command, the latter passed it to other Commands for transmission to the appropriate Groups, and these in turn passed it on to the stations concerned. In March 1941 authority was given to the Senior Medical Officer of Headquarters No. 18 Group to communicate direct with the senior medical officers of those groups which had stations in Scotland, sending copies of all such correspondence to the respective commands. This proved to be a great time saver and when, later, a number of commands authorised direct communication with their stations, even speedier action became possible.

In August 1940, the Senior Medical Officer, No. 18 Group, was appointed Royal Air Force representative to the Technical Committee of the Scottish National Blood Transfusion Association. In January 1941 he was also appointed part-time liaison officer with Scottish Command, and thus became the link between the Royal Air Force in Scotland and both the Army and the civil authorities. This arrangement was continued until the end of hostilities. In November 1941 this officer was appointed Royal Air Force representative to the Medical Personnel

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(Priority) Committee No. 11 Region and Royal Air Force representative in Scotland on the Inter-Services Committee.

MEDICAL BOARDS

It rapidly became obvious that if the normal procedure for Medical Boards in Army, Naval and Civil Hospitals continued to be applied in Scotland, chaos would result. The Scottish hospitals were dealing with an unfamiliar administrative routine involving group headquarters scattered throughout England and Scotland, and a large proportion of the medical documents were going astray; accordingly in April 1940 the Senior Medical Officer of No. 18 Group was authorised to act as Competent Medical Authority for Royal Air Force cases in hospitals in Scotland.

In the same month, a squadron leader medical officer was posted to the Group to act as President of a Permanent Medical Board which would tour the country holding boards on these Royal Air Force personnel and advising on their disposal. Originally, all Boards were convened at the hospitals because of lack of accommodation at Group Headquarters, but after completion of the station sick quarters at Pitreavie Castle, two days each week were reserved for the holding of Boards there, thus enabling the Boards to reduce the time spent in travelling and consequently undertake an increased number of appointments. In August 1940 the medical department of Group Headquarters was given the administrative status of a station hospital and was authorised to board cases direct from Royal Air Force stations.

OPHTHALMIC SERVICES IN SCOTLAND

Up to the end of 1941, ophthalmic work for Royal Air Force personnel stationed in the area of Scotland south of a straight line passing through Peterhead and Inverness was carried out by:

(*a*) Civilian Ophthalmic Specialists working in E.M.S. Hospitals and under the National Ophthalmic Treatment Board Scheme.

(*b*) Army Ophthalmic Specialists.

(*c*) Navy Ophthalmic Specialists (Royal Naval Hospital at Kingseat in the special instance of R.A.F. Station Dyce).

(*d*) One of the officers on the Headquarters No. 18 Group Medical Board who had ophthalmic specialist experience. He saw a number of cases in which a special knowledge of flying conditions or of ophthalmic standards in the Royal Air Force was required.

(*e*) The Ophthalmic Specialist at No. 11 Aviation Candidates Medical Board, Edinburgh who saw as many cases as his other work permitted.

Station medical officers had to send their patients to the nearest E.M.S. or Army Eye Specialist, although special cases (e.g. aircrew) sometimes had to travel considerable distances to be seen at No. 18

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Group Headquarters or No. 11 A.C.M.B. Royal Air Force stations in the neighbourhood of Edinburgh or Glasgow were adequately served, but those around Dumfries and Stranraer encountered great difficulty as there were no eye specialists in that area; ophthalmic cases from Oban, Islay and Tiree had to be sent to Edinburgh, Glasgow or Stirling, which necessitated an absence of up to four days from their unit. All in-patient hospital ophthalmic treatment for members of the Royal Air Force was carried out in E.M.S. or Army hospitals by the specialists attached to those institutions.

In June 1942 a Royal Air Force Ophthalmic Service was organised in the southern area of Scotland, the aim being firstly to make it possible for every member of the Royal Air Force requiring ophthalmic examination to be seen by the Royal Air Force Eye Specialist without travelling excessive distances or having to wait an undue time for an appointment, and secondly to provide in-patient hospital treatment.

The out-patient service was provided by the eye specialists visiting sub-centres at Pitreavie Castle, Edinburgh, Glasgow, Dumfries, Stranraer and Montrose, to which their ophthalmic cases were sent by stations within a radius of approximately 60 miles. (*See* Diagram below.)

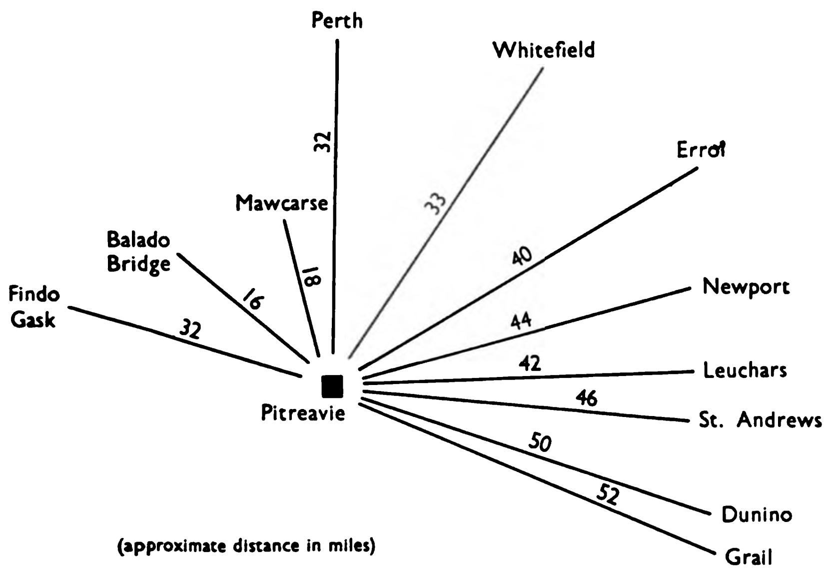

FIG. 2. Diagram showing area served by ophthalmic sub-centre at Pitreavie Castle.

Pitreavie Castle was the headquarters of the Royal Air Force Ophthalmic Specialist who saw patients here two days a week. In addition a monthly visit was made to Royal Air Force Station, Oban where personnel from that station and from Royal Air Force Station, Connel and urgent cases from R.A.F. Tiree and Benbecula were seen. Royal Air Force Stations, Islay and Tiree were visited once every two months.

The problem of in-patient treatment was eventually solved by the allocation to the Royal Air Force of twelve beds for ophthalmic cases in the E.M.S. Hospital, Gleneagles, which opened in January 1943. An orthoptist was established at the Gleneagles centre in January 1944 and worked there until February 1945. Treatment was given to 131 patients, of whom 16 required surgical interference. An optical dispensing unit was added to the centre in July 1944, and during the eleven months of its operation, 2,195 optical prescriptions were dispensed, with a maximum monthly total of 340 during November 1944.

NEUROPSYCHIATRIC SERVICES IN SCOTLAND

In June 1940 a Royal Air Force Neuropsychiatric Specialist was established at Headquarters No. 18 Group. His duties consisted of the investigation of neuropsychiatric cases, visiting various hospitals under the E.M.S. Scheme as required, and supervision of the N.Y.D.N. centre at Dunblane, an Army convalescent depot where a number of beds were made available to the Royal Air Force for N.Y.D.N. cases. The policy was for him to keep in close touch with the executive side by visiting Royal Air Force stations in the area, the frequency of these visits varying with the probable incidence of flying stress. In addition, whenever possible he assisted the Senior Medical Officer at No. 18 Group in routine work and medical boards.

In the middle of 1941 it became apparent that neuropsychiatric cases were not receiving the specialist attention which should have been made available to them. They were being admitted to E.M.S. Hospitals all over Scotland and some of the head injury cases were being sent back to their units after three or four days' treatment. The Department of Health for Scotland was requested to nominate an E.M.S. Hospital to which all Royal Air Force neuropsychiatric cases could be admitted and visited by a Royal Air Force Specialist, who would arrange investigation and disposal; eventually twelve beds were made available in No. 33 General Hospital, Peebles together with consulting rooms and offices. A Royal Air Force Specialist was established at Headquarters No. 18 Group for duty at this N.Y.D.N. Centre which opened on September 1, 1941; he also visited the following hospitals to give advice on Royal Air Force patients:

Carstairs E.M.S. Hospital .	once in ten days
Bangour E.M.S. Hospital .	(neuro-surgical unit) once in two or three weeks.
Bellesdyke Military Hospital .	(psychosis and psychopathic states) once in six weeks.
Dumfries Military Hospital .	(officers only) once in six weeks.

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Flying stations south of Dyce were visited regularly but stations north of Dyce, including the Orkneys and the Shetlands, were visited by the Senior Medical Officer, No. 14 Group, who was also a neuropsychiatrist. A quarter of the patients seen by him were referred for further investigation at Peebles.

ROYAL AIR FORCE N.Y.D.N. CENTRE

No. 33 Army General Hospital, Peebles. The Centre worked satisfactorily for both in- and out-patients. There were good facilities for investigation by Ophthalmic, E.N.T. and Radiological Specialists and it was possible for out-patients coming from long distances to be detained for twenty-four or forty-eight hours. Ground personnel were medically boarded at the hospital but aircrew personnel were usually sent to No. 11 A.C.M.B. Edinburgh. The chief disadvantage of the Centre was its inaccessibility and poor train service, although there was an excellent bus service to and from Edinburgh. The twelve beds were found sufficient and there was reasonable accommodation for officers; there were no indoor sports or amusements but a good cinema in the town and outdoor recreation was available in the summer. The administration had to be carried out in a small consulting-room-cum-office; most of the interviews were therefore of necessity carried out in the presence of the medical clerk.

E.M.S. Hospital, Gleneagles. Although this hospital was sixteen miles from the nearest town, Perth, and somewhat bleak in winter, it had good rail and bus connexions, full facilities for medical investigation and pleasant grounds for patients' recreation; the N.Y.D.N. Centre moved there in the summer of 1942, and remained until the end of the war. About 100 cases were seen each month. The policy regarding this Centre was re-stated in September 1943, when it was laid down that the following cases would be admitted:

(*a*) Mental disturbance of any form including psychosis, neurosis, epilepsy and mental defect.

(*b*) Organic neurological disorders, head injuries, peripheral nerve injuries and sciatica.

(*c*) Doubtful neurological disorders, severe migraine.

(*d*) Obscure medical cases of doubtful organic or functional origin.

CHIROPODY

On December 31, 1942, a chiropodist was posted to Headquarters No. 18 Group, his work being at first confined to stations of that group, which he visited at the request of the station medical officers, staying as long as was required to treat all those needing attention. Later, he visited stations outside No. 18 Group at the request of the senior medical officers of the groups concerned.

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As other Royal Air Force chiropodists were operating in Scotland from different Group Headquarters, the areas overlapped and it would possibly have been more economical in man-power and travelling time to organise this service on a regional rather than on a group basis. The service was popular with medical officers and prevented much non-effectiveness due to minor foot conditions.

W.A.A.F. MEDICAL WELFARE

On February 11, 1943, a nursing sister of the Princess Mary's Royal Air Force Nursing Service was posted to Royal Air Force Station, Wick for W.A.A.F. medical welfare duties. Her sphere of activity very quickly spread to other Royal Air Force units in the north of Scotland, covering an area as far south as Dyce, across to the west coast and including the Orkneys. Her assistance in dealing with W.A.A.F. problems was of great value to medical officers and the visits were continued until late in 1944, when the scarcity of nursing sisters at the Bignold Hospital at Wick made it impossible to release one to tour the stations.

An establishment for a nursing sister for W.A.A.F. medical welfare was created at Headquarters No. 18 Group late in 1943, but owing to the great demand for nursing sisters at this period of the war, the post was never filled. It was considered by all Senior Medical Officers that a nursing sister of the right type could be invaluable in this sphere but one of the wrong type a menace. The ideal was a woman of mature years, placid and kindly, a good listener, possessing sound judgment and a profound knowledge not only of nursing and allied subjects but of everyday problems peculiar to the female sex.

STATIONS AND MEDICAL PROBLEMS

The mainland stations comprising No. 18 Group changed from time to time, depending on the operational commitments of the Group. (*See* Maps 1, 2 and 6.) At the outbreak of war, they were Leuchars, Dyce, Invergordon, Wick, Oban, Helensburgh, Abbotsinch and Montrose; of these Leuchars, Wick and Helensburgh were the only ones to remain in the Group until the end of hostilities. Greenock and Tain came into the Group at a later date and towards the end of 1944 Milltown, Dallachy, Banff and Frazerburgh were taken over to facilitate operations against the U-boats heading for the Atlantic *via* the north coast of Scotland.

In the Shetlands, the two stations Sumburgh and Sullom Voe were in the Group throughout the war. Flying boats of No. 100 Wing were operating from Sullom Voe in the very early stages, using S.S. *Manela*, anchored in the Voe, as a base, while the station was being built. Vaagar, in the Faroes, came into the Group in 1942, and is the subject of a separate section.

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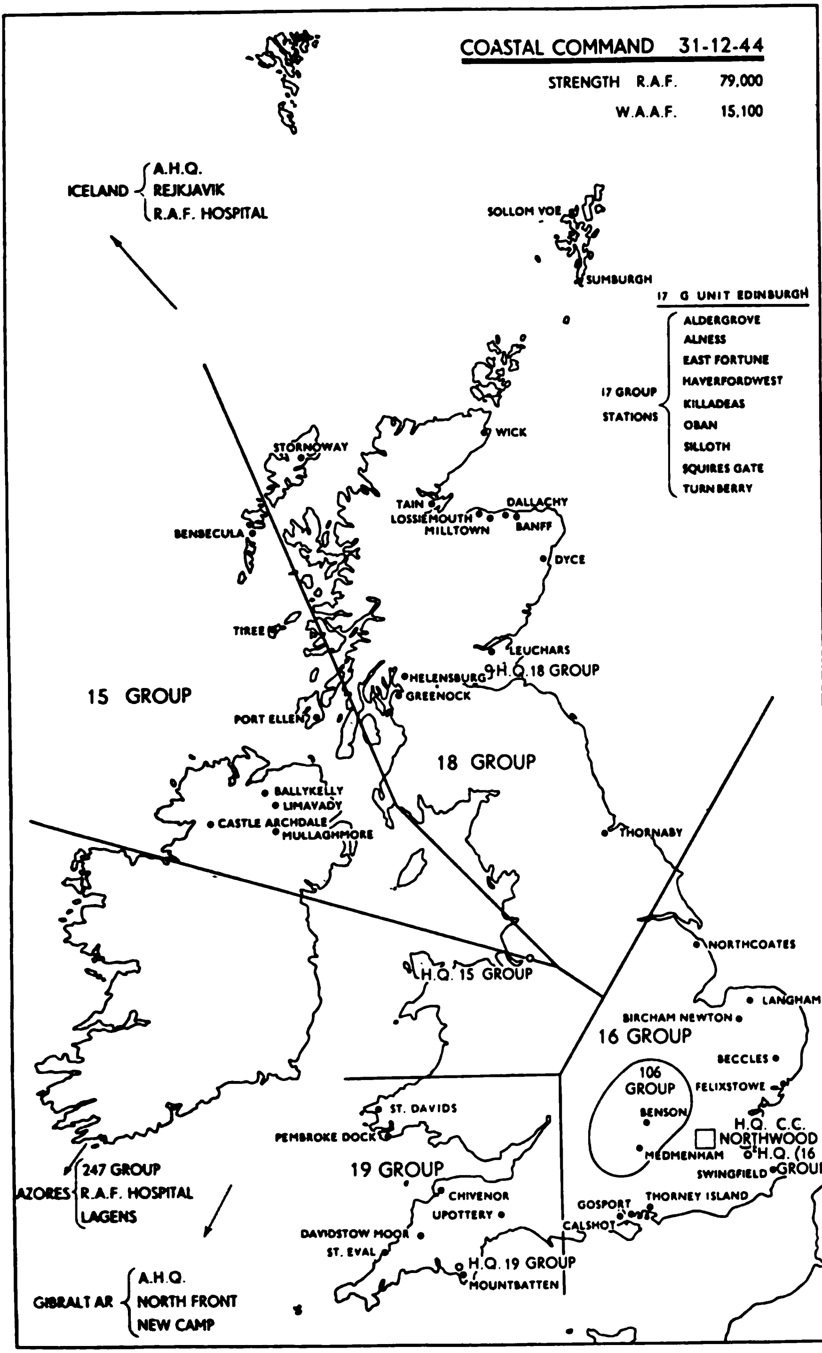

MAP 6. Stations in Coastal Command on December 31, 1944.

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Some of the units were pre-war stations of permanent brick construction, others were entirely hutted camps, and some were located in requisitioned buildings in urban areas. On the pre-war stations, the permanent buildings were insufficient to house the war-time establishments and were supplemented by type-design hutted buildings. The problems encountered were mainly those of hygiene and preventive medicine, varying slightly with the type of station, but in the main similar to those encountered throughout the Service; these have been adequately dealt with elsewhere. (*See* Chapter 1.)

Laundry. This presented special difficulties in the early days, varying according to the isolation of the station. On the mainland, where civilian laundries were available, suitable contracts were eventually made. The main difficulty was experienced at Wick, a large station near a small urban area.

In the Shetlands, however, civilian facilities were largely non-existent. A trial was made of sending laundry to the mainland, but this was most unsatisfactory as it took a minimum of six weeks to return. Laundries were then constructed at Sullom Voe and Sumburgh, so that airmen could do their own washing, but unfortunately the water supply was inadequate.

MEDICAL ORGANISATION AT STATIONS

Most stations had sick quarters, the size depending on the strength of the particular station. The normal Royal Air Force policy of providing dispersed sick quarters was difficult to apply in these areas, as suitable buildings outside the target area were not easily acquired.

At Dyce, which was transferred to No. 17 Group on February 11, 1943, a dispersed station sick quarters was opened on the last day of 1941; this proved to be a doubtful asset as it was situated 8 miles from the unit and the resultant splitting of the medical staff made it difficult for both sick quarters to operate efficiently, apart from the obvious transport problems. In retrospect, one cannot but regard dispersal to this extent as uneconomic, resulting in increased use of transport and the stretching of the medical establishment beyond its limit.

Wick Station Hospital. The only other station in the Group which could be considered to have had a dispersed sick quarters was Wick. It was housed in the former Bignold Hospital on the perimeter of the airfield, and when fully staffed, it was equivalent to a small station hospital providing surgical and other specialist facilities. In addition to accepting patients from Royal Air Force Station Wick, the hospital provided in-patient and out-patient treatment for personnel of other Royal Air Force units and units of other Services in the area.

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The opening of the Bignold sick quarters at the beginning of 1944 was the culmination of protracted discussion and planning within the Royal Air Force and lengthy negotiations with the local Health Authority. From the beginning of the war, concern had been felt at the scarcity of accommodation for acute hospital cases, especially surgical, in the Caithness area. Shortly after the outbreak of hostilities, the civilian staff of the Bignold Hospital moved to a school building at Lybster, 16 miles from Wick, taking with them most of the hospital equipment and leaving no suitable hospital in the area.

Various schemes were mooted to compensate for this deficiency and the first active step was taken by the Royal Air Force in April 1941 when a Special Treatment Centre was opened at the station sick quarters at Wick. This proved a great saving in man-hours, as previously all patients had to travel to Aberdeen or Glasgow for continuation treatment, each visit involving an absence of at least three days. In October 1941 a Royal Air Force surgeon was posted to Wick to supervise Service patients in the civil hospital at Lybster and the Special Treatment Centre at Wick; the Centre continued to function very efficiently until the end of the war, but the initial arrangements for surgical cases were by no means satisfactory.

Facilities for surgical treatment were improved by the opening, in 1943, of a theatre with X-ray in the station sick quarters at Wick. Lack of beds prevented their full use, but this was accepted as an interim measure; unfortunately the plan to build a station hospital was abandoned owing to the shortage of both labour and materials and negotiations were opened with the local Health Authority to take over the evacuated Bignold Hospital. Agreement was eventually reached, and after a number of structural alterations, the hospital was opened in January 1944.

In January 1943 the Royal Air Force surgeon at Wick had been given the status of surgical specialist, and after the opening of the hospital, regular visits were paid by Ear, Nose and Throat and Ophthalmic Specialists. The availability of these specialists and of facilities for laboratory and radiological examinations saved a great amount of time, both in returning personnel to duty and in invaliding. The hospital functioned most efficiently throughout the war and was handed back to the civil authorities shortly after the end of hostilities.

There is no doubt that the hospital amply justified its existence. It provided in-patient accommodation and skilled medical and nursing attention in a remote area where the civilian resources could not deal with the greatly increased population. Its success in the eighteen months of its existence indicated that, in war-time, the early establishment in remote areas of similar units undoubtedly results in economy of man-power and probably saves lives.

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Anti-Gas Defence. At the commencement of the war, no adequate accommodation existed for the decontamination of wounded or unwounded personnel. Decontamination centres were improvised while liaison with local A.R.P. authorities ensured assistance in the event of an emergency beyond the resources of stations; these centres were constructed fairly quickly at most stations and at the end of hostilities Vaagar—a most unlikely target—was the only station without adequate facilities.

AIR ATTACK

The stations of No. 18 Group suffered very little from enemy action at any stage of the war and on no occasion therefore were the medical arrangements for dealing with casualties tested to the full. In the early months and again in January and February 1942 a few minor sporadic attacks were made at Sullom Voe, Sumburgh and Wick. The only fatalities which occurred were at Sumburgh where one airman was killed outright and another died later from injuries; all other casualties were of a minor nature. During the attack on Wick, the medical officers, nursing orderlies and ambulances were able to assist the civil authorities with civilian casualties.

Air Sea Rescue. The Air Sea Rescue bases on the east coast of Scotland and in the Shetlands were under the operational control of Headquarters No. 18 Group. Shortage of medical staff did not always allow a nursing orderly to be available for each launch, but in practice, few operational sorties took place without a nursing orderly being included in the crew.

At more isolated bases where there was little medical work to do, a nursing orderly tended to become more of a motor boat crewman than a nursing orderly and it is doubtful in these circumstances whether a nursing orderly was an essential member of a crew, as an intelligent non-medical member of the crew, trained in first aid and resuscitation methods, would probably have sufficed. (*See* Volume I, Chapter 11, Air Sea Rescue.)

Mountain Rescue. A Mountain Rescue Service, centred at Royal Air Force Station Wick, was formed late in 1944, composed entirely of volunteers, skilled or interested in mountaineering. The organisation was necessary owing to the nature of the terrain on which aircraft might and often did crash. In less wild country it was usually possible for ambulances and other rescue vehicles to approach sufficiently near the scene of accidents for injured crew members to be carried from the crash to the ambulance. In these wild uplands and hills, however, few roads existed and many of the tracks were impassable to motor vehicles; furthermore the exact location of the crash was often in doubt. Thus the teams consisted of stretcher bearers and medical personnel, specially trained in carrying and manoeuvring stretchers over the roughest

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of country or down mountain sides; the teams were often provided with wireless so that contact with the base could be maintained. The service operated on numerous occasions in the north-east area of Scotland and fully justified its existence. (*See* Chapter 8, Flying Training Command.)

HEALTH OF THE GROUP

Throughout the war years No. 18 Group was singularly free from any major outbreak of disease. There were the usual seasonal increases in upper respiratory infections and occasional outbreaks of influenza, but these occurred only at times when the civilian population was similarly affected. Occasional outbreaks of gastro-enteritis occurred, but the number of cases was never large, no individual case was of a serious nature, and all responded quickly to treatment. Towards the end of 1943 and during the first three months of 1944, there was an unusually high incidence of infective hepatitis at Sullom Voe and Leuchars; the numbers never assumed epidemic proportions although fresh cases kept occurring over a long period. A feature of interest was the number of Norwegians affected, which was quite out of proportion to their relative strength; careful examination of all the case histories offered no explanation for this phenomenon.

Skin conditions were comparatively rare despite occasional shortages of water and lack of adequate ablution facilities in the early months of the war. Tinea, scabies and infestations with pediculi occurred regularly, a high proportion of cases arising after personnel had been on leave.

As the Shetlands were not regarded as an overseas posting, of necessity a fairly high proportion of Grade III personnel were sent there and generally did not give efficient service under the conditions prevailing. Neuropsychiatric and chronic middle ear cases were particularly adversely affected and usually had to be returned to the mainland after a comparatively short period; it is assumed that the isolation and primitive conditions were too great a strain for the unstable personalities and that the climatic conditions, in particular the almost constant high winds, stirred up, as might be expected, the middle ear infections. The numbers returned to the mainland were such as to suggest that it was uneconomic to post cases of these types to the Shetlands or to areas where similar conditions prevail.

Venereal Disease. The incidence of venereal disease was roughly similar to that of other commands but a notable feature was the absence of locally contracted infections on stations in the Shetlands. Personnel treated there were either continuation cases or infections contracted while on leave on the mainland. Treatment was available at the Military Hospital at Scalloway and loss of time for those undergoing treatment was minimal.

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Aircrew. Flying stress problems were encountered but to a lesser degree than in most other operational Commands, as the operational tasks of Coastal Command in Scotland were mainly convoy protection, anti-submarine patrols and attacks against shipping.

The first and second of these necessitated long hours in the air, in the instance of Catalinas up to twenty hours and over; in such circumstances, the strain was as much physical as mental, and boredom was probably as great an enemy as fear. Meals in the air were a big problem which had not been satisfactorily solved by the end of the war, although a considerable amount of research had been carried out by Transport Command and the Institute of Aviation Medicine at Farnborough.

With the 'strike' squadrons, it was found that a long stand-to, even if the sortie were finally cancelled, was a greater strain than an actual operational trip. (*See* Chapter 1, Bomber Command.)

Operations Rooms. Certain problems presented by operations room staff were peculiar to such personnel. The fact that all their work was carried out in artificial light appeared to exert a not inconsiderable psychological influence on a large number of personnel and fluorescent lighting was installed in many operations rooms in an attempt to remedy matters; although this was an improvement, it was not a complete success and up to the end of the war, occasional instances arose where strain was noticeable after personnel had worked for comparatively short periods under these conditions. The difficulty was probably temperamental, and careful selection of personnel would appear to be the best solution.

Twenty-four hour watches had to be maintained at Group Headquarters and on all stations. The four-watch system, with four people covering a four-day cycle, was adopted and continued until early in 1944, when a system in which each individual did a full week of night duty was tried; this, however, was quickly abandoned as it proved most unpopular and appeared to be a much greater strain than the former system. In a hospital, where a nurse goes on night duty for months at a time, she is able to become accustomed to this change, and after the first fortnight, can carry on quite happily. To condemn watchkeepers to a week of night duty every fourth week was subjecting them to this trying acclimatisation period at regularly recurring intervals and inevitably to a far greater strain than the one-night-duty-in-four cycle. Short of putting watchkeepers on night duty for periods extending into months—a system which would ultimately have broken down after allowance had been made for attachments, courses, postings and sickness—the four-day cycle was the fairest and least fatiguing. Even when one of the four personnel was absent, as frequently happened, the resultant three-day cycle was more acceptable and less fatiguing than the week of continuous night duty.

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NO. 19 GROUP

Headquarters No. 19 Group was formed in 1940 when Headquarters No. 15 Group moved from Mountrose, Plymouth, to Liverpool (*see* section on No. 15 Group). The new Group took over the vacated Headquarters building, in combination with the new Naval Command at Plymouth, and controlled Coastal Command operational stations in South Wales and South-west England.

The primary object of the Group was the detection and destruction of enemy submarines and surface craft, but it was also, in common with the other Groups, actively engaged in meteorological flights and Air Sea Rescue.

The Area Combined Headquarters was, as was customary, underground, with the attendant problems of lighting and ventilation. Half-yearly medical examinations were instituted for airwomen working in these conditions, and it was found necessary to transfer them from the three to four watch system, as they were showing signs of fatigue, anorexia, insomnia and irritability.

ROYAL AIR FORCE STATION, PEMBROKE DOCK

Although Pembroke Dock was a pre-war station, no sick quarters had been built because of its proximity to the military hospital; it became evident, however, that a station sick quarters would be necessary and accommodation was improvised by taking over two large married quarters, a step which proved to be particularly fortunate, as the military hospital was later destroyed by bombing. Personnel of a R.A.A.F. Squadron stationed here in the winter of 1940 showed a very high rate of upper respiratory infections, which culminated in an outbreak of cerebro-spinal meningitis, but all cases were successfully treated in the station sick quarters.

Early in 1941 it was possible to open a dispersed sick quarters at Holyland House, a few miles from Pembroke Dock, where there was accommodation for 40 in-patients and cases such as pneumonia, pneumothorax and fractures, not usually nursed in sick quarters, were treated successfully. Patients were accepted from the naval base at Pembroke Dock and the Fleet Air Arm, Talbenny, as well as from four other R.A.F. stations in the area, but a request for personnel to be admitted from Army units at Manorbier had to be refused owing to shortage of beds.

In 1941, the Meyrick Nursing Home in Pembroke closed down, unfortunately depriving the R.A.F. of local X-ray facilities and making it necessary to send all patients requiring X-rays to the Pembroke County War Memorial Hospital at Haverfordwest; this involved considerable loss of time and was an added burden on transport. Eventually, however, the X-ray plant from the Meyrick Nursing Home

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was installed in Woodbine House Hospital, Pembroke, which, as will be seen later, became a combined R.A.F. and E.M.S. hospital.

Surgical Facilities. A very serious lack of surgical facilities in the South Wales area led to the holding of a conference in April 1942 between representatives of the E.M.S. and the three Services, the R.A.F. being represented by the C.O. of R.A.F. Hospital, St. Athan and the S.M.O., Headquarters No. 19 Group. It was eventually agreed that the Public Assistance Institution at Woodbine House, Pembroke, should be taken over as an E.M.S. Hospital, equipped, supplied and staffed by the E.M.S. but available for E.M.S., Navy, Army and R.A.F. patients, the Services undertaking to provide an experienced surgeon to run the hospital. It was later decided to ask the Air Ministry to send such a surgeon to Pembroke Dock and in July 1942 a Flight Lieutenant surgeon who was a F.R.C.S. was posted in for station duties as the second medical officer allowed by the establishment of Pembroke Dock and also to engage in part-time surgical duties at Woodbine House Hospital.

It soon became evident, however, that the medical officer concerned could not discharge his surgical functions satisfactorily except at the expense of his station duties, and after further representations, a medical officer from the Group pool was attached to Pembroke Dock, freeing the surgeon for full-time hospital duties. Even when this surgeon was made available for full duty the position was not satisfactory, because, as the only suitably qualified man in the area, he was necessarily on call for 24 hours every day. No anaesthetist was provided and the services of any medical officer who could spare the time from his station duties had to be employed. It was sometimes difficult to find such an officer, especially in an emergency, and there could be no guarantee that he was experienced in the advanced technique required for certain major operations.

After some discussion and following a visit by the D.G.M.S., R.A.F., in March 1943, it was decided to provide a 100-bedded R.A.F. hospital at Haverfordwest to serve the area, but owing to building delays this hospital did not become available until January 1945. The Woodbine House Hospital, therefore, continued in use for a further period of eighteen months.

It would appear that before the visit of the D.G.M.S., higher authority had failed to appreciate that the Woodbine House Hospital was responsible for the surgical care of 20,000 Service personnel as well as for the local civil population. As an indication of the size of this commitment, details of the surgical work carried out during the first year are tabulated below:

Total Surgical in- and out-patients . . .	3,293

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Out-patients	2,779		
In-patients	514		
Operations	437	Navy	55
		Army	130
		R.A.F.	183
		E.M.S.	69
X-rays	2,500 (approximately)		
Deaths	5		

The whole-hearted co-operation of the medical officers of Pembroke Dock and the S.M.O. No. 19 Group, alone made it possible to achieve this result. The Commanding Officer of the station gave unfailing support, granting every facility in his power, and some of the officers' wives assisted voluntarily as masseuses and secretaries. The Master of Woodbine, though his first allegiance was to the Public Assistance Committee, proved a staunch friend and ally throughout, and his help and co-operation were invaluable.

Bush House. This was a large house originally requisitioned as an emergency operations block but taken over in 1942 as a dispersed sick quarters for airwomen; there were 10 beds, which were also utilised by other stations in the area, Talbenny, Carew Cheriton and Manorbier. In accordance with Air Ministry policy, a P.M.R.A.F.N.S. sister was posted to Pembroke Dock to supervise the hygiene and welfare of W.A.A.F. personnel in the area and to assist in the nursing of patients in the various sick quarters.

ROYAL AIR FORCE STATION, ST. EVAL

R.A.F. Station, St. Eval was situated eight miles from Newquay in Cornwall, on fairly high ground (about two hundred feet above sea level) and roughly a mile inland. The station was planned in 1938, building beginning the following year, and was uncompleted at the outbreak of war; the lay-out conformed fairly closely to pre-war and early war designs for R.A.F. stations, the station proper comprising the usual wooden administrative buildings, accommodation blocks and messes. Numerous enemy attacks in 1940 and 1941 made it necessary to use dispersed sites for large numbers of personnel and this gave rise to accommodation, sanitation, sewage disposal, water supply and allied problems.

Requisitioned Accommodation. Large houses and hotels in this area were built primarily for the short holiday season in peace-time; water and sanitation services were therefore of an equally temporary nature and soon gave rise to difficulties when these buildings were occupied all the year round by greater numbers than had ever been intended. In addition, the requisitioned houses were anything up to ten miles from the station and perhaps separated from one another by twelve

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miles or more; this placed an extra burden on the medical staff who had to visit sick personnel in billets, maintain the sanitary diary and arrange air-raid precautions in each instance, besides various routine duties.

Sewage Disposal on the Station. This was planned for a population of about a thousand and consequently, from 1942 onwards, when the station strength was between three and four thousand, the system was constantly over-loaded and when the effluent was tested there were found to be 16 instead of 3 parts of organic matter per 100,000; fortunately, however, the danger of pollution was extremely slight, as the stream into which the effluent flowed was short and soon reached the sea, passing through an unpopulated region.

Sanitation on Gun-sites. Gun-sites and other dispersed sites around the perimeter of the station depended on Elsan closets or bucket latrines, the disposal of bucket contents being by Otway pits.

Water Supply. R.A.F. Station, St. Eval had two sources of water supply—the Music Water Springs, supplying about 72,000 gallons a day, and Padstow Council, about 12,000 gallons a day, giving a total of 84,000 to 90,000 gallons per day; this fell to about 70,000 gallons in summer, when the Padstow supply failed, and water was cut off on several occasions in the summers of 1941, 1942 and 1943.

In the Mawganporth area there were three billets which were dependent on the local water supply; owing to the state of overcrowding and inadequate installations, this supply tended to run dry during the summer months and water was considerably restricted in consequence, sometimes being cut off completely; the inconvenience caused was especially great as these billets were occupied by aircrew and the sick quarters was also in this area, but a suggestion that a new pipe line should be laid to bring an auxiliary supply to the main reservoir was not followed up, because the area medical officer of health considered that restriction was the more economical way of solving the problem.

The billets in the Trevarnon Bay Hotel area were dependent on relatively shallow wells which were liable to be affected by drought in the summer months and also presented the very real danger of contamination, so that all water had to be boiled before being used for drinking. The supply was augmented from the station, using water trailers, but this placed a great strain on the already overburdened station supply and on the transport section.

In 1943, a 5,000 gallon per hour pump was installed at the Music Springs Reservoir to replace the existing 3,000 gallon per hour pump. Matters were considerably improved by this alteration, but it was not until 1945, when a large leak in the main supply was discovered and remedied, that the water supply ceased to give anxiety; this fracture of the main pipe adjacent to married quarters had presumably occurred

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during the bombing of the station in 1940, but it was a remarkable fact that throughout the period 1940 to 1945 water analysis showed that there was no contamination.

Station Sick Quarters. The normal wooden sick quarters on the station functioned until St. Eval was affected by raids in 1940. After this date a hotel about three miles away was requisitioned and used as a dispersed sick quarters; there was accommodation here for 35 R.A.F. patients and a private house nearby, requisitioned a little later, provided ten beds for W.A.A.F. These buildings, which remained in use until the end of the war, constituted an excellent dispersed sick quarters and the orderlies enjoyed working there.

R.A.F. STATION, DUNKESWELL

R.A.F. Station, Dunkeswell was opened on July 1, 1943, and manned by R.A.F. personnel. Two U.S.A.A.F. squadrons operated from here until October 1943, when they were replaced by Nos. 103, 105 and 110 Squadrons of No. 7 Wing U.S. Navy Air Force. On October 23, the U.S. Navy took over the R.A.F. sick quarters and the R.A.F. opened up a small sick quarters in the W.A.A.F. officers' mess. Later, in February 1944, the U.S. Navy took over the complete medical care of all R.A.F. and W.A.A.F. personnel on the station, an arrangement which was reasonably satisfactory. At that time the strength of the unit was in the neighbourhood of 2,400. It is interesting to note that the R.A.F. medical section had a total staff of nine whereas the American medical establishment was thirty-nine.

R.A.F. STATION, ST. DAVIDS

This unit, which opened in September 1943, provides a good example of the problems which arose when a station began functioning before the domestic services were fully operative. Within a week of the opening of the station, when there were about a hundred R.A.F. personnel on the strength, there was an outbreak of diarrhoea affecting 60 per cent. of the personnel; there was no medical officer, no sick quarters and only one nursing orderly with no medical supplies, so that a sick quarters had to be improvised from an airmen's hut and medical stores borrowed from neighbouring stations. The station sick quarters was not ready until six weeks later and medical stores did not arrive for two months, while of the three ambulances supplied, two were never completely serviceable.

Water Supply. No analysis of the water was made before the station opened but analysis immediately after the outbreak of diarrhoea showed five faecal organisms per 100 c.c. On investigation it was found that the water was being pumped directly into the mains from a local stream and that, although there was an hydraulic chlorinator injector, this had

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become choked and was not functioning; accordingly for the next week all drinking water was boiled before use, until four water trailers were brought into operation pending investigation of the water supply.

On September 17, 1943, when the station supply was connected to the mains and the system flushed out, a sample analysis showed eighteen faecal coliform organisms per 100 c.c. Further investigation showed that the district water supply was drawn from an upland area of sixteen acres and passed through a crushed limestone filter; although this had become heavily contaminated, no steps had been taken to chlorinate or sterilise the water and it was not until October 20, 1943, that these precautions were taken.

The Air Ministry Works Department then built a pumping station to provide an additional 25,000 gallons of water per day, as the rural source gave only 12,000 gallons per day; the new plant both filtered and chlorinated the water but, unfortunately, then injected the water into the district main supply near its source, already proved to be contaminated. Various analyses throughout 1944 proved unsatisfactory and in January 1945 a conference was held to discuss the question of the water supply at R.A.F. Station, St. Davids and its satellite Braudy. The Welsh authorities were inclined to question the validity of R.A.F. reports of contamination, but admitted that one spring from which the water supply was drawn had been closed because their own analyses revealed pollution. Suitable action to deal with the sources of pollution and chlorination eventually resulted in the provision of a potable water supply.

Sewage Disposal. The camp sewage drained to two septic tanks in parallel. There were no grids or settling tanks between the main sewage pipe and the septic tank and the effluent from the latter flowed directly into a small open stream and thence to the sea. The stream soon showed gross contamination where it flowed through the shingle, forming an ideal breeding ground for flies, and to make matters worse the prevailing wind blew directly from the sludge towards the cook-houses, which were not fly-proofed. Plans were accordingly drawn up for piping the effluent to the low water mark, although this would prove a difficult task owing to the nature of the seas; when the necessary pipes were delivered, however, they were found to be manufactured from terra cotta and, as it was decided that these would not be sufficiently durable, the scheme was finally abandoned.

R.A.F. STATION, HAMWORTHY

When this station opened on August 1, 1942, no medical arrangements had been made except that a private house (still occupied by the owners) had been requisitioned as a sick quarters and agreement reached that any personnel requiring in-patient treatment would be admitted to

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Bournemouth central sick quarters. After five days, however, the requisitioned house was vacated and the medical stores had arrived, so that, although the only furniture was a few chairs and tables, it was possible to hold sick parades and carry out minor treatments and also to open a temporary office.

The first major difficulty arose from the position of the sick quarters itself; the house was situated close to the slipway where maintenance work was carried out, but some distance from the quay where crews would land and casualties be brought in, the landing pier beside the slipway not being considered suitable for this latter purpose. Fortunately the local hospital, well staffed and equipped under the E.M.S. scheme, was only ten minutes from the quay by ambulance and it was therefore decided that injured aircrew personnel should be taken direct to this hospital, where fifteen beds were reserved for the purpose, the authorities being made aware that such casualties would probably arrive with little or no warning. This arrangement, although very convenient, reduced the importance of the sick quarters to some extent, but in view of the shortage of staff and difficulty of obtaining equipment and the fact that the squadron was due to arrive on August 14, it was felt to be the best way of ensuring at least some state of preparedness. The arrival date for the squadron was later postponed to the first week of September, by which time treatment for crash and battle casualties was well organised, crash boats and ambulances ready and fitted with first-aid boxes, and liaison established with the civil hospital.

An opportunity to improve on the medical arrangements was presented by the proposal to transfer practically the whole station from Hamworthy, on the west side of Poole, to Parkstone on the east; a new station sick quarters would be required and a house, Folly Cottage, near Salterns Pier (the new landing pier) was earmarked as suitable and later approved by the P.M.O. The move took place during the last week of November 1942, as soon as it was certain that the new pier would be used, and a small M.I. room was set up near the original slipway, where a daily sick parade was held for personnel working in that area.

There was a small sick quarters for airwomen in one of the W.A.A.F. hostels—Stretton Court; this consisted of three rooms, the bathroom adjoining being shared with occupants of the hostel. This arrangement was not entirely satisfactory and the W.A.A.F. sick quarters was later transferred to the top floor of Brudennal House, which was both commodious and comfortable; although it was impossible to carry a stretcher up to the third floor, this was not a practical problem as a stretcher patient was invariably taken direct to hospital; the other disadvantage—the distance from the airwomen's main place of work—was overcome by holding W.A.A.F. sick parades in the R.A.F. sick quarters.

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Air Raid Precautions. The next problem was that of dealing with the air raid casualties which were likely to occur in this very vulnerable area. Station personnel were scattered throughout the town, both in their places of work and in their billets, and it was quite impossible to equip or to man sufficient first-aid posts to cater specially for Service personnel; the obvious solution was to combine with the civilian A.R.P. services and this course was adopted, with the approval and willing co-operation of the local medical officer of health, who was in charge of civilian arrangements. The station sick quarters, W.A.A.F. sick quarters and the M.I. room at Hamworthy became first-aid posts in the general scheme for the whole district and provided, as did the numerous civilian first-aid posts, for treatment of both Service and civilian casualties, while the large fleet of civilian ambulances was available in emergency. The Royal Navy, Fleet Air Arm and the Army also participated in the scheme so that first-aid posts and ambulance depots were ideally scattered throughout the district, but the efficiency of the arrangements was never fully tested as only 'tip and run' raids were experienced and the casualties from these all occurred in districts served by civilian first-aid posts.

FAROE ISLANDS

The Faroe Islands situated between Iceland and the Shetlands, 200 miles north-west of the latter, belong to Denmark, of which they form a county. Seventeen of the twenty-one islands, whose area totals 511 square miles, are inhabited. They consist of rocks and hills, separated by narrow steep valleys and ravines; the coast is everywhere formed of steep and broken cliffs; the sea pierces the islands in deep fiords, with very fast tidal currents; trees are scarce, but there is evidence that they existed formerly. The fundamental formation is columnar basalt, upon which rest layers of dolomite. The existing surface features were formed by ice erosion during the glacial period.

The climate is oceanic, fogs are common and violent storms are frequent at all seasons. Although July and August are the only summer months winters are not very severe and harbours are rarely ice-bound, because the islands lie directly in the path of the warm North Atlantic ocean drift. Their maritime situation on the Polar front means that the weather is dominated by depressions, which travel eastwards across the North Atlantic.

The population totals about 200,000 and the majority of the inhabitants are engaged in agriculture or fishing. Agriculture is very primitive, less than 3 per cent. of the total surface being under cultivation. Hay is the principal crop. The houses are nearly all of wood, turf covered, and the people are pastoral and healthy.

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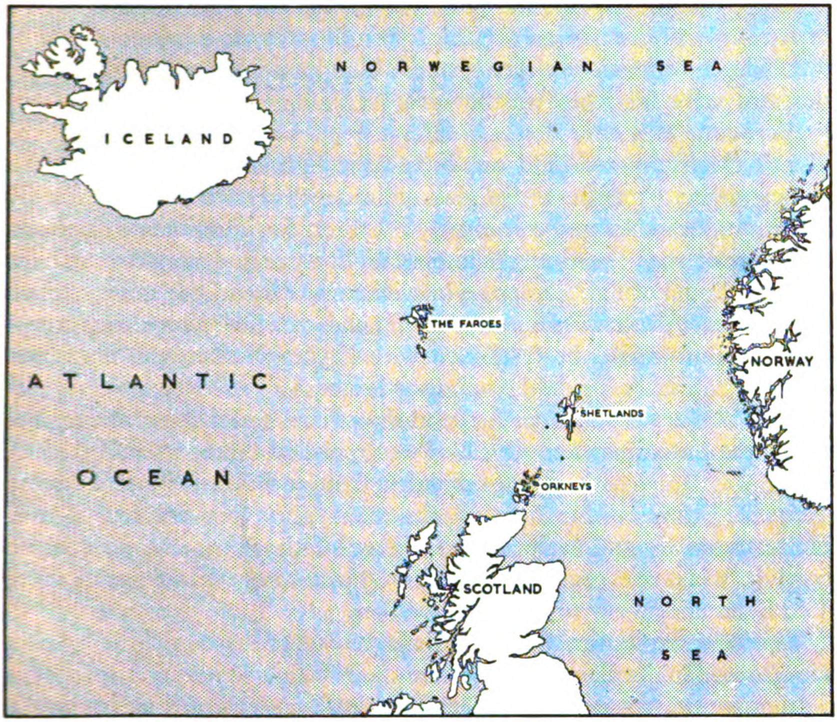

MAP 7. Sketch Map showing position of Faroe Islands.

FORMATION OF R.A.F. STATION, VAAGAR

In 1941 the increased air escort for the convoys to Russia necessitated a plan for the establishment of a base in the Faroe Islands and the Island of Vaagar was selected. A flying boat base was planned on the lake and a station nearby for four land based fighter squadrons (two very long range, one long range, one short range) with a station hospital of one hundred beds. Building was begun in 1941 by the Army (R.Es. and Pioneers) who had a Field Hospital at Sandevag on Vaagar Island. The site chosen for the R.A.F. station was at Midvag and building was begun before the site was drained. There was only one road across the island from Sorvag through Midvag to Sandevag and this was merely a track which was quickly reduced to a morass and had to be rebuilt; when the Royal Air Force arrived in July 1942, the road was still in an appalling condition.

Accommodation. The advance party of the Royal Air Force were accommodated in a tented camp North of Sorvags Vatn. This site was very badly chosen in a valley on the bank of a river, the soil was

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undrained and the site flooded on several occasions; however, this tented site was only in occupation for about two months, as a hutted camp of 16 ft. Nissen huts was quickly erected. The huts were built on concrete piles and were far from weather-proof although they were improved by alterations at a later date.

Until electricity was laid on, huts were lighted by oil lamps with an incandescent mantle and a glass chimney but as these were easily broken, hurricane lamps were chiefly relied on for illumination. During the winter of 1942 the airmen's huts at night were in deep gloom except for a small pool of light from the hurricane lamps and the stove around which the occupants were huddled on benches or a bed, all wearing great-coats; the hut would be festooned with drying clothes, the floor wet and a pool of water inside the windward door.

There was never sufficient fuel and the official scales were inadequate to keep the huts warm and dry; coal was supplied through the R.A.S.C. and it was only with great difficulty that additional supplies were obtained. Firewood for lighting fires was also very scarce, as was demonstrated by the early disappearance of the latrine seats, and on occasion, when the coal ran out, cinders round the main paths were sifted in an endeavour to find any live fuel.

Sanitation. Sanitation was by means of bucket type latrines, the bucket being housed in the usual open wooden sheds which were very unpleasant in driving rain, snow or an eighty mile an hour gale. Where possible they were sited facing away from the prevailing winds, but in the early days latrines blew over at regular intervals. The contents were disposed of by the Army sanitary squad, who had to use very rough roads, so that much splashing of the bucket contents occurred; later, however, urinals draining into the river were instituted, the river bed being flushed at regular intervals by the heavy rain.

Water Supplies. Supplies for the station were obtained from the river and sterilised in a 500-gallon water trailer; the chlorinating unit soon broke down and hand chlorination was carried out and continued as long as the Royal Air Force remained on Vaagar. In the winter the trailer used to freeze up regularly and the first task each morning was to thaw it out with an aircraft de-froster.

Clothing. This was very good, better by far than the Army issue, though most of their personnel worked in the open. The kapok coats supplied were excellent except that they tended to act as 'wings' and in a gale made progress difficult; gum boots were worn continually.

Diet. Food was monotonous, largely out of tins and chiefly 'M. and V.' (meat and vegetable) and tinned potatoes, quite a large percentage of the food being consumed after the expiration of the dates shown on the tins. Bread was baked by the Army but never issued new. Fresh meat and vegetables were provided whenever ships came in and fish was

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obtainable locally, although not as easily as might have been expected.

In view of the shortage of fresh vegetables, vitamin C tablets were made available to all personnel at the rate of two tablets per day; notices were published at intervals in Daily Routine Orders drawing attention to the importance of taking these tablets.

Sick Quarters. Sick quarters was in a tent but was soon transferred to a Nissen hut with four beds at one end and a makeshift M.I. Room at the other; medical equipment arrived in August, 1942. This accommodation was not entirely satisfactory and accordingly a new sick quarters was designed and built on the hard standing near the lake; it consisted of two Nissen huts, with provision for a consulting room, treatment room, office, dispensary, crash theatre and ward. The original hut in the main camp was retained as an eight-bedded ward; a nursing orderly slept there and personnel falling sick after working hours reported to this hut.

Hospital. Patients requiring hospital treatment were all transferred to No. 14 Army Field Hospital, Sandevag where a surgical specialist was established and with which a close liaison was maintained. In the early days the roads were so bad that the 6-mile journey from the Royal Air Force station took one and a half hours.

LATER DEVELOPMENTS—1943 AND 1944

By 1943 the build-up of the two stations had advanced considerably and the flying-boat base and the land station had both become more or less capable of operating aircraft; this major construction work was continued by the Royal Engineers and Pioneers until September 1943 when a Royal Air Force works flight took over. In the spring of 1943 the difficulties of operating aircraft from these Islands were considered to be insuperable and it was decided to reduce the commitment to a care and maintenance basis. Consequently a certain number of Royal Air Force personnel including the Sanitary Assistant were withdrawn from the Island; the withdrawal of the Sanitary Assistant was considered to be a mistake in view of the very primitive hygiene and sanitation. In spite of the reduction to a care and maintenance basis, work continued on the two flights. The flying-boat base and five of the sites on the land station were occupied by the Royal Air Force, four sites being provided with water-borne sanitation and a good ablutions block. Electric light had been installed in the huts in the early part of the year; the voltage was at first inadequate but was increased later in the year.

The water-borne sanitation from the sites mentioned above drained into concrete cesspits which should have been emptied periodically by a sewage tender but this tender was unserviceable for ten out of twelve months. Alternative arrangements operated during the periods of unserviceability whereby the cesspits in use were pumped into 50-gallon drums by means of a small suction pump. The drums were

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conveyed by lorry to a disposal point where they were emptied into Sorvag Fiord.

In 1944 the War Office decided that Army units should leave the Island and the Royal Air Force soon followed suit. When No. 4 Army Field Hospital closed down on March 3, there were about 500 Royal Air Force and 150 Army personnel remaining on the Island, their medical care being in the hands of one Army medical officer, one Royal Air Force medical officer, a sergeant nursing orderly and two L.A.C. nursing orderlies. After the departure of the field hospital the nearest Service hospital was No. 9 Army Field Hospital, at Thorshavn on Streymoy Island, some two or three hours' journey by sea in favourable weather, but fortunately it was never necessary to transfer patients to this hospital.

Health of Personnel. Considering the bad weather and, in the early stages, the poor living conditions and primitive sanitation, the health of the Royal Air Force personnel stationed in the Islands was remarkably good. Diseases of the respiratory tract were surprisingly few, although this was possibly because personnel were working in the open air and not exposed to droplet infections as were those working near towns and cities.

Both the Army and Royal Air Force medical authorities noted the high incidence of diarrhoea among Service personnel on the Island; it is not possible to quote exact figures because the large majority of personnel affected did not report sick but those who did stated that a number of their friends were similarly affected. Occasional sporadic outbursts occurred, as for example, at one anti-aircraft site where there were 60 cases in one day. A feature of the attacks was their duration—usually two or three days and sometimes longer—and the almost complete absence of colic; there was rarely any pyrexia or tachycardia, and all cases cleared up rapidly with routine treatment. It was not possible to examine the stools of any patients as the requisite bacteriological equipment was not available, neither was it possible to state definitely the cause of the attacks, although evidence pointed to their being due to the consumption of tinned meat and vegetables which had warranty dates that had expired, sometimes as much as two years previously.

There was no case of venereal disease contracted in the Island, due no doubt to the lack of opportunity and probably the absence of the disease in the Island. In the few cases encountered the disease was contracted in England before embarkation and first appeared in the Island.

NORTHERN IRELAND

In 1912, the Belfast authorities bought land to build a civil airport but this was a complete failure because of the bogginess of the ground.

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During the 1914–18 War an aerodrome was built at Aldergrove and No. 502 Special Reserve Squadron formed there. In 1935–6 when more bombing ranges were required, one was opened at Lough Neagh, for the use of squadrons transferred to Aldergrove from Scotland. About 1936, the Air Ministry built Newtownards Airport and another airport was built at Sydenham by the Belfast Harbour Commissioners.

HEADQUARTERS, R.A.F., NORTHERN IRELAND

Nothing further was done about the building of aerodromes until after the fall of France, when in view of the possible danger of invasion from the enemy landing in Eire, No. 61 Group, with headquarters at Belfast, was formed to act as an advanced striking force. The squadrons of No. 61 Group were stationed at Aldergrove, Newtownards and Sydenham, the Wing Servicing Unit went to Dromore and an Air Ministry Experimental Station formed at Glenarm, while small mobile units comprised a radar screen which was thrown out all round the headlands and along the Northern Ireland-Eire border.

A month after its formation, No. 61 Group became known as Headquarters, R.A.F., Northern Ireland. In 1941, aerodromes were built at Longkesh, Limavady, Lough Erne, Ballyhalbert, Eglinton, Ballykelly and later at Nutts Corner, Killadeas, Madhaberry and St. Angelo; air sea rescue units were formed at Donaghadee and at Larne, the latter being a naval unit equipped by the Royal Air Force. Gradually more units were transferred from various Groups and No. 82 Group was established in Belfast to administer the growing number of fighter stations. A new Northern Ireland Command was formed in October 1944 and took over the administration of all units in Northern Ireland, co-operating with Fighter Command on all matters of operational policy.

During the first few months of R.A.F. tenure in Northern Ireland, the majority of the personnel were accommodated in billets although a number were living in huts on the permanent camp at Aldergrove. As the new stations opened, they were usually occupied before completion, and, although houses were requisitioned wherever possible, there was often a certain amount of overcrowding when there were no houses in the vicinity.

MEDICAL ARRANGEMENTS

Owing to the dispersed nature of the units, especially those forming the radar screen, medical care presented a difficult problem and arrangements were made with local doctors to give their services when required.

Sick quarters were opened at Headquarters and at all aerodromes and large units either in requisitioned premises or in specially constructed

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buildings and sometimes in temporary huts. At first there were very few W.A.A.F. personnel but when their numbers increased separate W.A.A.F. sick quarters were opened where necessary.

In the early days, H.Q. Northern Ireland formed its own Aviation Candidates Medical Board, as it was only necessary to deal with local entrants and ophthalmic and E.N.T. specialists were available in the area. Later, however, when the scheme was inaugurated under which Army personnel were allowed to transfer to the R.A.F., the numbers were too great to be dealt with in this manner and additional personnel to form the nucleus of an Aviation Candidates Medical Board visited Northern Ireland periodically. Headquarters also held all Invaliding Boards required. A N.Y.D.N. Centre was opened but ceased to function after a few months in view of the small demand for its services.

Until the formation of Northern Ireland Command, the various units stationed there were the responsibility of the P.M.O. of their parent Command and this increased the difficulties of the P.M.O., Northern Ireland who had little or no control over them. He was, however, responsible for the sanitation arrangements of R.A.F. units and also acted as liaison officer with the Army medical authorities and the Emergency Medical Services.

To illustrate some of the problems which arose on these units, brief notes are given here on some of the Coastal Command stations in Northern Ireland.

R.A.F. Station, Aldergrove. Aldergrove was a pre-war station with permanent buildings. In 1940, the station sick quarters became too small for the increased numbers on the station and a new sick quarters was constructed; the addition of an annexe in 1943 for W.A.A.F. personnel, who had previously used a Warrant Officer's married quarters, gave a total of twenty male and eight female beds.

From Aldergrove operated two general reconnaissance squadrons and a Meteorological Flight, the latter being equipped with Gladiator and Spitfire aircraft. The Gladiators ascended three times daily to 28,000 ft. and the Spitfires twice daily to 40,000 ft.; this gave rise to upper respiratory infections and general fatigue and occasionally semi-chronic eustachian tube catarrh and sinusitis developed; although continued high flying aggravated these conditions, it was difficult to ground the personnel concerned, as there were very few qualified meteorological pilots and the sickness or leave of one of them threw an added strain on the remainder; it was a point of honour with members of the meteorological flight not to allow a sortie to be cancelled, if this could possibly be avoided.

R.A.F. Station, Castle Archdale. Owing to urgent operational requirements in 1941, this station became operational only three weeks after the arrival of the advance party. Sanitation and cooking facilities were

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of the most primitive kind and water was not laid on until the winter of 1942. It had been realised that conditions would be bad for a time but the heavy continuous rain greatly aggravated the discomforts, and only strenuous and untiring efforts of administrative and medical staff eventually brought order out of chaos; the inclusion of a sanitary assistant in the advance party proved to be a great asset.

A medical inspection room with Z.1. equipment was opened, after much improvisation and hard work, in a dilapidated outhouse of the Castle, while a dispersed sick quarters was established in a large medieval-cum-modern building (Necerne Castle) where accommodation for fifty patients was available, although the necessary renovation and alterations took one and a half to two years to complete. The large number of beds made it possible to treat most conditions satisfactorily and various emergency operations, such as acute appendicitis and ruptured ovarian cysts, were performed. Two members of the P.M.R.A.F.N.S. were established at this sick quarters.

A well equipped resuscitation hut, with electric heating, was established on the edge of the lake near the flying-boat moorings, for treating casualties from flying-boat crashes, and was found to be so valuable that it was recommended for universal adoption and inclusion in the plans of all flying-boat bases.

Cases requiring hospitalisation were admitted to the local E.M.S. hospital at Enniskillen or the Military Hospital in Belfast except during 1943, and part of 1944, when R.A.F. patients were accepted by the American 28th Station Hospital, situated in the grounds of Necerne Castle; this latter arrangement was so satisfactory that on the departure of the American hospital the station requested that the building might be taken over as a unit sick quarters; owing to various difficulties however, and the large staff that would have been required, this was not permitted and R.A.F. cases were again sent to Enniskillen or Belfast. At the E.M.S. hospital all cases were admitted to a common ward and allowed to remain only until fit to be moved to other accommodation; although this arrangement was not ideal no complaints were made and the standard of surgical treatment was high.

In February 1944, No. 201 Squadron was replaced by No. 422 (R.C.A.F.) Squadron; it was found that the Canadian personnel suffered very much from minor ailments such as coryza, sinusitis and lumbago, etc., due no doubt to the unaccustomed cold and wet weather conditions prevailing throughout most of the year.

R.A.F. Station, Limavady. Limavady was the first Coastal Command station in Northern Ireland to be completed on the dispersed site plan. A house in the town was used as a sick quarters until a hutted sick quarters of twenty beds was built on the station; the house was then retained as a dispersed sick quarters.

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Limavady was originally an operational station operating one general reconnaissance squadron; later it became an Operational Training Unit and finally, in 1944, again operated G.R. squadrons. During the period 1942–4 when it was an O.T.U. the usual welfare problems arose among maintenance personnel; these personnel were working at least a 60-hour and frequently a 70 or 75-hour week; many were too tired to take advantage of their day off and the sickness rate was very high, the main symptoms being general nervous complaints, debility, lack of energy, tiredness, anorexia, and gastric complaints. It was found that at this stage two or three days off duty with complete rest was the best treatment. When working hours became more normal (roughly 60 hours per week) it took three or four weeks for the men to become adjusted and for the sick incidence to fall.

R.A.F. Station, Killadeas. This station was originally built for U.S. Forces and consequently the lay-out differed from the normal dispersed site stations of the Royal Air Force. In 1942, it was taken over by Coastal Command and housed No. 131 (Coastal) O.T.U. which trained flying-boat crews and flying-boat ferry crews; the output of aircrew personnel was, in January 1944, approximately 200 per month.

At the end of 1943, a satellite station at St. Angelo came under the administrative control of Killadeas; St. Angelo was a land aerodrome and the headquarters of No. 12 Flying Instructor School. In 1944, in addition to this satellite, Killadeas maintained an attachment on Boa Island, situated at the most northerly point of Lough Erne and connected to the mainland by a bridge at either end. This small camp consisted of quarters for all ranks and officers', sergeants' and airmen's messes were all served by the same kitchen; its purpose was to provide and maintain accommodation for crews unable to return to the flying-boat base at Killadeas in the event of adverse weather conditions.

There were no sick quarters at Killadeas or St. Angelo although both stations had a medical inspection room, that at Killadeas, a long Nissen hut divided into offices, having been constructed with little appreciation of the amount or type of medical work on the station, which included an overseas medical examination for every pupil, with vaccination and tetanus, typhoid, and plague inoculations and blood grouping of a large number of personnel.

Personnel requiring in-patient treatment were admitted to Necerne Castle, the sick quarters of R.A.F. Station, Castle Archdale, that station also undertaking medical responsibility for staff and visiting crews at Boa Island.

PHOTOGRAPHIC RECONNAISSANCE

The conditions under which the war was fought, so far as the Western European area was concerned, tended to make air photography a highly specialised subject. The absence of a clearly defined front and the very

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great efficiency of enemy air defence methods and fighter cover made it quite impossible, except in quiet parts of the war zone, to use aircraft of relatively low performance for photography as was done in the 1914–18 War and the vital need for an efficient photographic service led to the creation of the Photographic Reconnaissance Unit.

The unit came into being at Heston in October 1939, a peace-time Surveying Unit forming the nucleus of the new formation. Many of the personnel were civilians who had specialised in survey before the war, several of them having carried out very important photographic work over the Continent during 1939. The new Unit used the standard civilian equipment and was organised on the same lines as had been found satisfactory in the Surveying Unit. Photography was carried out at varying altitudes but mainly from very considerable heights, in order to maintain secrecy concerning the activities of the unit; to this end also the aircraft employed were camouflaged with special colours which rendered them almost invisible against the sky. Fighter aircraft were used to give the performance necessary at great heights, the photographic flight (later squadron) eventually being equipped almost entirely with Spitfires although Hudson aircraft were used in quiet areas and later in the war Mosquitoes were used for long distance sorties.

On November 6, 1939, a flight of the P.R.U. was detached to France, returning to Heston in mid-January 1940. Operations during this period proved that the modified Spitfire was a success, sorties generally taking place at 32,000 ft. Further operations in France were carried out between January and June 1940 but after the German advance the flight finally returned to Heston on June 14. The unit was then moved to Benson and formed into five squadrons. R.A.F. Station, Benson, with a satellite at Mount Farm, and R.A.F. Station, Dyce comprised No. 106 Wing which was in May 1944 formed into No. 106 Group with stations Medmenham and Nuneham Park, detached flights being maintained at Leuchars, St. Eval and Gibraltar. Operational flying took place from Benson, Mount Farm, Leuchars and St. Eval, while Dyce was a training establishment.

DECOMPRESSION TESTS

The medical category of A.1.B* was considered adequate for all types of flying up to 28,000 ft., but for flights above that height a decompression test to ascertain the pilot's suitability was necessary. Photographic reconnaissance was carried out at greater heights than in any other type of flying, averaging 32,000–35,000 ft., and a suitable decompression test had to be evolved. It was decided that this should consist of three 'runs' in the decompression trailer, simulating ascent to 35,000 ft.,

* Fit for full flying duties.

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remaining there for one hour and descending slowly; incapacitating 'bends' or central collapse on two of these tests would be sufficient to disqualify aircrew from photographic reconnaissance work.

In Coastal Command, mobile decompression chambers were located at Benson and at No. 8 (Coastal) O.T.U., Dyce, each trailer being operated by a nursing orderly who had been trained for the work at the R.A.F. Physiological Laboratory at Farnborough. Although pupils should all have been tested for P.R.U. work before they were posted to Dyce, it was found that approximately 50 per cent. of the personnel arriving there had not undergone a complete test, as is shown by the following figures for a typical period of six months:

Number of pupils posted to O.T.U. at Dyce—151

Complete decompression test prior to posting	72 (47·5 per cent.)
Two ,, ,, ,, ,, ,,	11 (7·5 per cent.)
One ,, ,, ,, ,, ,,	40 (26·5 per cent.)
No ,, ,, ,, ,, ,,	28 (18·5 per cent.)

Accordingly, all pupils were given a complete decompression test on arrival at Dyce unless they could produce a certificate that they had undergone three full decompression tests and had satisfied the requirements. Objections by staff of the Training Wing to releasing pupils for the tests were withdrawn when it was found that all members of a new course could be tested within a week of their arrival. About 7-10 per cent. of the pupils failed to pass the full decompression test. Approximately 80 per cent. of these failures were due to bends and decompression symptoms, about 15 per cent. to sinus pain and 5 per cent. found unfit for other reasons. At R.A.F. Station, Benson, the numbers passed through the decompression trailer were about double those at Dyce and the percentage of failures was 20 per cent., bends and similar decompression symptoms again accounting for about 80 to 85 per cent. of the failures.

STATIONS OF NO. 106 (P.R.) GROUP

R.A.F. Station, Benson. R.A.F. Station, Benson was an excellent prewar station with permanent standard barrack blocks and communal buildings. The total strength was approximately 2,300, greatly in excess of the station's normal capacity, but by utilising married quarters and placing extra beds in barracks, etc., the accommodation problem was overcome without undue overcrowding.

There were three problems of hygiene at this station, each connected with the photographic section, and because these difficulties were peculiar to this type of station they are described fully in the following paragraphs:

(*a*) *Ventilation of the photographic processing rooms.*

The problem was to accommodate heavy reprograph machines, each producing a considerable amount of heat and attended by three

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men, in a photographically dark room. The accommodation provided was a 30-ft. Nissen hut, with an outer corrugated iron shell and a lining of masonite, most of the internal space being taken up by a large inner room partitioned off up to the ceiling. There were no windows in this inner room which was ventilated by a share of a 24-in. up-cast ridge, combined with inlet tubes of Tobin pattern from the outer air but only some 2 ft. from the floor. This would have been adequate if the room were only occupied by men and unheated machines, but the powerful heaters made it necessary to resort to positive plenum ventilation, temperatures recorded in the inner reprograph room for the seven days before the introduction of this system being 110°, 108°, 110°, 105°, 110°, 105°, and 98° respectively; such temperatures not only interfered with the photographic process but constituted a menace to health. Accordingly the Tobin tubes were raised to the usual level of six feet from the floor and the plenum system was installed, with the motors outside the building to reduce the amount of noise in the room. This alteration resulted in considerable improvement in working conditions in the processing rooms.

(*b*) *Hours of work for airwomen in the photographic section.*

A serious problem which came to a head in 1944 was the excessively long hours being worked by airwomen in the photographic section—an average of seventy-three hours per week being the rule rather than the exception. The airwomen, the majority of whom were between 18 and 19 years old, worked in two shifts—0800 hours to 2130 hours and 2100 hours to 0800 hours—the half-hour overlap at night being found inevitable in practice; at the end of a shift they looked, and were, exhausted and some showed definite signs of over-strain. Although their morale and loyalty were of a high order, it was obvious that continuation of this rate of work would result in the collapse of a considerable number of personnel. Some idea of the tremendous volume of work which passed through the section can be gained by the fact that 401,000 photographs were prepared there during the month of April 1944. At that time double flying was being carried out—i.e. each target was covered twice—so that two separate photographs of each target had to be dealt with. A period of bad weather enabled the section to relax to some extent but during the ensuing fine spell a peak was reached and 700 per cent. more work was being done than at the same time the previous year, with a staff increased by only 40 per cent. The work was concentrated, much of it monotonous, and done by artificial light in an inadequately ventilated closed building where the rooms were hot, crowded and smelled of chemicals, and where, especially in the processing rooms, there was a continual noise from machinery.

This situation was brought to the attention of the Air Ministry. It was pointed out that all rush work for the whole of the R.A.F. and the U.S.A.A.F. was undertaken at Benson and that all available photographers in the Command had been posted or attached to that

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unit, so that no further action by Command Headquarters was possible. Accordingly, Air Ministry agreed to a 25 per cent. increase in the establishment and the situation was greatly alleviated by the immediate posting in of 21 airmen and 20 airwomen.

(c) *Disposal of effluent from the processing tanks.*

The liquid from the hand processing tanks was discharged into a pond in a field 400 yards from the unit. Local residents complained about the smell from the pond, as the waste liquid contained hypo which decomposed quickly, giving off hydrogen sulphide with a consequent evil smell. So serious a view of this nuisance was taken by the civilian population, that the parish council threatened to raise the question in Parliament, unless some improvement was effected. The problem was referred to the Royal Aircraft Establishment at Farnborough, who suggested that bleaching powder should be distributed as evenly as possible throughout the pond, the initial dose being one ton and repeated at suitable intervals. This was found to be effective.

R.A.F. Station, Medmenham. This station, the Central Interpretation Unit (C.I.U.), opened in April 1941 in a Nissen hutted camp. The station was built for about 500 people but the strength increased rapidly to 1,600 and reached a peak of 1,937 in May 1944; at that time an increase of staff had been granted by the Air Ministry in view of the long hours being worked by the photographic interpreters in connexion with preparations for the invasion of Europe, which necessitated very extensive photographic reconnaissance.

The original sewage plant proved quite inadequate for the greatly increased number of personnel and was enlarged in 1944.

Medical Arrangements. Medical supervision was provided by a civilian medical practitioner for the first six months, until a R.A.F. medical officer was posted to the unit, and in September 1942 a R.A.F. woman medical officer was established for station duty. An influenza epidemic in 1943 disclosed the need for an auxiliary station sick quarters, the existing sick quarters having beds for only five R.A.F. and six W.A.A.F. cases. A new sick quarters was therefore built and taken into use in December 1943 with sixteen R.A.F. and twenty-four W.A.A.F. beds.

In June 1944 an orthoptist and an oculist were posted to the station to supervise the eyesight of the photographic interpreters, but a few months' work showed that in spite of the continual close work in artificial lighting there was no evidence of deterioration of vision.

Incidence of Neurosis at Medmenham. An interesting feature of R.A.F. Station, Medmenham, from a medical point of view, was the high incidence of neurosis and the very high incidence of mild neurotic tendencies among both officers and other ranks of the R.A.F. and W.A.A.F. The explanation probably lay in the fact that the average age of personnel at Medmenham was higher than on most stations

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and that the majority of those concerned had been older than was usual when they joined the Service, and consequently found it more difficult to adapt themselves to the conditions of Service life. Moreover, the civilian occupations of many of the personnel on the station, including artists, sculptors, musicians, university lecturers, photographers and actors, were such that Service life presented a greater contrast to them than it did to many other people, beside the fact that this type of person tended to be intolerant of regimentation. As one commanding officer put it 'They work all right—they work like hell—but they don't always want to work at the time that they are supposed to'.

R.A.F. Station, Nuneham Park (satellite of Medmenham). This was a small Nissen hutted camp on a requisitioned estate close to Medmenham, erected in December 1941 as a training school for photographic interpreters. The average strength of the unit was less than 300 and there was no sick quarters, all personnel requiring in-patient treatment being sent to R.A.F. Station, Benson. Sanitation and drainage were satisfactory.

No. 104 Wing. No. 104 Wing was formed at R.A.F. Station, Benson in February 1945 and in March of that year proceeded to France to administer one photographic squadron. The strength was:

	R.A.F. officers	*W.A.A.F. officers*	*Other ranks*
No. 104 Wing . .	20	4	280
No. 540 Squadron .	40	—	125
Associated formations .	—	—	96

The Wing was accommodated in a college and five houses in Coulomniers. The college was a large building and provided billets for the airmen and rooms for photographic development, printing, interpretation, administration, intelligence section and equipment, but it was necessary to set up a cookhouse in a marquee in one quadrangle. The arrival of No. 540 Squadron and No. 8540 Servicing Echelon resulted in gross overcrowding of the billets, and a complete camp site for the airmen and marquee for the cookhouse and messes were set up on the airfield at Voisin, two and a half miles away. This proved a satisfactory arrangement, as the majority of the personnel in No. 104 Wing slept and worked at the college and those in No. 540 Squadron and No. 8540 Echelon worked on the airfield.

Messing. Coulomniers was under American administration and No. 104 Wing was issued with American rations of excellent quality and quantity, although an increased bread ration was later made available to satisfy British tastes. Stoves and boilers heated by petrol burners were used for most of the cooking and proved quite satisfactory.

Water Supplies. The water supply for Coulomniers was carried by conduit from a spring two miles outside the town; although contamination

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did not appear likely and samples examined at the Institute of Pathology, Halton, proved satisfactory, water was chlorinated before use as a precautionary measure. The airfield had no water supply and 350-gallon trailers carried water from the college to the airfield each day. This water was chlorinated.

Sanitation. All messes in the town had water carriage drainage systems and no difficulties arose, except in the college where blockage and overflowing tended to occur. On the camp site refuse was collected daily by a local contractor, ablutions water was pumped away to a sullage pit and latrine buckets were emptied daily into an Otway pit. In summer, the numerous flies in the cookhouse and messing rooms were quickly controlled by means of traps, fly-papers and D.D.T. spray.

Medical Organisation and Equipment. The sick quarters was established in a nine-roomed private house which had been requisitioned. There was a six-bedded ward for airmen, an officers' ward with two beds, a medical inspection room, consulting room and office. Cooking for patients and staff was done in the sick quarters' kitchen.

The main medical equipment on arrival consisted of the standard Z.1 equipment for squadrons. Additional medical stores were difficult to obtain at first, the nearest R.A.F. unit, in Paris, having been established about the same time and therefore possessing similar stores; however, the deficiency was partly overcome by borrowing from a fully established American camp on the aerodrome.

THE FLYING PERSONNEL MEDICAL OFFICER

In the following section the medical problems directly associated with flying which occurred in Coastal Command are outlined. The problems were investigated mainly by the Flying Personnel Medical Officer, though many helpful suggestions and observations were put forward by both unit and squadron medical officers.

The intention is to deal only with the points peculiar to Coastal Command as the general subject of aviation medicine has been fully covered in the appropriate section of the Bomber Command chapter in this volume.

THE SPECIAL DUTY LOOK-OUT TRAINING SCHOOL

With the object of ascertaining whether it was possible, by special training, to improve the efficiency of personnel engaged on look-out and sea searching duties, a special training school was started at Felixstowe in 1942. The original trainees were nine pupils who had been rejected by an aircrew selection board for other than medical reasons—e.g. failure in a mathematics examination; a visual standard of 6/6 in each eye and a score of at least 20 on the night test (rotating hexagon) was required of them.

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These personnel were given one week's training at Felixstowe, daily physical training being part of the course. The syllabus of instruction included:

(*a*) A daily night vision test on the rotating hexagon.
(*b*) A demonstration in the methods of focusing and using binoculars.
(*c*) Instruction in scanning methods.
(*d*) Practice in a specially-constructed and blacked-out theatre, using models on a stage which had controllable lighting.
(*e*) Practice scanning and spotting out of doors by day and night from a crane 150 ft. high.

The pupils were then taken to Silloth for a week's air experience and practice and tests including spotting R.A.F. launches at sea.

The results achieved seemed satisfactory and were sufficiently encouraging to make further training worthwhile, so these personnel were trained as air gunners at No. 9 Air Gunnery School, after which they were accepted as aircrew members and posted to operational flying-boat squadrons. The School at Felixstowe was then closed down for a short while and reopened in mid-April for training air observers and air gunners of operational squadrons of No. 16 Group, each course accommodating twelve personnel and lasting six days.

The first three courses were identical with that given to the original trainees, but the syllabus was later altered to include more outdoor practice and the rotating hexagon test was carried out three or four times a week instead of daily. It was found that an air observer with a high standard of intelligence but medically unfit for flying could be trained very satisfactorily as an instructor.

Representatives of Bomber, Fighter and Flying Training Commands attended the first or second week of this series to see whether the training would be suitable for personnel of their respective Commands. It was the intention that the Felixstowe training should be incorporated in the Schools of General Reconnaissance both at home and abroad, but this proved impossible without an undesirable lengthening of the G.R. course and it was therefore decided to include the essentials of the Felixstowe training in the syllabus of all Operational Training Units in Coastal Command. The Felixstowe school was accordingly closed down at the end of 1942, and, as a result of the experience gained there, six hours visual training was incorporated in the course at all Coastal O.T.Us., this training being extended to eight hours for O.T.Us. producing crews for squadrons equipped with the Leigh light—a searchlight for night pursuit of submarines.

Searching. It was found that the careful scanning and searching of the sea required throughout the whole of an anti-submarine sortie was very tiring for the eyes, one hour being considered the longest period for which it could be done efficiently. Accordingly a routine for searching

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was evolved for each aircraft and a rota arranged whereby each of the wireless operator/air gunners, who normally were responsible for the searching, carried out one hour's scanning, one hour on the radar equipment and one hour on the wireless set.

Binoculars. Crews were given special instruction in the use of binoculars, for when handled correctly these gave gratifying results, particularly in the first sighting of U-boats. The most useful binocular for day work was the 7 × 50 and for night-time the 4 × 50 fixed focus.

Anti-glare Spectacles. Some form of anti-glare spectacles was essential and those of polaroid glass were found to be the most satisfactory. Polaroid spectacles Mark V were supplied through the Ministry of Aircraft Production, but crews were generally dissatisfied with these as being too heavy and uncomfortable, and usually asked for a pair of ordinary commercial spectacles which, however, were never supplied. A later model, Mark VIII, was more satisfactory and came into general use, although aircrew personnel were still not entirely in favour of them.

OXYGEN

The Spitfire aircraft of the Photographic Reconnaissance Unit flew consistently higher than those of any other unit in the R.A.F. In the early days of the war, up to about 1942, flights were carried out at 32,000 to 33,000 ft.; later it became necessary to go even higher to avoid interception by enemy fighters and after 1942 flights took place at 38,000 to 42,000 ft. Thus it was essential for the pilots to have the best oxygen equipment available and this was achieved by the co-operation of the R.A.F. Physiological Laboratory at Farnborough. The P.R.U. was always first to receive new equipment, the G type oxygen mask and later the H type mask being first issued in quantity to this unit.

Two incidents which occurred in 1943 show the necessity for the very best equipment. One pilot, who had been detailed to photograph Berlin, reported on his return that he had made several good runs; his pictures, however, proved to be photographs of Dresden, a very much smaller town, which the pilot, who was experienced in photographic work, would never have mistaken for Berlin if he had been in full possession of his faculties. A little later, another pilot, also detailed to photograph Berlin, returned and said that he had not been able to take a photograph because of the weather, but when the films in his cameras were developed it was found that he had taken four good runs. These difficulties, caused by high altitude flying, were overcome by the introduction of the Pressure Breathing Equipment and, later, the Pressure Cabin; both of these systems are described briefly in the following paragraphs.

Pressure Breathing Equipment. In a paper reporting to the Committee on Aviation Medicine of the National Research Council of Canada in

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October 1942 it was shown that positive pressure breathing using an inflatable waistcoat and a pressurised mask could be of practical value in increasing the altitude man could tolerate.

This system was demonstrated at the R.A.F. Physiological Laboratory, Farnborough, and in 1943 several sets of this equipment, modified to operate with R.A.F. oxygen regulators, was produced for test and Service trials. A gain of 3,000 to 4,000 ft. in ceiling was claimed. The first equipment consisted of an inflatable waistcoat, which could also function as a flotation jacket, and a mask which had a special expiratory valve. This valve in the final equipment had three positions which allowed the user to select high, low or zero pressure. Any pressure built up in the mask and, therefore, in the lungs, was also applied to the waistcoat and the chest wall. The waistcoat also acted as a reservoir and made the 'economiser' unnecessary. (*See* Chapter 1, Bomber Command, Problems of Aviation Medicine Section.)

In November 1943, six sets had been tested by aircrew at Benson, in local flights up to 45,000 ft. and on operational flights to 42,000 ft. in unpressurised aircraft (Spitfire Mk. XI). On the basis of these tests further sets were made, using a modification of the R.A.F. type H mask in place of British made copies of the U.S.A.A.F. A.13 mask which had previously been used.

In the winter of 1943–4 the pressure waistcoat had a real value in allowing P.R.U. aircraft to fly above the vapour trail level, as these aircraft did not have sufficient edge of performance over the German intercepters to permit the making of trails. With this in mind, one hundred sets of equipment were made quickly, the waistcoats themselves coming from Canada and the accessories being made and assembled in the United Kingdom.

By March, thirteen pilots of No. 541 (P.R.) Squadron had been equipped with the apparatus and were using it operationally. Very shortly afterwards twenty-one pilots of No. 542 Squadron were also equipped. Both of these squadrons were stationed at Benson. No. 16 Squadron, 2nd T.A.F., P.R.U. was equipped later that year.

During this winter the waistcoats were used on operations with a degree of regularity. On one occasion a pilot spent four hours above 42,000 ft., two of them being at 44,000 ft.—an exceptional case. Later in the year the need for very high altitude flying diminished and the waistcoat assembly therefore became less popular.

In the autumn and winter of 1944 and spring of 1945, the advent of the pressure cabin in P.R.U. Spitfires reduced the need for the Pressure Breathing Equipment (P.B.E.). Finally, the advent of the Mk. XIX Spitfire with a performance better than the Me.109s. or F.W.190s. reduced the need for very high altitude operations.

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The Pressure Cabin. The best solution to the problem of oxygen in photographic reconnaissance was without doubt the pressure cabin, and two aircraft, the Spitfire X and Mosquito VI, were developed accordingly, but these aircraft were unpopular with the pilots because of misting and frosting of the cabin and loss of power. All P.R.U. pilots were very sensitive to any reduction of the power of their aircraft; the loss which was entailed by the engine driving a cabin supercharger was considerable enough to cause them disquiet and the Spitfire X was in fact rarely used on operations. Later developments of pressure cabin aircraft, the Spitfire XIX and Mosquito XXXIV, had better cabins and were used fairly extensively in 1945.

FEEDING OF AIRCREWS IN FLIGHT

Towards the end of 1940 and in the early part of 1941 it became apparent that inadequate feeding of flying personnel during long sorties, that is, sorties of twelve hours' duration and more, was leading to inefficiency on account of the physical and mental fatigue of the crews. At this time the only aircraft engaged on these long distance sorties were the flying boats, Sunderlands and Catalinas. The Sunderland aircraft had a galley and a paraffin burning cooking stove, the Clyde cooker, which was a stove 2 ft. long, 9 in. wide and 1 ft. high with two primus burners, an oven and a plate warmer. It was quite satisfactory and it was possible to supply the crew with a hot meal. The Catalina aircraft had an electric hotplate but this could not be used for any length of time owing to the very high consumption of electricity.

Sorties of eighteen hours in a noisy, uncomfortable aircraft coupled with a poor diet of sandwiches and warm fluid could lead to only one result—great physical and mental fatigue. All crews complained constantly of the lack of food and the poor quality of the rations supplied to them, and it was obvious that, if this state of affairs were allowed to continue, difficulties would arise and accidents soon follow, for aircrews would not be capable of completing their full operational tour of 1,000 hours owing to fatigue; longer rests would be required between sorties in order to cope with the fatigue, thus curtailing the squadron's activities considerably; and crews would become a danger to themselves in their fatigue state and be liable to crash on landing. Accordingly R.A.F. Station, Oban, where a Catalina flying-boat squadron was based, worked out a scheme for a Central Flying Ration Store from which special rations for flights were issued; food stuffs unobtainable from, or extra to, the day's rations were also issued and for this a special allowance from public funds was made of 1s. or 1s. 6d. per man according to the length of the flight. This, together with the installation of the Clyde cooker in the Catalina, produced a remarkable improvement in all the crews operating from Oban. From being introduced at individual stations,

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the scheme was eventually applied to all operational stations in Coastal Command. Aircrews returned from sorties showing far fewer signs of fatigue, controllers and intelligence officers noted marked improvement in the mental alertness of the crews when interrogated on return and the medical officer reported a very definite improvement in cerebration time and also considered that the morale of the crews was higher.

It was in this province of aircrew feeding that the value of a keen interest and acceptance of responsibility by the squadron medical officer was clearly manifest. The choice of articles of diet, the maintenance of quality and the smooth functioning of supply were in direct ratio to the enthusiasm he contributed.

The Oban scheme for a central flying ration store for the feeding of aircrew in flying boats was applied with variation to other aircraft in the Command, but with the introduction of aircraft undertaking even longer sorties, further difficulties arose. Most of the new aircraft were not fitted with the Clyde cooker and the installation of any electrical cooking device, besides entailing the practically full-time employment of a member of the crew on cooking, was always viewed with great disfavour by the engineering branch, as the aircraft's electric system was already heavily loaded with radar and other electrical devices. Neither did the engineering branch wholly approve of the Clyde cooker or other items such as self-heating tins of soup, because of the risk of fire.

Aircrew Canteens. At many stations in the Command there was an aircrew canteen at which crews ate their pre- and post-flight meals; this canteen was sometimes combined with the Central Flying Ration Store and this arrangement proved particularly useful at stations operating very long range land-based aircraft, where the meals in flight were mainly sandwiches. The combined aircrew canteen and central flying ration store was also instituted at some flying-boat bases and was of inestimable value.

Dietetics. In view of the heavy physical and mental strain involved, flying personnel engaged on long range flying required a diet of high calorie value, 4,500 calories per eighteen hours being allowed, in the proportion of protein 1, fat 1·12, carbohydrate 3·46.

The flying ration for one member of aircrew for a period of eighteen hours was made up of the following commodities:

1. Bacon	2 rashers	
2. Bread	12 oz.	
3. Butter	$\frac{1}{2}$ oz.	
4. Margarine	1 oz.	
5. Cheese	1 oz.	Items 1 to 15 drawn
6. Sugar	2 oz.	from Service sources
7. Tea	$\frac{3}{7}$ oz.	
8. Beefsteak	8 oz.	

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9. Dried fruit	3 oz.	
10. Potatoes	8 oz.	
11. Vegetables	8 oz.	
12. Milk	½ tin	
13. Oxo	1 cube	
14. Cornflakes	1 oz.	
15. Sausage	1	
16. Chocolate	4 oz.	
17. Orange	1	
18. Barley sugar	3 oz.	Items 16 to 22 bought from N.A.A.F.I.
19. Soup	½ tin	
20. Egg	1	
21. Chewing gum	2 packets	
22. Sardines	2½ oz.	

For a period of twelve to fourteen hours the same quantities were supplied, with two exceptions—no sardines were included and the amount of beefsteak was reduced to 6 oz.

This flying ration was divided into four meals for eighteen-hour sorties and three meals for twelve- to fourteen-hour sorties.

OPERATIONAL TOURS

In 1941, in an attempt to prevent flying stress, a limit was set to the number of hours to be flown by aircrew in any one tour, the length of tour varying according to the type of work on which personnel were engaged. The limits set, which were only to be exceeded in exceptional circumstances, were:

	hours
(*a*) Flying-boats	800
(*b*) Land-based general reconnaissance aircraft	500
(*c*) P.R.U. and land-based offensive aircraft	300

In 1942 the length of tour permitted was altered in some instances, the new limits being:

	hours
(*a*) Flying-boat and four-engined land-plane squadrons	1,000
(*b*) Land-plane G. R. squadrons, excluding P.R.U. but including meteorological flights	600
(*c*) Photographic reconnaissance squadrons	300
(*d*) Strike squadrons	300

In 1943 the operational tour was finally fixed as follows:

	hours
(*a*) Flying-boat and four-engined land-plane squadrons	800
(*b*) Other G.R. land-planes and meteorological squadrons	600
(*c*) Photographic reconnaissance squadrons	300
(*d*) Torpedo bomber and strike squadrons–200 hours or 12 months (whichever was reached first)	

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There was an overall limit of eighteen months in a G.R. squadron.

The limit for the torpedo bomber and strike squadrons was the one which presented the greatest problem, in view of the difficulty of taking into account the stress and strain of standing-by after briefing, waiting for a target—possibly a major naval unit; it was recognised that such strain might be considerable, but no satisfactory method was found whereby official recognition could be given to this aspect of the operational tour.

ULTRA-VIOLET LIGHT RADIATION THERAPY

A number of stations had an ultra-violet light plant which was used largely for the treatment of aircrews, particularly those in the north of Scotland and the various islands. Statistical investigation proved that the U.V.L. radiation was of great psychological value although of little direct physical benefit; there was no evidence that irradiated individuals contracted the common cold less frequently than others.

GIBRALTAR

CLIMATOLOGY

The climate is a maritime one, brilliant sunshine lasting from April to October, with little or no rain during that period. From November to February the rainfall is about 34 in. The maximum daily summer temperature is usually between 75° and 85° and the nights are warm. The 'Levanter' cloud tends to form a pall above the Rock; when this occurs the relative humidity is very high indeed, being roughly 10 less than the temperature reading: i.e. 90° temperature = 80 per cent. saturation, and as this is not infrequent, especially between April and October, conditions can be very fatiguing, despite such aids to comfort as tropical kit.

GENERAL

At the outbreak of war there was neither a R.A.F. station nor Air Force personnel in Gibraltar. On September 10, 1939, No. 202 Flying Boat Squadron, flying London aircraft, and a flight of four Swordfish moved there from Malta in the depot-ship S.S. *Dumana*. On September 25, R.A.F. Headquarters in Gibraltar was formed, under No. 200 Group, Mediterranean Command, administration being undertaken by No. 86 Wing of this Group. The R.A.F. Headquarters unit, consisting of three officers and five airmen, was allotted offices in the Tower and the Main Wharf, which also housed the staff of the Vice-Admiral, North Atlantic. The officers were accommodated in the Rock Hotel and the

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airmen in the Victoria Hotel. Almost all the squadron personnel lived in the *Dumana*, a few of them being housed in barracks ashore. The strength of No. 202 Squadron was approximately 22 officers and 190 airmen.

Operational duties at this time consisted of anti-submarine patrols, searches for survivors of torpedoed ships, routine patrols, air escort duties with convoys and liaison with the British and the French Navies. Considerable attention was paid to the German ships lying in Spanish ports and used for refuelling U-boats. The Swordfish aircraft carried out dawn and dusk patrols in the Straits and patrols to the eastward. Flights by the Londons averaged six hours though on occasion they lasted up to nine or ten hours. On April 17, 1940, the S.S. *Dumana* returned to Malta, leaving No. 202 Squadron, which was now shore-based, behind. It was the practice to fly the Londons of the Squadron to England, a seventeen-hour flight, for engine overhauls at the end of every 360 flying hours, thus enabling pilots and crews to have two or three weeks in England at approximately six-monthly intervals.

Until the entry of Italy into the war on June 10, 1940, Gibraltar could have been regarded, from the R.A.F. point of view, as operating more or less on a peace-time basis. When Italy declared war, a general evacuation of Service families and civilians began, so that by January 1942, there were only about 1,000 civilians still resident in Gibraltar. The French collapse which soon followed led to British naval action against the French Fleet in Oran and resulted in an immediate increase in the activities and importance of the R.A.F. in Gibraltar. On July 5 aircraft based there confirmed the damage to the French Fleet in Mers-el-Kebir and made leaflet raids on Casablanca, Medouina, Rabat and Port Lyautey. On July 26, 1940, occurred the first air raid on Gibraltar, which was attacked by four enemy aircraft. A further air raid on Gibraltar was made by a large force, believed to be French, on September 24 when two of the attacking aircraft were shot down. This was repeated on the next day with a raid lasting three-and-a-half hours made by identified French aircraft of which three were shot down. There were a number of civilian and naval casualties in these two raids but no R.A.F. casualties. The strength of No. 202 Squadron was now 182 personnel, providing crews to man six flying-boats. There were only two Swordfish aircraft of No. 3 Anti-Aircraft Co-operation Unit with fourteen personnel.

Routine work continued to increase during the early months of 1941, when the landing ground of the old racecourse, previously used as a training base for the Fleet Air Arm, was made serviceable for the transit aircraft which were now urgently required in the Middle East. This landing ground was used from March 1941 onwards and had to make provision for a large number and variety of machines. It was finally taken over from the Navy in August as R.A.F. Station, North Front.

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By the middle of the year the R.A.F. strength at Gibraltar had risen to 63 officers and 557 airmen. This comprised personnel of No. 200 Group (administrative) with 50 officers and men; R.A.F. Station, New Camp with approximately 150 personnel (administrative); No. 202 Squadron with 21 officers and 193 men; the transit camp, near North Front, for overseas aircraft delivery (Delivery Flight Servicing Unit) staffed by one officer and six men and 'lodgers' consisting of transit aircrews averaging 20 officers and 90 airmen on each. In addition there were various signals and wireless units of between 30 and 40 men.

One of these detached Wireless Telegraphy units was housed near Europa Point in five Nissen huts, separate from accommodation previously shared with naval wireless personnel. A similar unit worked at 'Rock Gun' on the east side of the top of the Rock; and others at various sites to the south of the harbour on the way towards Europa Point. R.A.F. Station, North Front was of increasing importance as the year went on, being the only aerodrome capable of taking transit land machines. The existing landing ground consisted of a narrow strip 960 yards long. With the support of the Governor, Lord Gort, a plan was approved for the laying down of a permanent runway on the site of the existing strip with an extension into the sea on the western side. Work was begun on this in 1941 and finished towards the end of 1942. Sometimes aircraft required for local operations were based there, as in December 1941, when a flight of ten Hudsons of No. 233 Squadron was accommodated. During the same month No. 200 Group was disbanded, its personnel being absorbed into the newly formed Air Headquarters on the Main Wharf, and North Front being established on a proper station basis with a Wing Commander as Station Commander. (*See* Map 8.)

By January 1942 the total R.A.F. personnel at Gibraltar amounted to 180 officers and 1,040 airmen. Six hundred of them came under R.A.F. Station, New Camp, which included No. 202 Squadron and the signals units; the remainder were at North Front which had an average of 350 transit aircrew personnel, the balance being made up of station headquarters staff, a transit and servicing party, a repair and recovery party, a signals section and Fleet Air Arm personnel under training amounting to an additional 20 officers and 130 ratings.

The rate of transit of aircraft passing through Gibraltar in 1941 was approximately 120 per month. Losses in transit were not infrequent, and there were crashes due chiefly to inexperience but also to defects and very cramped conditions on an aerodrome which had never been intended for anything more ambitious than a landing ground and training base for the Fleet Air Arm. As an example of transit work during January 1942, total arrivals were 137 aircraft and total departures 121. Machines concerned were Beaufighters, Blenheims, Catalinas,

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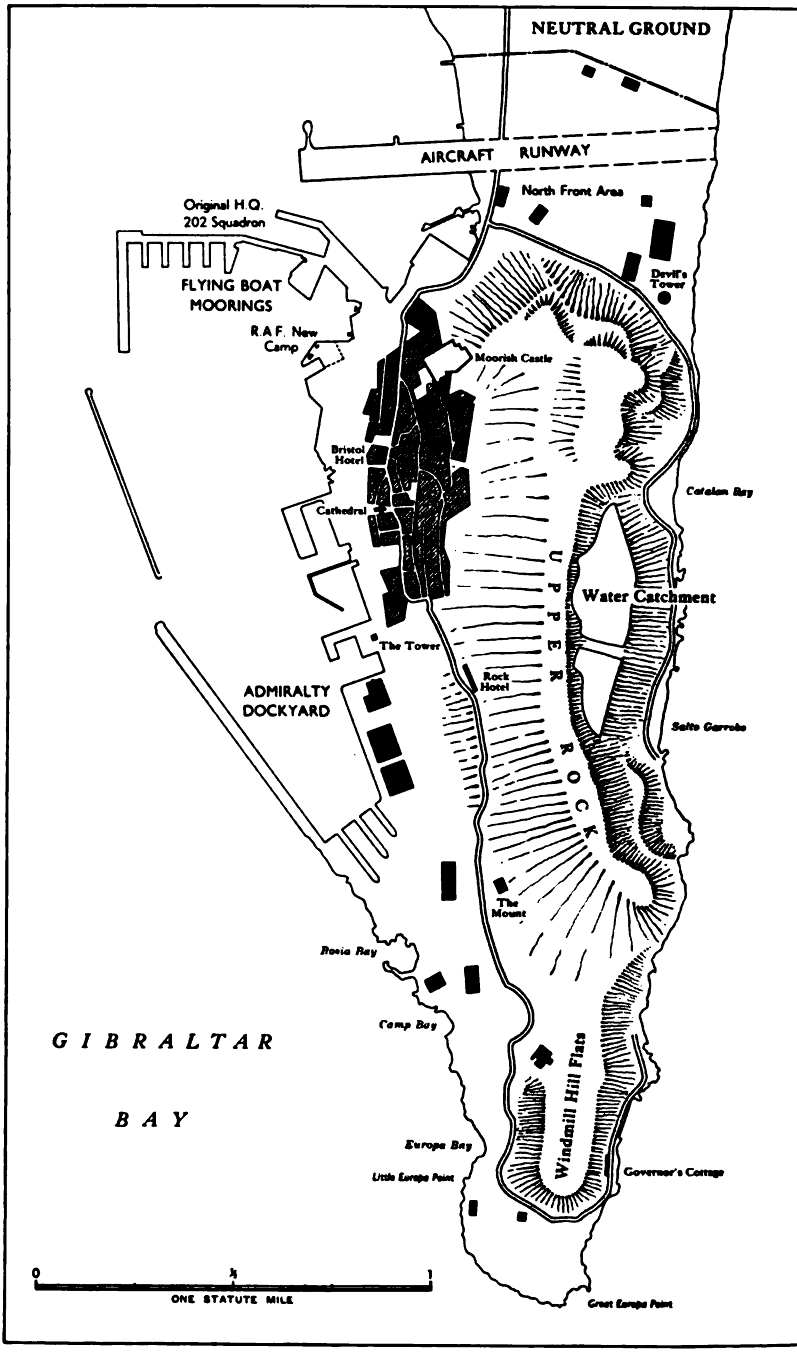

MAP. 8. Gibraltar, showing Air Force Establishments.

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Flamingoes, Hudsons, Marylands, Mosquitoes, Sunderlands and civil flying-boats. There were fourteen accidents involving transit aircraft—mostly 'missing'.

EXPANSION FOLLOWING FORMATION OF AIR HEADQUARTERS

After the formation of Air Headquarters, Gibraltar, in December 1941 the expansion of the R.A.F. in Gibraltar proceeded at a greatly increased rate. The average total strength of the R.A.F. was 3,261 in 1942, 4,114 in 1943, 4,050 in the first half of 1944, falling to 2,500 during the second half of that year and 1,861 in 1945. Area Combined Headquarters was located in a tunnel in the Rock and was an Admiralty responsibility. R.A.F. personnel employed in the tunnel were badly positioned and were subject to fatiguing conditions throughout 1943 with poor ventilation and inadequate lighting. In summer, when temperature and relative humidity were high, complaints were frequent and justified, eyestrain being a common source of trouble. By the end of 1943, fluorescent lighting and an adequate ventilation plant were installed and proved successful in ameliorating working conditions. In 1944, twenty-five W.A.A.F. officers and five airwomen who were posted to Gibraltar for duties such as cypher and clerical work were accommodated in four requisitioned private houses under excellent conditions.

R.A.F. Station, New Camp. Building on R.A.F. Station, New Camp proceeded and on May 1, 1942, it ceased to be a satellite of R.A.F. North Front and became an independent station. New Camp operated one (later one and a half) flying-boat squadrons (Catalinas), while transient Sunderlands and Catalinas were frequent visitors. During the year 25 Nissen huts were erected to add to the dormitory accommodation, but even with these the station was overcrowded, with 14 or 15 men in one Nissen hut, although the Gibraltar standard was 12 per hut; in addition 150 men had to sleep in the hangar. Accommodation remained a problem until the end of 1943.

The sick quarters at R.A.F. Station, New Camp was a two storied building of concrete brick, with accommodation for eleven beds and ancillary rooms, but it was found that it was impossible to get a stretcher from the crash room on the lower floor into the wards on the upper floor. At the end of 1942, therefore, a new building was taken over which was satisfactory and was equipped with heating and hot and cold water systems. Sanitation was water-borne throughout the station by the beginning of 1944, draining into the main town sewer.

In the autumn of 1944 the flying boat squadrons ceased to operate and the station again became a satellite of R.A.F. Station, North Front, at the same time providing domestic accommodation for the whole of the R.A.F. in Gibraltar.

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R.A.F. Station, North Front. From 1942 onwards R.A.F. Station, North Front expanded very considerably. The work of building a runway on the landing ground which was begun in 1941 proceeded apace, an extension to the existing landing ground being obtained by building out into the sea. This runway was completed in December 1942, a further extension eastward being constructed later. From operating one Hudson squadron in 1941, the station expanded to accommodate and operate four land-based general reconnaissance squadrons and one Spitfire photographic reconnaissance flight. At the same time there was a continuous flow of transient aircraft. In the latter months of 1942 and in 1943 four to five thousand hours per month were being flown by aircraft operating from this station. The peak of the population was recorded in January 1944, when 2,440 officers and men were on the strength.

By the end of 1943, R.A.F. Station, North Front had become stabilised and the completed runway, surfaced roads, new messes and improved sanitary conditions presented a very different picture from that in the days of runway and road construction, overcrowding and perpetual blasting and quarry dust, aggravated by incessant noise day and night. The original sick quarters was in a hexagonal building in the grandstand area of the old racecourse. A Nissen hut was added early in 1943 and later in the year a new sick quarters with a Dental Centre was planned and constructed. The original sick quarters had been a flimsy building with no blast walls and the inadequacy of the early arrangements was demonstrated during an air raid on June 29, 1942, when one small anti-personnel bomb fell on a Nissen hut and there were nine casualties, three of which were serious.

MEDICAL ARRANGEMENTS

The S.S. *Dumana* which arrived at Gibraltar in September 1939, carried a medical complement of one flight lieutenant, one sergeant, one corporal and three aircraftmen. These were on the strength of No. 86 Wing and worked in a small sick-bay on the ship, where all sick parades were held and medical administration carried out. The sick-bay was little more than a medical inspection room, all personnel who required more than the simplest of treatment being sent to the Military Hospital, Gibraltar. By the time the S.S. *Dumana* left in April 1940, all personnel were shore-based and, the R.A.F. medical staff having sailed with No. 86 Wing, all medical arrangements were in the hands of the Army. Sick parades were held in the military medical inspection room and sanitary rounds and inspections were conducted by a R.A.M.C. officer.

This arrangement continued during June 1940, when administrative control of No. 200 Group and No. 202 Squadron was transferred from Mediterranean to Coastal Command. In November of that year it was

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decided to establish a separate medical staff and sick quarters; accordingly a squadron leader, acting both as Senior Medical Officer No. 200 Group and medical officer of No. 202 Squadron, together with one sergeant, one corporal and three aircraftmen, was posted on November 16 and arrived at Gibraltar at the end of that month. They were responsible for the medical care of all R.A.F. personnel. Dental treatment was undertaken by the Army Dental Corps, patients attending the centre on two mornings a week except for urgent cases which could be seen at once. Slow progress in building and general shortage of accommodation did not allow the Senior Medical Officer to take his sick parades in the Garrison Dispensary until January 1941, treatment even then being undertaken by the R.A.M.C. and sick personnel being admitted to the Army Hospital. This arrangement continued until June, when a four-roomed station sick quarters was completed at R.A.F. Station, New Camp, with the establishment usual for an operational station, one flying officer as squadron medical officer, a sergeant, a corporal and five aircraftmen. Four beds were equipped and the station sick quarters was able to offer limited facilities.

The outlying units described in the preceding section had been established between December 1940 and June 1941, but only one of them was provided with a nursing orderly. One of the units was housed in Loretto Convent, in company with naval and military detachments. Owing to its situation two miles from the station sick quarters, personnel stationed there attended the military medical inspection room a few hundred yards away at Buenavista. For the old Royal Naval Air Station, later to become R.A.F. Station, North Front, whose personnel serviced transit aircraft, medical arrangements were at first difficult to arrange owing to shortage of accommodation and the variation in the numbers of 'lodger' personnel. Medical attention was provided by visiting medical officers from New Camp. On the landing ground there was a naval ambulance in attendance for crash duty manned by two nursing orderlies and whenever possible a medical officer. This was a temporary arrangement, pending the take-over by the R.A.F. of the whole station in August 1941. After this date the R.A.F. undertook medical care of their own and naval personnel, a small sick-bay being enlarged and made into a subsidiary sick quarters; beds were installed in January 1942. In September 1941 this sick quarters was staffed by a corporal and two nursing orderlies, equipment and drugs being issued from the main R.A.F. station sick quarters. By this time an ambulance and driver had been obtained from the R.A.S.C. and a R.A.F. medical officer visited the station daily, undertaking all medical responsibilities.

The situation in the event of enemy attack on R.A.F. Station, North Front would have been difficult, as the site was exposed and there were no shelters within reasonable distance. Arrangements were made for

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evacuation to two Army aid posts, one in Catalan Bay, under the comparative shelter of the east side of the rock and the other in MacFarlane's Gallery. It was considered that air attack was less of a problem than the danger of land bombardment from Spain, which would find both R.A.F. stations in exposed positions and would be likely to inflict serious initial casualties, making evacuation very difficult. In the event of attack on Gibraltar through Spain, it was planned that the R.A.F. should be evacuated in the cableship *Murra*.

No anti-gas arrangements were made in the period up to April 1940. A small decontamination centre was then sited near No. 202 Squadron offices and workshops in No. 20 Shed, North Mole, but there was no provision for the cleansing of contaminated wounded. By June 1941, the R.A.F. Station had a small decontamination centre but again no provision for the cleansing of contaminated wounded. A nursing orderly was to be detached for duty to this decontamination centre when necessary. For the rest of the year the anti-gas arrangements remained indefinite and though a sick annexe was proposed, it was not completed by the end of the year. A large civilian centre 300 yards from the entrance to the station was available for use if a gas attack occurred before the station arrangements were ready.

LIAISON WITH OTHER SERVICES

Close liaison was maintained between the Senior Medical Officer, Gibraltar and the Army medical authorities. This enabled the R.A.F. to organise a skeleton medical service pending the arrival of their own stores and equipment. They were, until the end of June 1941, entirely dependent on the Army for medical stores, medical inspection room facilities and ambulances. The staff of the military hospital were most co-operative and R.A.F. medical officers were encouraged to follow up their cases in hospital, assist in the theatre and administer anaesthetics. During the latter part of 1941 the D.D.M.S. Royal Army Medical Corps put such first-aid posts as were necessary at the disposal of the R.A.F. medical officers, who were also able to call on stretcher bearers and ambulances from R.A.M.C. sources in an emergency.

WORKING AND LIVING CONDITIONS

The acute shortage of accommodation and the rapidly increasing number of personnel in each of the three fighting Services was a striking feature at Gibraltar, as it was in many other units overseas. Soon after the arrival of the R.A.F. in Gibraltar, a station was planned on the reclaimed land on the edge of the harbour; it was to be built of locally made concrete bricks, but on the departure of the S.S. *Dumana* in April 1940 the construction of the camp was not sufficiently advanced for personnel to be housed in it and it was necessary to billet officers of

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No. 202 Squadron in the Bristol Hotel and airmen in the Town Range Barracks. After March 1941, the R.A.F. personnel were accommodated in the new barrack blocks as soon as they became habitable. The greatest accommodation difficulties occurred during the first six months of 1941, when full use had to be made of tentage and Nissen huts and even with all possible improvisation there was considerable overcrowding for short periods. Towards the end of the year a large brick airmen's cook-house was constructed but until its completion all cooking was carried out in a field kitchen at the North Front station; it was possible, however, to provide a small brick cookhouse for the sergeants' mess.

It was found that the old barrack buildings in which the airmen were first quartered were heavily infested with *Cimex lectularius* (the common bed-bug) and that after the move into the new quarters these were also found to be infested; however, it was possible to keep the infestation under control by standard measures though the pest was never completely eradicated.

Messing. The R.A.F. were supplied by the Royal Army Service Corps and all rations were drawn in kind. The vast reserve of food in the Garrison stores had to be 'turned over' as much as possible and a very large proportion of the stores was in the form of tinned meat and vegetables. This predominance of tinned food coupled with the lack of fresh vegetables gave rise to a series of complaints from the airmen, for which there was no immediate remedy. In December 1941, however, approval was given for the R.A.F. to transfer to the Naval system of messing, drawing part rations and part cash equivalent, and it was then found possible for the catering officers to present a more varied and attractive diet.

Fresh bread, which was supplied from the Army bakehouses, was frequently in short supply and it was found necessary to have 'breadless days' when biscuits were issued instead. This particular problem arose in many Middle East and Far East stations, but although inconvenient it could not be considered a hardship.

A problem which was more serious and caused the medical authorities considerable uneasiness was the supply of drinking water. As has been stated in the section on climatology, the period from April to October was comparatively dry and as the main supply of water depended on two catchments in the rock face, supplemented by a few wells in the North Front area, strict economy measures had to be enforced. In all barracks salt water with its attendant disadvantages was used for washing and only at the Rock Hotel was piped fresh water available. This paucity of supply coupled with the ever-increasing number of personnel on the Rock, made water supply one of the key medical problems and would no doubt have become a factor of major importance if the Garrison had been subjected to continuous enemy attack.

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CARE OF FLYING PERSONNEL

In general, flying from Gibraltar was on anti-submarine patrol, convoy escort or transport flying. Weather conditions were very good for most of the year and hazards were mostly those of normal flying and those arising from action against enemy submarines. 'Flying Stress' was uncommon and supervision of flying personnel by squadron medical officers was of a high order. It was necessary to curtail the tour of a small number of aircrew personnel, but cases of 'lack of moral fibre' were rare.

In the early days of the introduction of the operational tour system (under which aircrew completed a set number of hours for the particular type of aircraft and duty) difficulties arose in No. 202 Flying-Boat Squadron; at that time flying-boat crews were very difficult to replace and in December 1941 there were three officers who had completed 2,000 hours operational flying without a break, this being double the normal tour. During the same period four Catalinas and crews were ordered to the Far East, although the crews had almost completed their 1,000 hours tour. The executive were unable to assist and the medical officer was instructed that all aircrew who were medically fit should proceed, regardless of the number of hours they had flown. Two N.C.O. aircrew members were found unfit and medically boarded but the remainder had to accept the executive's ruling.

Living conditions for aircrew, as for other personnel, were poor in the period of expansion from 1942 to 1944, but were always adequate. The aircrew who manned the Leigh Light Wellingtons (Wellington aircraft fitted with searchlights for night pursuit of submarines) were provided with sleeping quarters well away from the aerodrome area in order that the noise of planes should not prevent them from sleeping during the daytime. A similar situation had to be faced at New Camp but unfortunately it was difficult to provide quiet day sleeping accommodation on such a compact station and a serious problem remained, particularly as sorties of 20–22 hours each had to be flown by many of the crews.

The supply of special aircrew rations was maintained at both North Front and New Camp Stations and despite the very long sorties that were flown it was possible to provide suitable meals for all flying personnel.

INVALIDING AND MEDICAL BOARDS

At this period of the war the transport of invalids to the United Kingdom was extremely difficult to arrange. There were no hospital ships and those convoys which were available were limited in the main to 7–8 knots. Occasionally passages could be arranged on suitable Naval craft, and wherever practicable use was made of aircraft returning to the United Kingdom for the carriage of both R.A.F. and Army invalids.

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It was also possible to use these aircraft for flying pathological specimens to the Institute of Pathology at Halton; this was of particular value during the epidemic of cerebro-spinal meningitis in 1941.

It was unfortunately impossible to load general service stretchers on to the Sunderland aircraft and in every instance it was necessary to employ Neil-Robertson stretchers; the Catalina aircraft, however, could accommodate the general service stretcher and they were employed wherever possible.

Up to December 1940, boards on proposed R.A.F. invalids were held on the authority of the Army D.D.M.S., Gibraltar; the candidates for aircrew duties were given a preliminary medical examination in Gibraltar, being sent to Malta for their final medical examination, during the time that No. 200 Group came under Mediterranean Command, and to the United Kingdom after the Group had been transferred to Coastal Command. This procedure was extremely wasteful of both time and shipping accommodation, the latter often being difficult to procure. After December 1940, however, the Senior Medical Officer in No. 200 Group was empowered to act as president of all R.A.F. medical and aircrew boards at Gibraltar. After the introduction of this arrangement 37 personnel were boarded in the next six months and 76 in the following six months.

In 1943 the Principal Medical Officer, Coastal Command, evolved the following scheme for the escort of invalids requiring medical attention en route to the United Kingdom. Invalids despatched by air were to be accompanied by a nursing orderly, who would hand over the patient and the relevant medical documents to the medical officer at the station of arrival in the United Kingdom together with a letter requesting the medical officer to send the nursing orderly to the Principal Medical Officer's office, Coastal Command; the orderly would then be given one week's leave and a return flight to Gibraltar would be arranged. Three nursing orderlies were posted to Gibraltar for this specific task, but it was possible for all nursing orderlies there to take their turn in this much sought-after duty.

Under this arrangement it was possible to return a considerable number of invalids, both from the R.A.F. and from other sources, to the United Kingdom. In 1942–3 a total of 72 invalids was returned to U.K. from Gibraltar and in addition 23 invalids from other Mediterranean areas passed through Gibraltar and were during their stay the direct responsibility of the S.M.O. Gibraltar. Approximately 60 per cent. of the invalids travelled by air and the remainder by sea. In 1944 it was possible to return 295 invalids, made up of 39 from Malta, 156 from North Africa and 100 from Gibraltar. In 1945 the number invalided was only 67, although this was due in the main to the diminishing numbers of personnel throughout the Services.

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Invalids in transit, though relatively few in number, created many problems. Whenever possible they were housed in the station sick quarters, but if this was not convenient they had to be accommodated in the Military Hospital and collected at a suitable time for emplaning. This caused considerable difficulty when flights were cancelled at the last moment. Latterly Dakota aircraft were mainly used, as they were very adaptable for transporting stretcher cases, but no empty aircraft of a suitable type was allowed to fly without invalids; if necessary the patients were accommodated on 'safari' beds which were preferable to G.S. stretchers, being lighter in weight than the latter and more easily stowed on the floor of the aircraft.

SANITATION AND HYGIENE

Sewage Disposal. There was only one sewage outfall from the Rock, situated at Europa Point, and it was necessary for all sewage to be lifted by a series of compressed air pumps to the main 12-in. drain. The water-borne sewage system came under the control of the City Council and the Army Authorities.

R.A.F. Station, New Camp, planned in 1940, possessed a properly constructed sewage system, with which little or no difficulty was experienced, the outflow pipe emptying into the main town sewage system.

R.A.F. Station, North Front, however, was less fortunate, the station having developed after very hurried planning. The racecourse grandstand had been provided originally with only two water closets and a urinal, draining into a privately owned 4-in. pipe with a fall of only 1 in 750. When this system was used daily by approximately 600 officers and airmen living permanently on the racecourse, troubles continually arose despite careful maintenance. The outfall pipe was continually becoming blocked and finally, in August 1942, was found to be broken at a point some 200 yds. outside the boundary of the camp; this pipe was replaced by a 9-in. pipe with a fall of 1 in 600 and considerable improvement was noted, although the ejector pump was not thought to be sufficiently powerful for this new rate of flow. Surface water was disposed of partly by drains which led into the sewage system, but, if anything more than light rain fell it was found that sewage regurgitated through manholes and inspection caps. The northern part of the station was better provided for, having a water-borne system emptying into a septic tank, and no sewage problems arose.

Yellow Fever Control. The problem of yellow fever had to be borne in mind, as aircraft occasionally arrived from infected areas such as Bathurst and Freetown and it was necessary to enforce full anti-amaryl precautions; the interiors of aircraft were sprayed on arrival and, wherever possible, the crew and passengers inspected by medical officers

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daily for five days. The use of mosquito nets for crew and passengers was encouraged. As an epidemic of the disease had been recorded in the early part of this century, and the vector, *Aëdes aegypti*, was numerous locally, the authorities were concerned over the possibility of another outbreak and stringent control measures were instituted for both sea and air travellers.

In 1941 only a relatively small number of flying boats passed through Gibraltar on their way to the United Kingdom from West Africa, a yellow fever area, and the problems created were easily dealt with. Aircraft were sprayed with insecticide and passengers were kept under observation as mentioned above; no certificate of yellow fever inoculation was required.

However, in 1942, when the numbers of aircraft on this route had very greatly increased, more stringent measures were applied. The medical officer of the R.A.F. station concerned was informed of the impending arrival of each aircraft from yellow fever areas and as soon as it alighted, he entered, examined passengers and crew and checked yellow fever inoculation certificates; while he was thus engaged, a nursing orderly sprayed the interior of the aircraft with R.399 insecticide under pressure. It was only after these formalities were completed to the medical officer's satisfaction that personnel were permitted to disemplane. A mosquito-proofed house was available at North Front for the segregation of personnel who arrived without a valid certificate and the Army 10th General Hospital had suitable accommodation for suspected and proven cases. In 1943 it was necessary to quarantine a number of persons in the screened quarters at Gibraltar. No control was exercised over personnel who arrived indirectly from yellow fever areas.

The regulations laid down for the prevention of yellow fever were adequate, if strictly adhered to, but considerable difficulty was experienced in enforcing them. Flying-boats were usually moored a considerable distance from the shore, which meant that it took some time, especially if there were several aircraft, for the medical staff to visit and spray each one and pilots often grew impatient and took off before this precaution had been carried out; this was particularly the case when civil (usually foreign) air lines were concerned. A further difficulty arose from a clause in the regulations on vaccination and inoculation certificates whereby a Governor was empowered to give a dispensation in the instance of high officials travelling on matters of national importance; although this measure was reasonable and necessary in an extreme emergency, it was open to abuse and left a loophole in the otherwise well-organised precautions.

Gastro-Enteritis. This was undoubtedly the most common cause of sickness in Gibraltar and the majority of personnel at one time or another

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suffered an attack of 'Gib tummy' as it was known; this was characterised by diarrhoea for a few hours or days, the stools not however containing blood, but occasionally mucus. The majority of cases were treated as outpatients but it was necessary to admit a number to sick quarters for forty-eight hours or more. Any personnel who passed blood or mucus in the stool were investigated bacteriologically to identify a possible bacillary or amoebic dysentery.

It was found that a small number of cases occurred each month, the figure usually being in the region of 20–30, with a sharp rise in the summer months from May onwards reaching a peak in September. The incidence corresponded with the increase in the fly population associated with the warmer weather, but although all possible steps were taken to combat the fly menace, many of the breeding grounds were on the Spanish side of the border and preventive measures were of necessity limited in their scope.

Dysentery. An average of 1–5 cases of dysentery were discovered each month but in October and November of 1943 there was a severe outbreak when 68 cases were recorded. In spite of careful investigation the exact cause of the outbreak was never known, although the delay in the onset of the rainy season and the associated increase in the fly population were probably important factors. The majority of cases were due to the *Shiga* organism, although *Flexner* and *Sonné* infections were also isolated in a few instances. The outbreak was confined almost entirely to the officers' mess and it was necessary to hospitalise forty-four of the officers, as well as one or two of the mess waiters who were undoubtedly partly responsible for the spread of the epidemic; fortunately the outbreak did not reach the other messes. However, the outbreak did have the salutary effect of stressing the importance of immediate action being taken on all recommendations made by the medical authorities in the sanitary diary.

A smaller epidemic occurred in the hot season of 1944 and twenty-seven cases were diagnosed, the majority being of the *Flexner* type. As in the previous outbreak no causal factor was found apart from the obvious likelihood of epidemics at that time of the year.

Typhoid Fever. Two small outbreaks were recorded in 1944 and 1945 respectively. The former occurred in August 1944 in the W.A.A.F. officers' mess, when five cases were diagnosed and thorough investigation failed to reveal the cause of the outbreak; all the officers affected were fully protected with T.A.B.C. and no sequelae developed. On the second occasion, in May 1945, two fully protected airmen were affected. Despite examination of numerous stool specimens no carriers were isolated and, as the airmen concerned had not left the Rock, the medical authorities were of the opinion that the infection must have been contracted through eating unwashed fruit or salad.

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Typhus. The amount of work involved in the construction of barrack blocks and extensions to the airfield made it necessary to employ considerable numbers of Spanish labourers of both sexes, who travelled daily from Spain into the Rock area; the consequent danger of infection being introduced demanded continual vigilance on the part of the medical authorities.

During 1941 an outbreak of typhus was feared after its discovery in two escaped Allied prisoners-of-war in the Military Hospital; the position was made more grave by the fact that sporadic cases had occurred in Spain within 25 miles of the border. Immediate prophylactic measures were taken by the Naval, Army and R.A.F. medical authorities. All Spanish labourers were examined and deloused, and, in the instance of the 400 employed by the R.A.F., the task was undertaken by R.A.F. medical officers. All R.A.F. personnel were inspected at regular intervals and the seriousness of the situation was stressed in lectures by medical officers.

Smallpox. An outbreak of smallpox occurred in Gibraltar early in 1944. The original case, notified on February 24, was that of a sailor who had contracted the disease in Suez, where an epidemic had broken out a few weeks earlier. Unfortunately the authorities in Gibraltar were not informed of the epidemic until a week or so after the initial case. Twenty-three cases were recorded in the Gibraltar area, eight of which were fatal; no R.A.F. personnel were affected.

As soon as the possibility of an outbreak was realised, lymph was procured by air from the United Kingdom and all personnel were vaccinated irrespective of the date of their last vaccination. Of the 2,000 personnel vaccinated thirty developed a degree of vaccinia which necessitated absence from duty. The epidemic died out at the end of April.

Anterior Poliomyelitis. In July 1941 a severe case of anterior poliomyelitis occurred in an airman living in a Nissen hut on one station. The severity of the infection necessitated 'iron lung' treatment and only after four-and-a-half weeks was it possible to invalid the patient, almost totally paralysed, to the United Kingdom under the care of a medical officer. In September, October and November of the same year there was an outbreak of cerebro-spinal meningitis totalling about 40 cases among the three Services. Four of these cases developed paralysis of varying degree and two unfortunately died from massive respiratory failure. The outbreak was regarded clinically as one of anterior poliomyelitis, but fortunately in an abortive form, actual paralysis being a rare symptom.

Venereal Disease. In the first eighteen months of R.A.F. occupation of the Rock there were very few cases of V.D. and those personnel in whom it was discovered had all contracted the disease in the United Kingdom.

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In 1941, with the increasing number of personnel in transit, nine cases were recorded, again having their origin in the United Kingdom. Twenty-six cases were recorded in 1942 of which fourteen had contracted V.D. in the United Kingdom and the remainder locally. It was in this year that personnel were permitted to enter Spain, on day passes, a country which was known to have a relatively high incidence of V.D. All routine measures for the control of the disease were instituted, such as lectures, prophylactic rooms and the free provision of condoms. However, the following year, despite all prophylactic measures the cases had risen to thirty, and in 1944 when facilities for entry into Spain were made easier the number increased to seventy-one cases in the year.

No treatment of venereal disease was undertaken by the R.A.F. medical authorities, all cases being admitted to the Military Hospital at Gibraltar.

THE AZORES FORCE

Consequent upon negotiations between the British and Portuguese Governments, it was decided to form 'Force 131', to land it in the Azores in September 1943 and to obtain there the following facilities:

(*a*) The establishment of an Air Base on the Island of Terceira for the the operation of G.R. aircraft taking part in the Battle of the Atlantic.

(*b*) The establishment of a Staging Post to meet the requirements of Transport Command.

(*c*) The increase of the ship fuelling facilities then available at Ponta Delgada on the Island of San Miguel by the establishment of a Naval Base at Horta on the Island of Faial.

(*d*) Continued use of the transatlantic cables which pass through Horta on the Island of Faial.

The forces comprising this planned expedition to the Azores consisted of:

(*a*) A R.A.F. Group Headquarters (No. 247 Group in Coastal Command), with all the requisite R.N. and R.A.F. staff for an operational group conducting anti-submarine warfare, convoy patrols, air sea rescue, etc.

(*b*) R.A.F. personnel for two Fortress squadrons and one Hudson squadron.

(*c*) Army details of R.E., R.A.S.C., R.E.M.E., Royal Corps of Signals and Pioneers.

(*d*) R.N. personnel for the R.N. Base, Horta, and on H.M. trawlers and other H.M. ships permanently or temporarily based on the Azores.

(*e*) A skeleton R.A.F. Mobile Field Hospital closely allied to the Force Headquarters.

BRIEF OPERATIONAL SURVEY

The R.A.F. was operating from the Azores in order to 'close the gap' in the Battle of the Atlantic by the operation of squadrons of Coastal

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PLATE XXI: The R.A.F. Field Hospital at Angra

PLATE XXII: The R.A.F. Establishment at Fort San Sebastian, including a 12-bedded Sick Quarters

[facing p. 312

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Plate XXIII: R.A.F. Hospital, Lagens in Foreground, with American Forces Accommodation behind

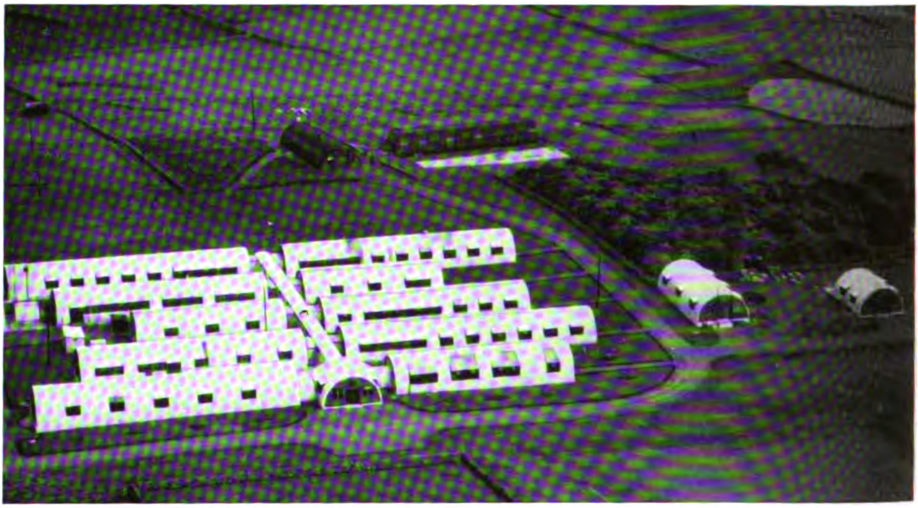

Plate XXIV: R.A.F. Hospital, Lagens. View showing Construction and Layout of Buildings

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PLATE XXV: Typical Ward in R.A.F. Hospital, Lagens. Note Curved Walls and Recessed Windows

PLATE XXVI: Repairs being effected to R.A.F. Hospital, Lagens, after the Hurricane and Rainstorm in October 1944

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Command and to improve Transport Command's facilities by providing an alternative and possibly safer route, particularly in winter.

Coastal Command. Coastal Command operations began as soon as the two Fortress squadrons reached the Azores from the United Kingdom in October 1943. They were reinforced in November by two flights of Leigh Light Wellington aircraft. Some success against U-boats was gained, and at the end of December 1943 one flight returned to Gibraltar, while the other returned to the United Kingdom in April 1944.

Transport Command. From the earliest days of the availability of the airfield Transport Command utilised Lagens both for transatlantic flights from Canada or U.S.A. to the United Kingdom, and for the maintenance of a mail, passenger and freight service to the Azores. This service, known as the 'U.A.' was originally carried out to a weekly programme by Dakotas running United Kingdom–Gibraltar–Lagens–United Kingdom; the service was irregular until the summer of 1944, but by April 1945 a twice weekly service with Yorks had begun.

U.S.A.T.C. During 1944 the use of the airfield by R.A.F. Transport Command was completely dwarfed by the vast numbers of aircraft of the U.S. Air Transport Command which passed through. The great majority of westbound Skymasters were engaged in ferrying U.S. casualties to U.S.A. from European, Mediterranean and Far Eastern theatres of war, details of the numbers being as follows:

Month	*Stretcher Patients*	*Ambulatory Patients*	*Totals*
1944			
January	—	—	—
February	—	—	—
March	6	51	57
April	11	150	161
May	10	24	34
June	55	332	387
July	310	487	797
August	640	376	1,016
September	919	601	1,520
October	1,107	699	1,806
November	918	697	1,615
December	1,135	971	2,106
	5,111	4,388	9,499
1945			
January	1,483	1,022	2,505
February	2,099	917	3,016
March	3,658	1,448	5,106
April	2,561	1,309	3,870
	9,801	4,696	14,497
Totals March 1944 to April 1945	14,912	9,084	23,996

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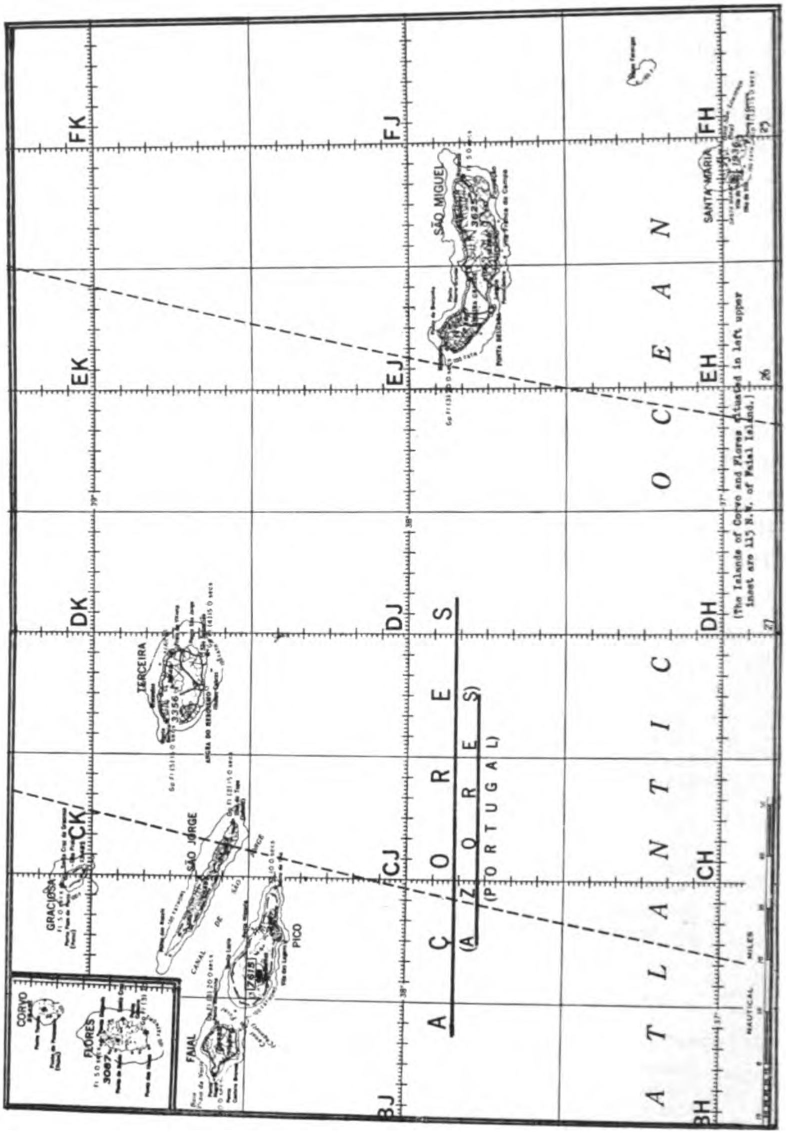

MAP 9. Map of Azores showing relationship of the several islands.

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DESCRIPTION OF TERRAIN

The Azores is an archipelago in the Atlantic Ocean belonging to Portugal, with an area of 922 square miles and a population of 232,000. The islands extend from north-west to south-east between 36° 53′ and 29° 55′ N. and between 25° and 31° 16′ W. They are divided into three widely separated groups; the south-eastern group consists of San Miguel, Santa Maria and Formigas, the centre of Faial, Pico, San Jorge, Terceira and Graciosa; the north-western of Flores and Corvo. They are volcanic in origin and all the islands are similar, rising steeply from scree-lined shores to heights reaching 7,600 ft. in Pico. (*See* Map 9.) Vegetation generally is of sub-tropical character and the islands are extremely fertile. The climate of the coastal area generally has an average annual temperature of between 62° and 65° F. with comparatively small variation; the relative humidity is rather high being rarely less than 50 per cent. and frequently as high as 95 per cent., while atmospheric pressure is above normal with a high rainfall.

On the island of Terceira there is a civil population of about 54,000 (1940 census) of whom about one-fifth live in the chief town of Angra do Heroismo, which is also a Military Garrison housing about 5,000 men of the Portuguese Army. Since almost the whole of the population occupies the coastal belt of the island, where the climatic conditions are better, they are in fact much more crowded than the density figures of 122 inhabitants per sq. km. indicate. They are a peace-loving peasant people living in primitive simplicity, the men being engaged almost entirely in cattle breeding, the dairy industry and agriculture, while the women occupy themselves working at home for the embroidery industry.

Endemic and Epidemic Disease. Typhoid fever, plague and cerebro-spinal meningitis show the highest incidence while diphtheria, polio-myelitis and whooping cough occur spasmodically. Neither dysentery nor tuberculosis is notifiable, although the latter is undoubtedly of high incidence.

Entomology. It was observed that the vectors of malaria and yellow fever were not present anywhere in the islands, and, although cases of malaria were noted by both the British and Portuguese Forces, all were relapse cases, originating elsewhere. Mosquitoes were troublesome at certain camps at most seasons of the year and personnel were obliged to use nets continuously.

MEDICAL ARRANGEMENTS

The entire medical responsibility for the British Forces in the Azores (with the exception of the small R.N. Detachment at Horta) devolved on the R.A.F. The following were the medical facilities provided in August 1943:

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(a) *Force Headquarters*			
(i) *Staff*	*H. Qs.*	S.M.O.	1 W/Cdr.
		N/Ord.	1 F/S.
		San. Asst.	1 Sgt.
	M.F.H.	Surgical Specialist	1 S/Ldr.
		Medical Officers	2 F/Lts.
		Dental Officer	1 F/Lt.
		N/Ord.	1 F/S., 2 Cpls., 12 A.Cs.
		Rad., Lab. Asst., D.C.O. and Disp.	1 Sgt. each
		Cooks	1 Cpl., 2 A.Cs.
		A.C.H.	4 A.Cs.
		Clk./GD.	1 A.C.
(ii) *Equipment*	Medical	H.Qs. Scale Z.1 and special M.F.H. Scale.	
	Barrack	Tentage, beds, etc., to 50-bed scale for M.F.H.	
(iii) *Transport*	1 Staff car 2 Heavy ambulances 1 3-ton truck 1 15-cwt. truck 1 350-gallon water cart		
(b) 2 *V.L.R Squadrons* (Nos. 206 and 220)			
(i) Staff		M.O.	1 F/Lt.
		N/Ord.	1 Sgt., 1 Cpl., 2 A.Cs.
(ii) *Equipment*		Squadron Scale Z.1	
(iii) *Transport*		1 Heavy Ambulance	
(c) *R.A.F. Regt. Sqdn.* (No. 2710 *Sqdn.*)			
Staff		N/Ord.	1 Cpl., 1 A.C.
		N/Ord. S.S.A.	1 Cpl.
(d) *R.N. Base, Horta*			
(i) *Staff*		M.O.	1 Surg. Lt. Cdr., R.N.V.R.
		S.B.A.	2 Ratings
(ii) *Equipment*		Appropriate mobile equipment.	

These facilities were to be available for a Force of some 4,000 R.N., Army and R.A.F. personnel, stationed on islands as much as 100 miles apart in some instances. Arrangements were to be made on arrival to make full use of local Portuguese medical facilities, which were reported to be of good standard. Planning of medical supplies meant taking six months' stock, since shipping would at best call only at three monthly intervals and air transport was at first an unknown quantity. Planning for accommodation was based on everything being initially under canvas, while building material for permanent Nissen hutted accommodation was being taken and permanent M.I. rooms consisting of Nissen huts (66 ft. × 24 ft.) were planned for each of the V.L.R. squadrons. No Nissen material was included for the hospital since it was intended

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to occupy a 50-bed wing of the 150-bedded civil hospital at Praia da Victoria, about 4 miles from Lagens airfield. This was likely to be particularly suitable, as Praia was a possible site for Force Headquarters. This plan for hospital provision was made by the Air Ministry and was based on information which was later found to be seriously at fault.

In August 1943, the S.M.O. of the Force was appointed and arranged for the medical officers to attend a course in Tropical Medicine and Hygiene, for the dental officer to receive a month's instruction in anaesthetics and for the sanitary assistant to attend the School of Hygiene for a special course in water purification and the use of the 350-gallon water tender. The S.M.O. was hampered in his preparations by secrecy and security needs, but he was able to keep in close touch with the Commander Royal Engineers (C.R.E.) regarding water and sanitation plans and with the general staff concerning administrative and naval plans. On his recommendation, Force 131 received yellow fever inoculations before embarkation and certain of the medical stores were despatched to the port of embarkation.

Embarkation in H.M.T. *Franconia* proceeded on September 29, 1943, and the Force sailed on October 1. The S.M.O. of the Force was appointed S.M.O. of the troopship and his staff was chosen from medical personnel of the draft. This laid heavy responsibilities for the voyage on his shoulders when he needed time to perfect the medical plans for landing and establishment of the Force, although there was, in fact, on board the troopship a complete R.A.M.C. staff of medical officers and nursing orderlies, the regular medical staff of the troopship.

EVENTS ON ARRIVAL IN THE AZORES

Immediately on entering Angra Bay the S.M.O. went ashore with the Commander Royal Engineers, Deputy Adjutant and Quartermaster General, Senior Equipment Staff Officer and Security Officer in the first landing craft (personnel) to reconnoitre the Angra area for camp sites, as the personnel ship had to be cleared in less than 24 hours. He found it necessary to make special medical and sanitary arrangements, as soon as camps were sited, since it transpired that all top priority equipment for immediate use was loaded at the bottom of the hold of the main store ship. This ship had been loaded on the day before sailing from the originally correctly loaded ship, which had broken a propeller shaft. Thus all equipment was loaded in reverse order of priorities and all sections, medical, signals and R.E. alike, were seriously affected by this unforeseen but unavoidable complication. Immediately on landing, therefore, arrangements were made with the Portuguese military medical authorities for the admission into their hospital of all casualties requiring in-patient treatment. Fortunately there was a supply of field surgical haversacks on the *Franconia* and in addition a large

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quantity of medical equipment was obtained from H.M. ships in the bay, so that first-aid posts and M.I. rooms were equipped during the first 36–48 hours before some of the Z.1 scale equipment came to light.

Medical plans had been largely confined to the provision of first-aid facilities in the harbour area of Angra, where the landing craft (mechanical) were expected to tie up at 3 points, and to the setting up of M.I. rooms at the camps planned for personnel and stores in the Angra area and for the camp at the airfield at Lagens on the north side of the island. In addition, the field hospital had to be sited and set up as early as possible, while in conjunction with the C.R.E. early provision of water supply and sanitation at all sites was essential. In this connexion the lack of the equivalent of the R.A.M.C. Field Hygiene Section was noticeable and was commented upon by the Royal Engineers. Normal R.A.F. organisation is not suitable for field expeditions, the arrangements for R.A.F. Regiment, Servicing Commandos and Tactical Air Forces being the exceptions.

Within the first few days it was learned that bubonic plague was endemic in Terceira, and, as it was advisable that the whole Force should be protected against plague, the necessary stocks of vaccine were flown out with the first Fortresses from the United Kingdom. It also transpired that there was no hospital at Praia other than a most primitive 38-bedded Civil Hospital (totally inadequate for the civil population), while the only effective hospital in the island was the Portuguese Military Hospital, which was 17 miles from Lagens airfield over difficult mountain roads and about 3–4 miles west of Angra. A field hospital was therefore set up in Angra near Force Headquarters* for minor cases only and arrangements were made for all serious cases to go temporarily to the Portuguese Military Hospital (with the R.A.F. surgical specialist visiting daily from the field hospital); meanwhile a stone building (lately the Portuguese airmen's mess) at Lagens airfield was taken over as a temporary sick quarters, with a view to converting it to a hospital.

Difficulties of Water Supply. The provision of a safe water supply had given the C.R.E. and his staff much anxiety in the United Kingdom, particularly as not only was the supply in the Azores of doubtful quantity, but there was known to be widespread contamination and typhoid was believed to be particularly prevalent. In the first few days water was, where possible, sterilised in bulk and otherwise individually by the 'water bottle' method ; as soon as the water carts were available, they were in continuous use at the larger camps until pipelines could be laid. There were numerous small camps throughout the islands and these were provided with sterilised water delivered in 2 gallon cans, 2,000 of which had been put ashore filled with sterilised water from H.M.T. *Franconia* on the day of landing. At the end of three weeks, a

* *See* Plate XXI.

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$3\frac{1}{2}$ mile pipeline from the surface water supply at Nasce Agua was completed at Lagens, but units in Angra continued with the 350 gallon water tender which was, in fact, always required for the provision of water to units in the Angra area.

Standards of Hygiene and Sanitation. During October and November 1943 all the camps, with the exception of the Army, R.A.F. Regiment and R.A.F. Field Hospital camps, were criticised for their low standards of hygiene and sanitation, largely due to the lack of field training in the R.A.F., especially as far as officers were concerned. The insanitary state of camps was a continual source of anxiety because of the prevalence of typhoid and the possibility of cases of plague in the civil population close to the camps, especially while the medical services were so limited. In spite of the most energetic medical and sanitary recommendations it was not until the summer of 1944 that there was any improvement in camp sanitation and general hygiene.

Facilities at Santa Anna. On October 31, 1943, after negotiations with the Portuguese Government, a small R.A.F. party proceeded in civilian clothes to the Island of San Miguel and set up certain diversionary and emergency landing facilities at the airfield of Santa Anna. One corporal nursing orderly was despatched with this party, which for many weeks lived in isolation owing to the refusal of the G.O.C. Portuguese Army in the Azores to allow any communication with them.

RESPONSIBILITY OF BRITISH AND U.S. FORCES ON EXPANSION

By early December 1943 a policy of considerable expansion (up to 8,000 personnel) of the Azores Force, including the possible addition of U.S. forces (subject to agreement by the Portuguese Government) was disclosed as likely to occur within about a month, and at a conference of British and U.S. Missions at Lagens on December 4, 1943 the policy regarding the responsibility of British and U.S. engineers respectively for various constructional services was agreed upon. The U.S. was to build runways and other constructions and the British to build airfield lighting, hangars and other buildings, including a hospital. A scheme for a 110-bedded hospital had previously been prepared, but, at the request of the U.S. authorities, it was agreed, in view of the new figures, to consider 150 beds a minimum necessity.

Transfer of Field Hospital from Angra. On December 10, 1943, the buildings which had been altered and added to at Lagens for use as a temporary hospital were ready, and on that date the field hospital was transferred from Angra to its new accommodation, where beds were equipped in a ward 84 ft. × 24 ft. and overflow beds in adjacent marquees; these latter were immediately lost in a hurricane. After this move it was no longer necessary to admit cases to the Portuguese

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Military Hospital in Angra, except for major emergencies from the Angra area camps which could not be dealt with at the 12-bedded sick quarters now established in the buildings at Fort San Sebastian, Angra, or cases for the Portuguese ophthalmic and E.N.T. specialists, there being no such specialists with the Force. (*See* Plate XXII.)

Recommendations for a 150-bedded Hospital. In mid-December 1943 the P.M.O. H.Q. C.C. visited the Azores and fully endorsed all the medical and sanitary measures and recommendations already undertaken and submitted, including the provision of a hospital of 150 beds, to be sited at some suitable location near the planned domestic site and not as at that time on the edge of the airfield. In addition the P.M.O. very strongly supported the recommendation for the installation of water-borne sewage, since the distance to the sea from the domestic site was only about half a mile and sewage could be discharged untreated to the sea over the cliffs without involving any major engineering project. It was necessary in any case to find some method of disposal of sewage from buckets, which was at present taken several miles by lorry and deposited in the sea. The scheme, although at first rejected by the Air Ministry, was eventually accepted, and after many delays the hospital construction began early in June 1944. Meanwhile, during May, the construction of accommodation for the hospital male and female staff had been started and was soon completed. (*See* Plates XXIII, XXIV and XXV.)

During May also, a leave centre was proposed at Furnas, a beautiful resort in the mountains of San Miguel, and from July onwards parties of fifty at a time proceeded by sea from Terceira, a journey of 100 miles. Each party was accompanied by a nursing orderly, who had at his disposal certain medical equipment deposited at Furnas. This orderly could obtain assistance, if necessary, from the local Portuguese medical officer.

Outbreak of Anterior Poliomyelitis. At the beginning of June 1944 the medical staff received long awaited increases in strength, both nursing orderlies and specialist tradesmen, as a result of the amended establishment, providing for a hospital and station medical staff, submitted in December 1943 and approved during the S.M.O's. visit to the United Kingdom in February 1944. Their arrival was opportune, as it coincided with an outbreak of gastro-enteritis. The source of infection was never definitely established. It was quite probable that it was a manifestation of abortive cases of poliomyelitis, although the water supply was causing much anxiety at the time, the weather was hot and dusty and there were swarms of flies. Beginning on June 14, there followed a sharp and alarming outbreak of acute anterior poliomyelitis. This affected personnel from all areas of the camp at Lagens and was of such virulence that of 5 cases in the first three days, 4 died of respiratory

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paralysis within 36–48 hours of the onset of symptoms, while of the total of 9 cases in the first four days, 3 had developed serious paralytic symptoms, in addition to the 4 who had fatal respiratory paralysis. In the absence of any 'iron lung' an effort was made to save the life of the first case by arranging, immediately after diagnosis, for his transfer by air to the United Kingdom in an operational aircraft accompanied by a M.O. and two N.Os. Although the patient received continuous oxygen treatment *en route*, the effort proved unavailing and he died one hour before arrival in the United Kingdom.

Meanwhile further cases had occurred at Lagens and an urgent request was sent to the United Kingdom for 'iron lungs'. Pending their arrival it was decided that should there be many cases, the only possible policy to adopt, in view of the apparent virulent and fulminating nature of the disease, was to effect diagnosis at the earliest possible moment on discovery of an abnormal cell count in the C.S.F. and then to evacuate cases with medical escort immediately by air to the United Kingdom. One squadron of Fortress aircraft was fortunately available, as there were no operational commitments, and the weather was favourable. Ten cases, 3 of whom eventually died, were evacuated to the United Kingdom between June 14 and 20, and the only U.S. case was evacuated to U.S.A., where he died about a week later. By June 20, 2 Cabinet respirators and 1 Bragg Paul respirator had arrived at Lagens and it was possible to undertake the nursing of any further cases in the Azores, within the limits of respirator capacity. Fortunately their arrival coincided with a remission of the outbreak and by July 7 it was possible to lift certain quarantine restrictions which had been necessarily imposed, by agreement between the British, American and Portuguese authorities. During the outbreak there were 20 cases as follows:

	Azores		*United Kingdom*		*U.S.A.*	
	Cases	*Died*	*Cases*	*Died*	*Cases*	*Died*
British	9	4	10	3	—	—
U.S.	—	—	—	—	1	1
Totals	9	4	10	3	1	1

This outbreak naturally imposed a severe strain on the already inadequate medical in-patient facilities. In view of the large numbers of observation cases, arrangements were made to take over some recently completed Nissen huts in the officers' quarters adjacent to the hospital. By the use of these huts and additional tentage it was possible by the end of June to increase the bed state to about 70 beds and provide some 30 stretchers for observation cases. These arrangements enabled strict isolation to be observed in the nursing of cases and the one and only large ward to be devoted entirely to cases of poliomyelitis.

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Although recent research and local experience of the cases, which synchronised with a very sharp increase in the number of cases of gastro-enteritis (there were only 6 cases in 1942), seemed to indicate only a gastro-intestinal infection, it was considered wise at the outset to institute anti-droplet infection measures in addition, though these were later to a great extent relaxed. Judging by the available statistics, the disease is not common in Terceira (6 cases in 1942, 1 case in 1943) but it must be remembered that the civilian medical services on the island are very limited, that peasant life is exceptionally primitive, that much disease goes unrecorded and that it is quite common to see cases of paralysis among the peasants. Since human faeces are commonly used as manure and the outbreak occurred during an extremely dry and dusty spell of weather with a greatly increased fly population, there was a general tendency to consider that the cause was initially an intestinal infection spread by dust and flies; this view was strongly supported by the P.M.O. H.Q. C.C. who visited Lagens on June 20.

However, it had always been considered that the water supply was the greatest potential source of infection and it so happened that, during the early weeks of June in particular, there had been errors in the treatment of drinking water. It was worthy of note that, although the U.S. and British forces were approximately equal in strength, the U.S. had only 1 case to the 17 British cases, while the U.S. camp, being on the airfield perimeter, had a very much greater share of dust and an equal share of flies. They, however, treated their water supplies to achieve a reading of 2 to 2·5 p.p.m. free chlorine after one hour, whereas the R.A.F. were aiming only at ·7 p.p.m. after one hour. Even this, on numerous occasions, was by no means assured. As the source of supply was surface water, 3½ miles from the camp, which was exposed to human and animal contamination, it was a cause of anxiety and a potential source of intestinal infection. However, with the completion in August of an extension of the pipeline from the existing collection point to the source of the water 4 miles further up in the mountains, where the pipe was fitted into the rock face from which the water emerged (not true springs but surface water from the centre of the mountain range finding its way through volcanic fissures), the main anxiety regarding contamination had passed.

EVENTS, JULY 1944 TO APRIL 1945

During July and August there was a slight recrudescence of poliomyelitis with 7 cases, including one who developed respiratory paralysis and was eventually evacuated in an iron lung escorted by a medical officer and two nursing orderlies to the United Kingdom by U.S.A.T.C. Skymaster. In the same months the fly menace assumed serious proportions and in spite of the most energetic measures flies continued to

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be a source of trouble until the cooler weather. During August also there was a shortage of water, which necessitated the diversion of supplies from the unpolluted source for use at certain Portuguese mills and subsequent re-collection into the R.A.F. pipeline below the mills. This introduced grave risk of pollution and engineering arrangements for purification were not yet infallible. It is not surprising, therefore, that there was a sudden increase in the number of admissions for gastro-enteritis, 56 cases being recorded in July and 155 in August.

By September construction work on all aspects of the camp, both technical and domestic, was proceeding; and the hospital, designed to accommodate 80 cases, was complete except for electrical and plumbing fittings which had missed the last store ship to the Azores. Meanwhile the incidence of gastro-enteritis remained high (119 cases in September) and that and other conditions, in particular 20 cases of catarrhal jaundice, kept the limited resources amounting to 69 beds in scattered huts and 18 beds under canvas, in constant use, leaving little margin for emergencies. In order to hasten occupation of the hospital, therefore, arrangements were made to install most of the medical and barrack equipment (any which was not in use at the temporary site) while awaiting the electrical and plumbing fittings. This action proved to have been a wise one, when on October 14, without warning, a severe tropical hurricane, accompanied by torrential rain, swept over the Azores for more than twenty-four hours with maximum intensity at Terceira during a five-hour spell (0500–1000), during which period the wind maintained 80 m.p.h. velocity with gusts of over 100 miles per hour. Almost without exception all tentage (and there were about 1,000 British personnel still under canvas and an even greater number of Americans) not only collapsed but was torn to shreds, beyond repair, while technical and domestic buildings and aircraft all suffered damage of varying degree. Unfortunately, among the buildings damaged was the new hospital, from which considerable portions of roofing and some end walls were torn away and carried long distances. Tented ward space as well as M.I. room accommodation, the Special Treatment Centre and other sections at the temporary hospital had ceased to exist, but parties from the hospital staff immediately salvaged as much as possible and in addition went at once to the new hospital where they were able to limit the damage to loss of a small amount of equipment, none of which was really vital. (*See* Plate XXVI.)

This storm and its consequences, including the necessity to use the hospital for several weeks to billet 250–300 men homeless through loss of irreplaceable tentage, was yet another reverse. The hospital was now more than ever urgently required; with the approach of winter and the stepping up of numbers of transit aircraft, the airfield was in perpetual use and often flying conditions were extremely hazardous. For almost

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a year it had been necessary to empty beds of ambulant patients, not only when an aircraft was due to land in distress, but whenever aircraft landed during severe weather. There was still only one metal landing strip and this was not in line with the prevailing storm winds.

By early November the work on electrical and plumbing fittings at the hospital was well advanced and, following arrangements for a supply of electricity to be provided by mobile generators on the hospital site (mains electricity was not yet available on the camp), the hospital, equipped with 85 beds, was occupied and became fully operational on November 23, 1944, when the previous temporary buildings were taken over as station M.I. rooms. About this time there was a further slight recurrence of poliomyelitis, but fortunately only 2 cases occurred, neither of them serious. As a result of the excellent facilities now available on Terceira, the U.S. authorities stopped the work begun on their own hospital, and, although they did not in practice make routine use of the in-patient facilities, using only X-ray and laboratory equipment to any great extent, they made known their intention to rely on its existence should any emergency arise which could not be dealt with in their temporary dispensary of some 60 beds for base personnel and 80 beds for transient stretcher cases. In the meantime they planned to build a hospital on the island of Santa Maria, which was being developed as the primary U.S. airfield in the Azores, although Lagens would still remain a big transit airfield for U.S. aircraft. Freight and passenger aircraft would use Santa Maria, but all tactical aircraft would use Lagens.

At the close of 1944 most of the R.A.F. constructional work was well advanced and little remained to be done so far as domestic areas were concerned. By that time also very great improvements had been effected in matters of hygiene and sanitation on the camps and the water supply problem appeared to have been solved. Little fault could now be found with the methods of collection, purification and distribution and this was particularly satisfactory since during December there was a sharp increase in the number of cases of typhoid in the Portuguese population (177 civilian cases, 37 military cases), fortunately almost entirely confined to the town of Angra. There were no cases in the British or U.S. forces.

By the end of January 1945 the R.A.F. airfield construction squadron had largely completed its works commitment and it departed, leaving some 300–400 men to complete the programme and to act as Works Maintenance party. The electrical power was now connected and the hospital was installed on the mains supply, though the emergency lighting system was still deficient of certain parts. One serious consequence of some two months of using electrical power from mobile generators was that, apparently because of fluctuations in voltage, the

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X-ray tube for the Watson MX-2 set became soft, and as no spare was held for this item there was a delay of about two weeks in January until a new tube arrived.

On January 26, 1945 the first British women to be posted to the Azores—seven members of P.M.R.A.F.N.S.—reported for duty on arrival by sea. They settled quickly into their work at the hospital and, with a readjustment of staff, duties generally were less onerous than for a long time past, especially as with the cooler time of the year and some reduction in the strength of the Force, there was for a while a lower incidence of sickness than ever before. On March 10 a policy of reduction of the R.A.F. tour of duty in the Azores from two years to eighteen months was announced and when details of the changes involved were submitted, establishment recommendations were made eliminating any separate medical administration at R.A.F. Station, Lagens. The hospital was to become, in effect, a station hospital, the Force S.M.O. being also station medical officer, Lagens.

During the second half of 1945, a meteorological squadron continued to operate from R.A.F. Station, Lagens and the hospital continued in full working order, although the strength of British and Allied personnel was rapidly decreasing. The U.S.A.A.F., with a strength of about 250 personnel, maintained a dispensary with a medical officer and the U.S. Navy maintained a sick quarter of 15 beds with two medical officers. Admissions to the hospital declined from 108 in August 1945 to 38 in November. In December, the number of equipped beds was reduced from 80 to 63 and admissions for December 1945 were 32.

In 1946, the reduction of the station and hospital continued. In August 1946 the total strength of R.A.F. in the islands was 267, British Army 60 and U.S. forces 350. In October 1946 the R.A.F. hospital was handed over to the Portuguese authorities and the R.A.F. departed from the Azores, leaving behind a small rear party of 25 men who were rationed and cared for medically by the U.S. authorities.

Medical Personnel. The medical staff was adequate throughout although not in excess of requirements, and at times of stress, such as during the outbreak of poliomyelitis, was for several weeks working very long hours under strain. After the organisation had settled down into a smooth routine the staff had reasonable hours of work interspersed with short periods of considerable pressure.

LIAISON WITH OTHER SERVICES AND THE PORTUGUESE AUTHORITIES

Royal Navy. Visits were paid by the S.M.O. to the only R.N. medical officer in the Azores at Horta and assistance was given in establishing facilities. Arrangements were made to admit to the R.A.F. hospital all R.N. patients who could not be cared for in the small sick

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quarters at Horta. The medical officer was supplied with medical stores when for any reason his supply did not arrive or he was unable to obtain his requirements from H.M. ships calling at Horta. In addition a R.A.F. medical officer was provided as relief when he was on short local leave. Close co-operation was maintained at Lagens with the Senior British Naval Officer, Azores, who, with all his staff, was dependent on R.A.F. medical facilities and through whom arrangements were made regarding the point of landing and collection of casualties. Sometimes medical and dental officers went specially to ships at sea to render aid.

Army. No military medical services were present with the British Force, though in the Force as at first constituted there were over 1,000 Army personnel. Throughout, the S.M.O. had the fullest co-operation from the Army, the closest contacts being with the R.Es. and R.A.S.C., the latter in particular being very helpful in all matters affecting food supplies, hospital supplies and rationing.

United States Navy. Here also close co-operation was maintained and full use made of R.A.F. facilities. From January until June 1944 all their patients requiring hospital treatment were admitted to the R.A.F. hospital. They also kept the R.A.F. informed on all matters of interest to both Services.

United States Air Transport Command. Close liaison with this organisation was maintained from December 1943 to May 1944 and included the admission of any patients requiring hospital attention. After this date the U.S.A.T.C. preferred to nurse their in-patients (including U.S. Navy) in their own temporary accommodation, although the U.S. medical officers themselves all admitted that they would much rather care for in-patient base personnel in the R.A.F. hospital with its excellent facilities. Having said, however, in October, 1944 that they would not require to use it save in emergency, they continued to use their own accommodation, which served primarily for transient sick. However, all the U.S.A.T.C. medical staff worked at times at the R.A.F. hospital. The surgical, ophthalmic and E.N.T. specialists regularly assisted in the operating theatres and some of the U.S. Navy staff attended the hospital daily, seeing all cases in company with the R.A.F. medical officers. Clinical meetings of all U.S. and British medical officers were held from the summer of 1944 until the end of the occupation, alternating between the R.A.F. Hospital, the U.S. Navy Dispensary and the U.S.A.T.C. Dispensary. These meetings were of considerable value, stimulating professional thought and contributing to the improvement of Anglo-American relations.

Portuguese Military Authorities. Continuous contact was maintained with the Portuguese military medical authorities on all questions affecting relations with the Portuguese, whether military or civilian. By

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this means it was possible to assist them in a variety of ways, including the saving of lives both in Terceira and in other islands by the timely supply and delivery by sea or air, of drugs. For example, in April 1944 there was an enquiry one afternoon to know whether the R.A.F. could assist in the case of a child of eleven suffering from tetanus on the island of San Jorge, some 60 miles from Lagens. Plans were made immediately to land a Walrus off-shore at a selected spot after ensuring with Military Headquarters that it would not be fired upon. A medical officer with a large supply of anti-tetanic sera was sent to the island, the serum was safely delivered and the boy's life was saved. On occasion in emergency and when stocks were adequate, supplies of penicillin were provided for the Portuguese authorities, although by April 1945, some stocks were becoming available from Lisbon.

Portuguese Navy. There was only one Portuguese Naval medical officer in the Azores, stationed in Ponta Delgada, San Miguel. Little contact occurred as this service was very small, but the Navy, which was British trained, was always very co-operative. On one occasion, following the crash of a Portuguese Naval Flying Boat at Ponta Delgada, arrangements were made, at the request of the Commandant of the Portuguese Navy, for the senior R.A.F. dental officer in the Azores to proceed to San Miguel and carry out an emergency maxillo-facial operation on a Portuguese naval officer. Subsequently he recommended and arranged the immediate transfer of this officer to Lisbon for specialist treatment.

Portuguese Civil Authority. All dealings with the civil authorities were carried on through the Chief of the Military Health Services and, while much was done to assist them, it was always through the military authorities.

FLYING PERSONNEL PROBLEMS

Flying personnel problems peculiar to the Azores were not numerous, although in the early months certain points were a cause of worry to aircrews. Weather conditions in particular were often deplorable and, furthermore, while a metal strip runway was being laid, crews had to operate from very restricted space on the airfield. There were international complications hindering British use of the only diversionary airfield at Santa Anna on San Miguel and, before full radio aids were available, crews were at times apprehensive about returning, after a long sortie, to a small spot in the Atlantic. Air sea rescue facilities were confined to a Walrus whose ability to land and take off in the Atlantic was questionable, and to a R.N.L.I. lifeboat, whose operational range was very limited and whose speed was in the region of 7 knots. In practice, if diversion were required due to adverse weather, it was the rule to divert to the United Kingdom, Gibraltar or Rabat, but there were

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numerous occasions when the meteorological staff were unprepared. It was not until one day when five Fortresses emergency landed on San Miguel, causing a tremendous outcry from the Portuguese G.O.C. Azores, one Fortress landed after some difficulty by B.A.B.S.* at Lagens, and one Hudson crashed near Lagens with total loss of life, that negotiations resulted in improved facilities and arrangements for the diversion of aircraft to Santa Anna, San Miguel.

For 14 months there was only one metal strip runway at Lagens and for most of the year there was a cross-wind, usually 20 m.p.h. and often 50 m.p.h. These were flying hazards which had to be faced on returning from 12 hour sorties, but such was the skill of the pilots that there were singularly few mishaps and it was not until January 1945, when the three main runways were completed, that there was any serious accident.

Neuroses. In spite of the Force being marooned on an island in mid-Atlantic which was lacking in many of the amenities available even in battle areas, and being denied the excitement of participation in active combat, cases of any kind of neuroses were singularly few—in the course of 19 months there was one case of attempted suicide and only three or four cases of invaliding due to anxiety neurosis.

ICELAND

GEOGRAPHY AND CLIMATE

Iceland lies between latitudes 63°23′ and 66°32′ North, being just cut at its north-eastern extremity by the Arctic Circle; its lateral boundaries are longitudes 13°30′ and 24°35′ West. The island is roughly 500 miles from the nearest point on the Scottish coast, 170 miles from Greenland, 250 from the Faroes, and 560 from the nearest point in Norway. It occupies approximately 40,000 square miles and is therefore a little bigger than Ireland, which it much resembles in outline. The population was just over 120,000 in 1939 and in 1940, Reykjavik, the capital, had 40,000 inhabitants. (*See* Map 10.)

The climate is cold and damp, even in summer, and the skies are often overcast. Rainfall is similar to that of the United Kingdom, the yearly average for 1930–40 being nearly 40 inches; mist and fog are common and on a fine day the land, when approached from the south, is seen to be wrapped in mists; this is partly due to the cold water of glacier-fed rivers meeting the warm waters of the Gulf Stream which bathes its southern shores. In the winter there is much snow accompanied by icy winds. The cold is most intense in the first quarter of the year, but by way of compensation there is less rain at this time; the frost begins to disappear from the ground at the end of April. The

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* Beam Approach Beacon System.

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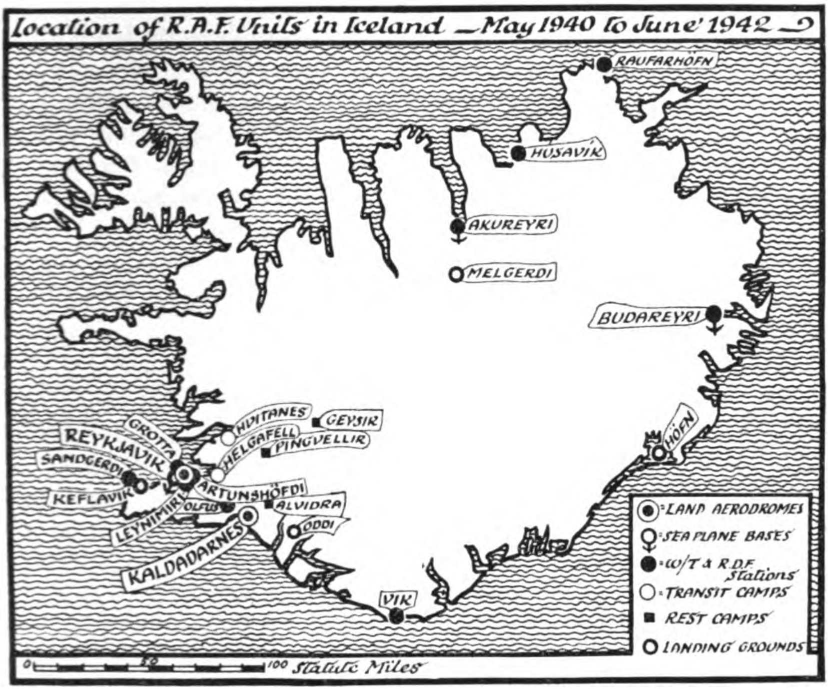

MAP 10. Location of R.A.F. Units in Iceland—May 1940–June 1942.

temperature may fall below zero Fahrenheit and seldom exceeds 66° even in the summer.

The area around Reykjavik, where the R.A.F. was mainly concentrated, is relatively low-lying, consisting of foot-hills of volcanic rock and an alluvial plain heavily studded with hot sulphurous springs and bubbling mud-ponds and freely traversed by swiftly running rivers which bring down much laval mud; the hot springs and geysers give a plentiful supply of water at boiling point. Most of the roads, which had loose, dusty surfaces, were little better than rough narrow tracks, with passage bays at intervals; the one exception was the modern road which ran 2 or 3 miles north-eastwards from just outside Reykjavik towards Helgafell; the Reykjavik-Kaldadarnes road was fairly good, although pot-holed, but the Kaldadarnes end was frequently impassable in winter.

Vegetation all over the island is poor, and trees very sparse and stunted, seldom being more than 6 ft. high. The fields are small, uneven and strewn with boulders; grass grows with difficulty, and green vegetables and potatoes are scarce. There is plenty of fish, particularly of the salmon family, in most of the rivers, but fishing rights are expensive; flat fish, resembling sole, cod and pollack can be caught in the sea.

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The rain, snow, humid atmosphere and damp soil of Iceland predispose the population to rheumatism and lung troubles, the latter being aggravated by inspiration of the fine laval dust raised by gales (which occur in all seasons except the short summer) and by road traffic. The dull, damp atmosphere, the scant sunshine and the long winter nights, combined with the monotony of the surroundings and the lack of recreational facilities, made the island a place where boredom, low spirits and loss of enthusiasm for work were quickly felt.

GENERAL NARRATIVE

The R.A.F. move to Iceland began at a time when the fortunes of war had turned heavily against the Allies. France had fallen, the British Forces had been driven out of Norway and the Air Battle for Britain was in prospect; R.A.F. losses had been severe and operational and training commitments at home and overseas were difficult to meet. In July 1940, all that could be spared for Iceland was a squadron of single-engined Fairey Battle bombers, but from this small beginning there grew up in the island during the next two years a R.A.F. component with a strength of over 3,000 personnel, to which, during 1941, United States Air Forces were added. Two main aerodromes—Reykjavik and Kaldadarnes—formed the nucleus of this organisation and in the course of time a number of flying boat bases, anchorages, landing grounds and radio direction finding and other wireless units were developed in various parts of the island.

1940

The 55 officers and men who comprised the advance party of No. 98 Squadron, which had re-formed at Gatwick after the fall of France, disembarked at Reykjavik on July 31, 1940 and the following day proceeded eastwards the fifty odd miles by road to Kaldadarnes in order to establish a tented camp there. The site was on low, marshy ground, bordering the left bank of the wide shallow Olfusa river, only a few miles from the sea. The camp was approximately 25 miles by air from Reykjavik and was separated from the latter by a range of hills rising to 2,000 ft.

The surrounding country was poor and sparsely populated, there being only three farms near the camp and a small village, Selfoss, some five miles up the river. Bell tents were pitched and constructional work on what was to become the aerodrome began at once. Cookhouses, transport sheds and workshops, wind-breaks and a road were required; much had to be done with little material and, as there was a shortage of labour, a small section of the Royal Engineers was detailed to assist the R.A.F. party.

On August 2, the main party arrived and on the 10th a detachment was sent to prepare and man an emergency landing ground near

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Akureyri, a town at the head of the Eyja Fjord, an inlet on the northern coast of the island, 140 miles away. On August 27 the squadron's first flight of nine Fairey Battles, escorted by two Sunderland flying boats, arrived from Scotland, the first British aircraft to land in Iceland. By the end of the month the squadron strength at Kaldadarnes had risen to 19 officers and approximately 300 airmen.

During October the wind-breaks on the aerodrome were completed and coastal, sea and inland reconnaissance patrols, which constituted the routine work of the squadron at Kaldadarnes, continued when the steadily deteriorating weather permitted; Kaldadarnes was attacked by German aircraft during this month, but without serious consequences. In November there was a heavy fall of snow, followed by a thaw and ice-bound roads, and towards the end of the month the aerodrome was almost unserviceable; however, during the next month work progressed on the main runway and in the drainage of the aerodrome. Nissen huts were in use by this time but some personnel were still accommodated in tents.

During this first winter in Iceland—fortunately not a severe one by island standards—the mean maximum temperature was 35° F. and the mean minimum 24° with the lowest reading 3° in February. There was a good deal of rain and snow, at its worst in December, during which rain fell for eighteen days and snow for ten; gales were frequent, causing snow drifts up to fourteen feet deep on the hilly Kaldadarnes-Reykjavik road, which was consequently often blocked; while a ninety-miles-an-hour gale was experienced at the end of February.

1941

In the spring, convoy work was added to the routine reconnaissance flights, patrols ranging as far as 200 miles from land and one week's escorted shipping totalling 247 merchant vessels; the frequent single-engine flying at low altitudes over open sea, combined with the knowledge of the poor conditions under which ground crews had to carry out maintenance work at the station, was a severe test for the aircrews. As there were no properly surfaced runways until April 1941, levelled crash-runways or small matting runways had to be used; sudden changes of wind direction were frequent and created an additional hazard productive of many 'incidents' in taking off and landing. The absence of hangars meant that ground crews had to work under great difficulties in the open air, and as the high winds made it impossible to use engine tents, much discomfort and a few cases of frostbite resulted; it reflected much credit on the maintenance staff that they were able to keep the aircraft serviceable and get engines started on all but three days during the winter. (*See* Plate XXVII.) Ration runs to Reykjavik and back presented M.T. drivers with an equally difficult task, for many

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hours had to be spent on the road coping with snow drifts which often isolated the camp for several days at a time.

Towards the end of March 1941, Headquarters, No. 30 Wing arrived at Reykjavik, with a skeleton staff, to take over command of the R.A.F. in Iceland and from then onwards the 'pioneers' at Kaldadarnes were diluted with increasing numbers of newcomers.

S.S. Manela. In April 1941 the depot ship S.S. *Manela*, formerly a British India Line cargo and passenger vessel, arrived at Reykjavik, carrying personnel of No. 100 Wing and of No. 204 (GR) Squadron, flying Sunderlands. The complement of the *Manela* was approximately 100 Merchant Service officers and men, while R.A.F. personnel totalled between 50 and 60 officers and 500 men, including the staff of No. 100 Wing Headquarters which was established on the ship. The *Manela* also acted as a base for No. 204 Squadron pending the setting up of a permanent shore establishment, later to become Reykjavik camp, and the squadron's flying boats were moored alongside.

R.A.F. medical arrangements were separate from those for the ship's company and two R.A.F. medical officers, with the appropriate number of nursing orderlies, were carried. Cabins on one side of the ship were set aside as dispensary, crash room, operating theatre and sick quarters while the boat deck provided accommodation for all infectious cases; when necessary, cases were accepted by No. 50 Army General Hospital, which had now been established in Reykjavik and acted as base hospital. One pinnace and three speed boats were attached to the ship, one of the speed boats (capable of taking four stretchers) being in theory earmarked as a rescue launch, although in practice it was frequently used for other purposes. At first, flying was controlled by No. 100 Wing Headquarters from an operations room on the *Manela*, but early in May the Wing moved ashore and it was from the new land base that operations against the German battleship *Bismarck* were directed.

The *Manela*, having transferred her marine craft section to the shore station at Reykjavik to provide facilities for the recently arrived Norwegian squadron (No. 330, flying Northrop float planes) and some American flying boats, left for Northern Ireland on July 17, 1941; she returned for a few days in August, before sailing for West Africa.

The Transit Camp. In the spring of 1941 it was decided to form a personnel transit camp in Iceland to accommodate aircrew travelling between Canada and the United Kingdom. They were accommodated at first at Reykjavik; the main party of the permanent staff arrived in the island on March 28; routeing commenced in April and the accommodation aimed at was for 1,000 men for periods up to fourteen days. The site chosen for the actual camp was Hvitanes, situated near the top of the Hval Fjord, where there was already a naval base and anchorage sufficient for a large battle fleet. It lay on a steep hillside sloping down

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to the southern shore of the fjord and was 18 miles by air north-east of Reykjavik. The route of approach was either by a very rough and hilly road, a distance of 45 miles, or by sea (40 miles); the road journey took two hours and the sea trip three, subject always to weather conditions which often made the sea approach unnavigable for several days at a time.

Despite attempts to accelerate the construction of a suitable camp at Hvitanes it was clear that the site could not be made ready for use before the end of June. It was therefore decided to take over the partly built Nissen-hutted premises intended for an Army hospital at Helgafell, only thirteen miles by a fairly good road from Reykjavik; here a temporary camp was opened at the beginning of April 1941, and this housed all transit personnel until it closed on September 10, after which date Iceland was no longer used for the routeing of aircrew.

Naval ratings—228 survivors from the *Rajputana*—were the first to occupy Helgafell camp on April 14. Four days later 69 R.C.A.F. aircrew arrived and thenceforward the numbers increased steadily. During the five months of its existence 3,842 personnel passed eastwards through the camp, and 3,281 westwards; the average population was approximately 700, but at one time there were as many as 1,200 men housed there. In addition to British and Dominion Air Force personnel, ferry pilots, naval ratings, members of the Fleet Air Arm and New Zealand foresters were accommodated at Helgafell.

At first primitive living conditions and lack of amenities were unavoidable and the men frequently had to sleep in blankets on bare boards. All drinking and washing water had to be carried; there were no baths; laundry arrangements were inadequate; conservancy was by bucket latrines. The camp was on a hillside 100 ft. above sea level and, as the contours and rock strewn nature of the land limited outdoor recreation and the nearest N.A.A.F.I. at Reykjavik was, for security reasons, placed out of bounds, complaints were frequent and many of them well justified. Towards the end of the Camp's existence, however, facilities for both work and recreation were greatly improved; occupation for the men, apart from general 'fatigues', included trench digging for cable lines, work under the Royal Engineers, bomb unloading, assembly and testing of Hurricanes and servicing of Sunderlands, while cinema shows, mountain climbing, bathing parties, whist drives, concerts, bus trips, football, softball and P.T. were provided on the recreation side and a 'hobbies workshop' and airmen's library became available.

A sick quarters comprising an inspection and dressing room with Scale Z.1 equipment was included in the camp, personnel requiring in-patient treatment being admitted to No. 160 Army Field Ambulance at Alafoss half-a-mile distant or direct to the Army Base Hospital (No. 50 British General) in Reykjavik.

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Developments at Reykjavik and Elsewhere. In August 1941 an independent Naval Command was formed in the island and No. 30 Wing, which became known as 'R.A.F. Iceland' and was located at Reykjavik, controlled all flying, coming under Coastal Command for administration. At first R.A.F. Headquarters was housed in a school shared with the Admiralty as a combined operations room, but it was later moved to Nissen-hutted accommodation near the hospital, the new site being named Atlantic Camp. The main runway of the new aerodrome at Reykjavik had been completed and its living, workshop, store and office accommodation was half finished. A Hurricane flight was based there while No. 330 Norwegian Float Plane Squadron, referred to earlier, was housed at Corbett Camp at the southern boundary of the aerodrome, near the shore of the Fossvogur anchorage. Early the same month No. 204 Squadron was replaced by No. 209 (GR) Squadron, flying Catalinas, this squadron in turn being relieved in October by No. 221 Squadron, equipped with Wellington aircraft; squadrons operated from Fossvogur, but personnel, operations room, etc. were based on Reykjavik station. It was a Catalina of No. 209 Squadron which located and trailed the *Bismarck*.

The Reykjavik station strength at the end of August was 45 officers and 345 airmen, the total R.A.F. strength for the whole of Iceland being 150 officers and 1,570 airmen. Aircraft included Hudsons, Northrops, Catalinas, Hurricanes and Tomahawks, with occasional visiting Whitleys and Sunderlands; flying boats and float planes were operated from Akureyri, Budareyri and Reykjavik; land machines from Reykjavik and Kaldadarnes. There were also landing grounds at Melgerdi (near Akureyri), Hofn (200 miles east of Reykjavik on the south-east coast of the island) and Oddi (an inland site just over 25 miles east-south-east of Kaldadarnes). The Central Transmitting Station was at Leynimiri and a W/T Receiving Station had been established nearby at a place named Artunshofdi, near Artun, which was the military headquarters five miles to the east of Reykjavik; R.D.F. stations with approximately 35 men each were now functioning at Grotta (on the tip of the promontory on which Reykjavik lies), at Olfus (15 miles from Kaldadarnes, near the hot springs at Hvadragheri) and at Vik (110 miles east from Kaldadarnes on the south coast)*; towards the end of the year another small unit housed in Nissen huts was established at Sandgerdi (on the west coast 40 miles away). The American Naval Force Headquarters was at Fossvogur with the depot ship for two flying squadrons, U.S.S.

* Olfus was taken over by the Americans and re-named 'Camp Lee' in March 1942. Vik was not completed until October 1941. Sometimes the wind at this station was so strong that the men had to go about their work on their hands and knees, and even then were, on occasion, picked up by the gale and flung through the air for distances of up to forty feet.

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Goldsborough, anchored in the fjord. During December the Hurricane fighter flight and No. 221 Squadron, flying on convoy protection and anti-submarine work, were withdrawn from Reykjavik, their place being taken by Whitleys of No. 612 Squadron. The year ended with a R.A.F. strength in Iceland of 187 officers and 2,072 airmen, almost half this number being stationed at Reykjavik.

1942

On January 15, 1942, a hurricane reaching 133 m.p.h., the worst since 1925, swept over the Reykjavik area, causing much damage; on the fjord the five American flying boats were sunk and many marine craft were blown on the rocks, and although no damage was sustained by British machines,* the station workshops were completely destroyed, as were two Nissen huts and the roof of the original control building; other Nissen huts, a hangar, the N.A.A.F.I. and the airmen's dining hall also sustained damage.

In both February and March an unidentified aircraft appeared off the south-west coast of the island; in April a F.W.200 was attacked by a Northrop, but although its guns were silenced the aircraft escaped into a fog bank, flying at 100 ft.; during May further enemy aircraft were plotted but no interceptions were made. During the first half of 1942 convoy work, anti-submarine sweeps and ice reconnaissance continued to be carried out as routine operations by Hudsons, Whitleys, American Catalinas and Sunderlands; in May 1942 transit flights between Canada and the United Kingdom had risen to 65, and included the ferrying eastwards of Venturas and some Liberators. There was a serious take-off accident to a Whitley in March, resulting in the aircraft hitting an ammunition dump on Reykjavik aerodrome and exploding, killing seven officers and airmen. In the same month an American amphibian was sunk in an attempt to take off an appendicitis case from a U.S. destroyer at sea, but there was no loss of life on this occasion.

In May 1942, the strength of the R.A.F. in Iceland was just over 3,000.

1943

Early in 1943 the Germans intensified their attacks on shipping in the Iceland area to a marked degree and the operational effort was stepped up to counteract these activities. In May, Hudson and Liberator aircraft sighted 60 U-boats of which at least 7 were sunk and several damaged; although this may not appear to be a very high rate of destruction it had the effect of keeping the U-boats below the surface, thus preventing the recharging of batteries, and of considerably undermining the morale of the crews by demonstrating the probability of attack when the U-boat surfaced.

* These aircraft, in addition to being picketed, were held down by relays of airmen, 40 to each plane, using ropes to prevent the aircraft from becoming airborne.

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In July, weather conditions were deplorable and flying was considerably curtailed but in the following month 105 anti-submarine patrols were flown by long range aircraft and several flights were undertaken to establish the position and condition of the polar ice, this information being of great value both to the meteorological departments and in the safe routeing of shipping.

The last three months of 1943 saw a further intensifying of action in the Battle of the Atlantic. U-boats were appearing in ever-increasing numbers and re-employing the technique of hunting convoys in packs; measures to combat this menace were stepped up and considerable success attended the adoption of the 'areas of probability' method. This, briefly, was a computation of the likely areas in which U-boats would concentrate to attack convoys, against the known positions of the U-boat packs; it was then possible to patrol these areas in a systematic manner and, even if U-boats were not destroyed, they were compelled to remain submerged, with consequent difficulties of battery charging. In October alone, of 35 U-boats sighted, 31 were attacked and 10 sunk, a considerable achievement in view of the long hours of darkness and the lack of Leigh Light aircraft.*

In December, much anxiety was caused by the fact that the raider *Scharnhorst* was 'at large' and many aircraft were engaged in patrols; flying was carried out in extremely poor weather and hazardous conditions; runways were covered in snow despite all efforts to clear them and the cold was so intense that chocks froze to the ground and the task of servicing the aircraft became a sheer test of endurance.

1944

In the early months of 1944, anti-U-boat operations were being carried out with increasing intensity and more long-range aircraft equipped with Leigh Lights were available; it was noticed at this period that the U-boats showed a tendency to remain on the surface† and engage in battle with the attacking aircraft, a policy much to the advantage of the R.A.F., for the risk of damage from anti-aircraft guns mounted on the submarines was not great in comparison with the increased opportunity for depth charge and bomb attack which was thus offered. In June, six U-boats were sunk and a considerable number damaged, probably to such a degree as to render them useless for further attack on Allied shipping. In July the Victoria Cross was awarded posthumously to a pilot for a courageous attack on a U-boat.

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* This comprises attacks by Iceland based aircraft together with aircraft of No. 15 Group.

† It was later learned that these submarines had been ordered by Admiral Doenitz to proceed as quickly as possible, hence on the surface, to the Normandy landing areas.

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From the early months of 1944 onwards the flow of aircraft across the Atlantic to England showed a continual increase in both quantity and variety. In February, 76 aircraft were received and 81 despatched to England (the additional five being aircraft remaining from the previous month for repairs), while 10 aircraft were received from England and 8 despatched to Canada or America. In January it was decided that wherever possible transit aircraft should be equipped with depth charges, so that any U-boats sighted could be attacked; previously, transit aircraft had been able to assist only by radioing the position of U-boats. The numbers of aircraft in transit reached such proportions that the detachment of Transport Command mainly responsible for them was moved from R.A.F. Station Reykjavik to Camp Corbett in April; this facilitated the speed of servicing and allowed additional comfort for the crews, whose numbers had become an embarrassment in Reykjavik.

The subject of station defence had not, in the early years of R.A.F. occupation in Iceland, received the attention it warranted, owing to the far more pressing problems involved in establishing reasonable living and working conditions, although some measure of defence organisation existed from the initial arrival of the R.A.F. in Iceland. Towards the end of 1943 it was possible to give serious consideration to the question and during the early months of 1944 much attention was given to station defence matters. The actual overall defence responsibility was that of the American Army forces on the island but the R.A.F. had accepted responsibility for the local defence of airfields, providing units to counter paratroop drops on the airfields and undertaking the anti-aircraft defence of the fields. In March 1944 a course was arranged for all officers and senior N.C.Os. with the object of providing leaders for defence sections, similar courses for airmen being organised the following month; the courses were comprehensive but concentrated to a large extent on weapon training; a high standard of proficiency was attained by all personnel.

In August the Command was able to accept training aircraft from England, the two-way flight being used as a navigational exercise for crews who would ultimately be engaged on long-distance flying; again, during the flight it was possible for aircraft to attack U-boats or to inform base of their position.

In September, receipt of information that large concentrations of U-boats would be leaving the Biscay area in an attempt to reach Norway led to a redoubling of operational effort and an additional Leigh Light Liberator squadron was moved from St. Eval in Cornwall, to Iceland, but, although many U-boats were sighted, few were destroyed.

Aircraft attacks were rendered more difficult by the fitting of U-boats with 'Schnorchel' apparatus, first mentioned in reports at the end of

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1944*. This device enabled a U-boat to remain several feet below the surface while running on its diesel engines, the Schnorchel tube disposing of the exhaust gases and providing an oxygen inlet for the crew, thus obviating the necessity for craft to remain on the surface when charging batteries.

1945

In May 1945, just after the end of the war in Europe, the celebrated Lancaster aircraft *Aries* arrived at Camp Geek and carried out two flights over the geographical and magnetic North Poles respectively; after the second flight the aircraft returned to England, covering the distance of approximately 4,170 miles non-stop.

So ends the war-time record of Iceland and the part it played in the Battle of the Atlantic. In the main the difficulties which had to be overcome were those resulting from the appalling weather conditions and, in the early stages, a general lack of all types of equipment and materials. Nevertheless, the R.A.F. in Iceland played a vital part in the hunting of U-boats, in the transit of the stream of lend-lease aircraft to our shores and, finally, in providing valuable meteorological information required both for planning air operations from England and for routeing vital convoys from America to England.

LIVING CONDITIONS

Accommodation and General Problems. Between the summer of 1940 and the end of 1941 the problem was to provide living and working accommodation for two main R.A.F. stations and aerodromes, a headquarters, four landing grounds, a seaplane base (with detached anchorages), seven Air Ministry Experimental Stations and similar outlying units and a transit camp. At the end of this period the number of personnel to be catered for totalled more than 2,000. The amount of available civilian accommodation was negligible; labour, building materials and fittings were scarce, and Naval, Military and United States claims on them competitive and persistent; transport and communications in and with Iceland were poor and geological and climatic conditions adverse.

Even by field Service standards living and working conditions during the first winter in Iceland were extremely primitive, but not long after this period Nissen huts almost entirely replaced tentage at Kaldadarnes, while Reykjavik aerodrome—previously a landing ground for Icelandic air mail planes—was being adapted as a R.A.F. camp. Personnel now began to arrive in the island at such a rate that during the rest of the year construction work could not proceed quickly enough to house them all in hutted buildings, let alone provide them with ablution,

* The Allies were first aware of the operational use of Schnorchel in mid-June 1944.

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bathing and latrine facilities as supplied on home stations, for operational requirements naturally took precedence over 'domestic' needs. Planning, particularly at Kaldadarnes, was often unsystematic, and seemed to take account of neither the ideal lines along which the camps should develop, nor the numbers of personnel for whom they would eventually have to cater. The Royal Engineers, who supervised the constructional work, did what they could; but demands on them were such that in the hurry of 'getting things started' liaison suffered and consequently the influence of the station medical officer in matters of hygiene and sanitation could seldom be brought to bear in the right quarter. In ideal conditions a R.A.F. works engineer would have given his undivided attention to a station and provided the necessary labour, but here no such arrangements were made until late in 1941 and in some instances tradesmen of all kinds, including aircrew, were drafted into constructional work under the direction of the Royal Engineers. The urgency of the task was increased by the need for construction to be as far advanced as possible before the onset of winter made digging and building difficult.

At Kaldadarnes and elsewhere constructional work fell behind schedule and later various defects made their appearance. Thus incinerators were built to a poor design, were too small, would not keep alight, and had to be replaced by improvised patterns; latrines were installed in such a way that they were difficult to keep clean; ablution blocks were built some distance from living quarters, so that personnel were very liable to get cold and wet in going to and from them; drainage systems were sometimes poorly planned, allowing percolation into the subsoil, and had insufficient inspection chambers; water storage tanks and pumps were inadequate; there was overcrowding in living quarters and at times sixteen airmen were sleeping in a Nissen hut 36 ft. × 16 ft. with no separate accommodation for messing or recreation.

Conditions gradually improved and by Christmas 1941 all personnel were living in a fairly reasonable state of comfort. Nissen huts were generally revetted with earth to a height of 4 ft., the ends lined with old petrol tins and the inside with 'tentest'; often a makeshift entrance lobby was constructed in the huts so that wet outer clothing and boots could be left there and snow and mud would not be taken inside. At Reykjavik inside distempering was being carried out to improve the lighting, and latrines were being reconstructed. At Kaldadarnes the officers were sleeping five and the airmen fourteen to a hut, beds being staggered when there were ten or more men. At the outlying stations of Olfus, Vik, Artunshofdi, Grotta, Leynimiri and Sandgerdi, accommodation in Nissen huts (three or four at each station) was satisfactory and not more than fourteen airmen were living in any one hut. In some of these small stations civilian sources of drinking water and mains

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electricity were available; in one, hot springs for bathing were only one-and-a-half miles away, and in the four which had no bathing facilities showers were provided; at each station a reasonable standard of comfort had been achieved.

Although the situation eased still further during 1942, the demands of each of the Services on available labour and materials made improvements slow to achieve and caused facilities to fall a good deal short of the requirements of the many R.A.F. personnel needed to maintain convoy work, reconnaissance, anti-submarine patrol and defence.

By early 1943, a higher standard of living conditions had been made possible by the increased availability of materials and manpower and by the hard-won experience of the previous years, while conditions generally were improved by the building of permanent roads and the careful grouping of huts so that personnel needed to be out of doors for the minimum amount of time in their everyday tasks. An improvement in clothing followed the adoption of certain recommendations made by a naval surgeon commander who was an expert in matters pertaining to arctic clothing and survival.

In June 1943, Camp Geek was taken over from the American Forces, thereby relieving the accommodation situation, which was at that time causing some anxiety owing to the influx of personnel from England. Considerable alterations had to be made at the camp in respect of both living and technical accommodation and it was necessary to provide permanent sanitation and water supplies, an M.I. room and recreation huts. The camp was operational by the end of the year.

In May 1943 the number of aircraft received from the United States and Canada necessitated the setting up of a spacious and comfortable cafeteria for the ferry crews; this was most desirable as aircraft arrived at Reykjavik throughout the twenty-four hours and rapid departure was often essential owing to weather conditions, the dominating factor in the flying picture in such latitudes. However, although the problem of catering was thereby eased, the billeting of these personnel created new accommodation difficulties which reached serious proportions as the flow of aircraft from the U.S.A. steadily increased; the problem became critical by late 1944 and overcrowding had to be condoned, while early in 1945 it was necessary to enlarge the cafeteria.

Heating and Lighting. At Kaldadarnes, during the early part of the first winter (1940–1) no means of heating were available other than the cookhouse stove. Later, small coke-burning stoves were installed in each Nissen hut on all units, while Canadian stoves were sometimes used and, in the larger messes, open fires. Lighting was at first provided by hurricane and incandescent paraffin lamps; as time went on these were superseded by electricity, but in winter the heavy day and night demand on the small generators which supplied the current resulted in

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poor illumination. A shortage of bulbs and fittings and the priority demands of operations rooms slowed down the provision of adequate lighting in the airmen's living quarters with consequent risks of eye-strain from reading and close work during the long winter nights. The pale brown finish of the inside of the huts reduced the general illumination by between 40 and 50 per cent. and lime-washing was widely adopted as a partial remedy, so that by the spring of 1942 there had been no objective evidence of eyestrain among the personnel. The problem of lighting, however, was kept constantly under review by the medical authorities in view of the fact that the very short hours of daylight, even in summer, meant that personnel worked by artificial light to a very great extent.

As generating plant became more readily available from 1943 onwards the supply of electric light to the smaller units improved considerably and medical records suggest that personnel sustained little if any damage to sight. Heating facilities also improved, although too much reliance was placed on the slow combustion type of stove, which was both inefficient and expensive in fuel and required continual adjustment if it was to be kept alight. In the later years of the war, however, more effective insulation of the huts was achieved and personnel were able to spend more time in recreation huts in which it was possible to use larger heating installations. Nevertheless, in the temperatures experienced on the island, heating constituted a considerable problem and one that was never solved completely.

Water Supply, Sanitation, Refuse and Swill Disposal. Water supply varied according to location and testing was undertaken by the Army medical authorities. At Kaldadarnes water came at first from the river but later from a surface well and from the well of the nearby American Hospital, supplemented on occasion by a civil source of supply. Headquarters, Reykjavik, was the only formation having a proper water drainage system and this was connected to the town mains; at Reykjavik camp, conservancy was by bucket latrines, with disposal by local contractor (arranged through the Army Hygiene Section) but elsewhere disposal was into pits. Refuse disposal was generally by burning in improvised incinerators or by burial, pits for the latter being usually dug during the summer because of the frozen state of the ground in the winter months. A serious drawback at Reykjavik and Kaldadarnes was the absence of rat-proof swill bins; the improvised receptacles available had ill-fitting lids and were a disadvantage at both the main stations, while the lack of proper storage bins for food led to further trouble with rats.

In the later years further marked improvement in water supplies was achieved by the construction of static tanks and large water towers. In August 1944, when the island's amenities were inspected by the

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Under Secretary of State for Air, a very satisfactory state of supply and conservancy was noted.

Diet and Messing. Rations were supplied by the R.A.S.C. on the Northern Hemisphere scale (3,800 calories per man per day) and were 50 per cent. tinned and 50 per cent. fresh; the normal milk supply was either tinned (condensed) or powdered, personnel being forbidden to consume raw milk—with the exception of that supplied to Reykjavik town, most of which was pasteurised by the 'flash' process—because of the prevalence of tuberculosis in dairy cattle. In April 1941 personnel on the depot ship *Manela* had a reasonably varied diet including lettuce and tomatoes, local cheese and fresh fish (salmon, pollack and cod); later in the year, when the strengths of all armed forces on the island had risen considerably, fresh food—especially vegetables—was not easy to obtain locally, owing mainly to the poverty of the soil and existing civilian needs, while vegetables imported from the United Kingdom deteriorated on the long sea-journey and were often useless on arrival. Seldom did the men get enough raw salads and although encouragement to local growers using soil near hot springs resulted in an improved output, the occurrence of hypovitaminosis always had to be guarded against. The possibility of using the dried vegetables introduced by the Ministry of Health at the end of 1941 was considered but did not materialise until the end of 1942; Marmite was supplied daily on the *Manela* and Bemax was also available in the summer of 1941. Fruit and fruit juices were in short supply at all times and this was probably responsible for much of the constipation which occurred and for some cases of malaise and slackness. Reference is made to this and to other supposed instances of hypovitaminosis in the 'Health of the R.A.F.' section below. National wheatmeal was sent to Iceland towards the end of 1941, but, owing to the large stocks of white flour which had accumulated, wheatmeal bread was only issued once or twice a week during the summer of 1942.

Kitchens and messing conditions slowly improved and in the summer of 1941 an unofficial cookery school was formed, with over 100 'students', the Senior Medical Officer acting in an advisory capacity. At the end of the year there was one catering and two messing officers. The position with regard to cooks steadily improved in the later years, but the standard of messing was never entirely satisfactory, owing to a combination of the shortage of experienced cooks, common to all commands, and food supply difficulties which would have tried even the most skilled chef. There was evidence, however, that R.A.F. personnel fed less well than did the American troops, chiefly because the latter were able to obtain superior rations.

With regard to alcohol, Icelandic 'near-beer' was found to be both expensive and comfortless and even if native brewers could have

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obtained more grain and hops it was not considered likely that they could have met the R.A.F. demand. Imported bottled beer arrived irregularly and was expensive for airmen, but some draught beer stood the sea-journey well and sold at 9d. a pint; non-alcoholic drinks were always expensive.

In August 1942, because of complaints about the quality and quantity of food received in Iceland the Director-General of Medical Services despatched a team of medical officers skilled in dietetics to investigate the allegations and particularly to determine whether there was any vitamin deficiency in the diet of R.A.F. personnel in Iceland.*

It was confirmed that messing was not up to normal Royal Air Force standards, that the unavoidable necessity of using tinned food of all descriptions and the lack of fresh vegetables were producing a diet of considerable monotony and that vitamin deficiencies, mainly of Vitamin A, Riboflavine and Vitamin C, were in fact likely to occur although to date no such deficiency had been diagnosed. The position was considered unsatisfactory but was largely due to the exigencies of war and especially to the difficulty of procuring an adequate supply of fresh vegetables in such a barren and isolated area. Arrangements were made for fresh vegetables to be provided whenever possible by air or sea; vitamin tablets were made available and all personnel made familiar with their purpose, while the ascorbic acid issue was increased to 50 mg. per day; considerable improvement was also achieved by the introduction of dehydrated foods which were then coming into general use.

In the latter part of 1945 a similar complaint was investigated and found to be largely true. The reason on this occasion was that vegetables had ceased to be flown in by air as the charter firm responsible had raised its charges to such a degree that they were unacceptable, while a considerable quantity of vegetables arriving by the sea route were uneatable on arrival—for example, 50 per cent. of all potatoes were unusable and such commodities as fresh cabbage unrecognisable. Steps were taken to remedy these defects. On examination no cases of vitamin deficiency were discovered and no other illnesses could with certainty be attributed to a dietary lack.

Clothing. In determining scales of dress for Iceland the chief aim was to ensure that the resistance of aircrews to disease and frostbite was not lowered as a result of the cold and wet. All aircrew personnel were issued with the R.A.F. flying suit of battle dress pattern but a recommendation, on health grounds, for a general issue of the battle dress was not approved by the Air Council†; however, supplementary

* Their findings were later circulated as a Flying Personnel Research Committee publication.

† At the end of 1941 authority was given for the issue of khaki battle dress (heavy duty dress) to ground personnel; this proved very satisfactory.

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cold-weather clothing was allowed for ground staff as well as for flying personnel. In addition to his ordinary kit, therefore, each member of aircrew and each ground airman was provided with:

Oilskin jacket and trousers	Alpine boots
Leather jerkin	4 pairs extra heavy socks
Tropal-lined coat*	2 pairs footless socks
2 sets woollen underclothing	Three-compartment extra gloves
Gumboots	Snow goggles†
Sou'wester hat	

Balaclava helmets, mufflers, extra mitts and fur caps with waterproof tops and lambswool lined mitts were recommended though not an official issue‡ and in some cases 'submarine stockings' were worn with gumboots. The Alpine boots issued proved very successful; they were sufficiently loose to allow several pairs of socks to be worn, gave a good grip on rough and slippery surfaces, and stood up well to the wear and tear caused by ground which was often hard and strewn with jagged rocks. It is not surprising that with so many extra articles required aircrews were frequently found deficient in clothing on arrival.

Authority was also given for Princess Mary's Royal Air Force nursing sisters to be provided with special clothing—i.e. duffle coats with hoods, a waterproof (in place of tropal-lined) coat, rubber knee boots and waterproof-covered lambswool gloves.

Personnel: Morale, Leave, Recreation, Relations with Icelanders. Climatic, living and working conditions have already been described in sufficient detail to indicate the kind of personnel problems which were encountered. Aircrews were severely tested during the winter, although in summer the actual flying conditions were often excellent; morale stood up to the anxieties and discomforts of the arctic surroundings very well‖ and there were very few cases of flying stress or 'wavering', confidence in the aircraft, particularly the Hudsons, being an important factor in ensuring stability. As with the majority of Coastal Command work, much of the flying was monotonous and consisted of wearying patrols over long stretches of water, relieved at rare intervals by dangerous and dramatic incidents. Maintenance crews played their part very well. As living conditions improved personnel problems diminished, but there were always two apparently irremediable difficulties—infrequent and

* The tropal coats proved unsatisfactory, except for travelling by car or lorry or for guard duties, being too stiff, heavy and cumbersome for movement.

† In practice these were seldom used, except during dust-storms in summer.

‡ Balaclavas and scarves were issued by 'Comforts' to all men without these items.

‖ Personnel of No. 269 Squadron, after being in Iceland for nine months, volunteered to stay for an extra half-year! This squadron had an exceptionally popular and efficient squadron commander and would have gone anywhere and done anything under his leadership.

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PLATE XXVII: Typical Scene on an Icelandic Airfield where continual Snow Clearance was necessary throughout the long Winter Months

PLATE XXVIII: Bathing in Hot Laval Springs near Kaldadarnes

[*facing p.* 344

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PLATE XXIX: R.A.F. Hospital, Reykjavik. An Aerial View taken in 1944

PLATE XXX: An Icelandic Patient being removed from a Northrop Float Plane

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irregular mail, and unduly long periods without leave in the United Kingdom. Both of these had an adverse effect on morale and, in the view of some medical officers, were liable to lead to a deterioration of performance.

Quarterly leave being impracticable from the operational point of view the next best thing was arranged and as from October 1941, half-yearly leave was allowed, 28 days at a time for aircrews*, 28 days in each year for ground staff. Time taken in the four-day sea-journey to and from the United Kingdom was deducted from leave and this often meant that the men only had from 17–19 days at home, so that some personnel preferred to serve their one year tour of duty and then have the full 28 days' leave in the United Kingdom. Local leave in Iceland was unsatisfactory on account of shortage of accommodation, expense and limitation of transport and at Kaldadarnes 48-hour passes were seldom taken, some personnel staying on the camp for as long as four months at a stretch. In spite of every effort throughout the years to improve the leave position, no satisfactory solution was reached, as the difficulties imposed by both the weather conditions and the isolated geographical situation were such that schemes which might have been acceptable were inoperable in wartime.

Another matter which caused much concern was the lack of recreational facilities, although the position began to improve after the first year. At first the Y.M.C.A. and Toc H in Reykjavik were almost the only centres to which airmen could go for relaxation during their free time and for extra food, and although there were two cinemas in the town each holding 300–400 people, the natural competition of the Icelanders generally deprived the airmen of seats when they were able to get away from the camp. As time went on buildings were erected by the Services, there was an all-round improvement in recreational facilities and an account of conditions at the end of 1941 reads like a hotel prospectus. At various times sports and pastimes included skating, ski-ing, lorry trips, mountain climbing, walks, football (much limited by the nature of the ground and the expense of hiring the stadium at Reykjavik), physical training, 'gym', swimming (indoor and out), fishing, boxing, cinema shows, table tennis, concerts, dances, debates, language lessons, reading (most camps had libraries), chess and draughts. By the end of 1941 most stations had a welfare organisation and a committee with the S.M.O. as chairman ensured equitable distribution of 'comforts'. Two education officer posts were established in the winter of 1941, but only one officer arrived and he was handicapped by lack of equipment and suitable accommodation.

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* The return of aircraft to the United Kingdom for overhaul often gave an opportunity for the crews flying them to take their leave while the machines were being repaired.

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From 1943 onwards recreational facilities were still further improved; entertainers sponsored by E.N.S.A. visited the island at intervals and with the arrival of increasing numbers of cinematographs even the smaller units were able to have frequent film shows of a reasonable standard. The introduction of more recreation huts was welcomed and the authorities did everything possible to encourage amateur talent to stage plays and revues.

Relations with the islanders were 'tricky' at first, but improved in course of time when the rationale of the Allies' occupation and the friendliness of their intentions were realised. German propaganda had had the expected adverse effects on many of the Icelandic youths and a report in May 1942 stated 'Some of the inhabitants are not yet completely Anglophile!' Despite this attitude, however, and the necessity of placing Reykjavik out of bounds on the National Independence Day, relations could at no time have been regarded as strained, while between Service and civilian medical practitioners co-operation was excellent. Conversational exchanges with the peasantry were limited by the language difficulties and in at least one out-of-the-way place consisted of little more than hearty guffaws and slaps on the back.

R.A.F. STATION, KALDADARNES

As will have been seen in the preceding sections of this chapter, the task of establishing R.A.F. bases in Iceland was fraught with difficulties, created by the unusual conditions prevailing there. As the medical* problems which had to be faced were therefore to some extent unique, it is proposed to relate in detail the history of R.A.F. Station, Kaldadarnes from its formation as a makeshift tented camp in a desolate countryside to its growth, in under two years, to a full-sized operational station.

On other stations, similar problems, though still formidable, were easier to deal with. In the first place the R.A.F. camps were, with the exception of Hvitanes (which was in fact never used) and some of the outlying R.D.F. stations and emergency landing grounds, within reasonable access of the island's capital, Reykjavik, a town of 40,000 inhabitants with hospital and other facilities. Secondly, the S.S. *Manela* provided a self-contained base, housing all the personnel brought by the ship until shore accommodation could be provided. Finally, the air reinforcements which arrived in the spring of 1941 had at least seven months during which constructional work could proceed unhampered by the extremely short daylight and the severities of an Icelandic winter. Nevertheless, the shortage of building material and labour and the many demands made by all three Services, and later also

* Using the word 'medical' in a broad sense as covering all aspects of life which had a bearing on the health and well-being of personnel.

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by the Armed Forces of the U.S.A., resulted in a probably unavoidable delay in meeting the housing needs of the personnel required for air operations on and about the island.

As already stated, the advance party of No. 98 Squadron, housed in bell tents, began the work of station construction at Kaldadarnes in August 1940. Their cookhouse, entered through a small opening, measured 15 by 12 by 8 ft. and had turf and caked-mud walls, an earth floor, a turf roof strengthened with corrugated iron, and a small hole in one wall to act as window and ventilator. In this room, until April 1941, food for up to 300 N.C.Os. and airmen was prepared on one cooker and a Soyer stove. The bulk of the rations was tinned and although bread was available and occasionally fresh fish and vegetables and frozen meat, the diet was monotonous.

The tents had no floor-boarding. There was no heating and no facilities for drying other than the cookhouse stove. Sleeping bags were obtained only after protest to the Director-General, Army Medical Services, in January 1941, and until that date airmen had an average of eight blankets each; on the rare occasions when their clothes were not too wet they slept in these as well. As winter drew on, with its customary gales, it was the exception rather than the rule for tents to remain *in situ* for more than five days at a stretch and sometimes as many as six tents, with their occupants' belongings, would be scattered simultaneously across the marsh by the wind.

Off-duty hours in the evening offered little but boredom and discomfort. Apart from a village (Selfoss) of 300 inhabitants 5 miles away and some distant hot springs there was no inducement to leave the camp; nor were the short hours of daylight encouraging in this respect. The men adapted themselves well to the conditions and the grumbles and complaints that did arise unanimously expressed a defiance of the elements and confidence in the future. In the words of the medical officer: 'there was everywhere a spirit of friendly tolerance and no thought of resignation or defeat'.

Also in August a local farmhouse was requisitioned for use as an officers' mess and as sleeping accommodation for the four senior officers. A considerable amount of cleaning, including the removal of two spadefuls of dead flies from the living room, was required to make this building habitable; there was still no running water and no drainage, only one stove for heating and only two chairs, but it provided a dining-room, ante-room and bar for twenty-five officers; all officers lived in the farmhouse during the winter. Outside the mess a small Icelandic cemetery, still visited by local mourners, took up part of the grounds, the rest being occupied by out-buildings, some of which were cleared and used as an equipment store and one as an office. Many loads of dung, part human and part bovine, were removed from the byre in order to make additional

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space. The subsequent discovery that the equipment office was situated directly over a cesspool necessitated alternative accommodation being found. A colony of numerous and highly destructive rats (*rattus Norvegicus*)* was taken over with the mess buildings.

A well 10 ft. from the cemetery having been condemned, the water supply for Kaldadarnes station came from the adjacent Olfusa river, which provided a mixture of glacier and upland surface water with a fairly heavy sediment. Into the Olfusa the sewage from Selfoss village, 5 miles up-stream, was discharged, as also was the waste from a nearby dairy and slaughterhouse. Three 500-gallon-an-hour water trailers were used to obtain drinking water from the river, being brought as near to the bank as the risk of being bogged in the mud would allow; for a short time the trailers worked well, except for interference with the filters by suspended matter; when the river froze over the trailers were driven over the ice to a bore-hole and with the assistance of blow-lamps to thaw out the frozen valves, joints and connexions, and two braziers to prevent freezing as the water entered the main tanks, mechanical pumping was started; the water was distributed round the camp after the braziers had been left in position long enough to prevent re-freezing, although sometimes ice had to be man-handled out of the tank and at one period messes received their water ration in the form of so many blocks of ice. After a while defects in the automatic doser necessitated hand-dosing with chlorine in the tank, and eventually the mechanical pumps broke down, so that hand-pumping was required, one-hour shifts three or four times daily for each trailer. In the end these water carts were used merely as storage tanks.

Until March 1941 when a 12-shower bath-house was opened in the camp, there were no washing or bathing facilities at Kaldadarnes and the men used the river, either washing themselves there or bringing water back to their tents in improvised receptacles; little use was made of the outdoor hot springs some 15 miles away. (*See* Plate XXVIII.)

Latrines were of the dry-bucket type, disposal being to an Otway pit. For the first six months labour shortage (the sanitary squad consisted of two men only) and the prior claims of the squadron's constructional and operational work resulted in delay in the disposal of excreta, swill and refuse; only infrequently could a lorry be detailed for removal of the more obvious accumulation out of reach of the rats and flies to some lava fields† two miles away.

By April 1941, Kaldadarnes camp had grown considerably in size and most of the accommodation was now in Nissen huts each housing fifteen men. Planning, however, had never been on more than a day-to-day

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* Iceland was badly plagued with rats and constant and intensive measures to keep them under control were necessary.

† For some reason the refuse dumps in the lava fields failed to attract the rats.

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basis and it was now evident that something more ambitious was necessary. With the assistance of Royal Engineers staff, therefore, work was put in hand for the building of a water-tower, with mains to all cookhouses, the installation of a proper drainage system and the erection of an incinerator. At the same time the sanitary squad, now raised to a strength of 15, was set to work cleaning the camp daily of all swill and wet and dry refuse, and during May a six months' accumulation of refuse, the result of the low priority accorded to sanitary work, was removed to the lava fields; the bases of the original dumps were then fired and the turf limed and inverted over them with the object of freeing the camp of rats. In due course a pump-house was built at the river bank and this fed four 400-gallon tanks fixed at the top of a tower from which water-mains led; for drainage, a central cesspool which received waste from the cookhouses and urinals was pumped out into the river. Dry bucket latrines and urinals were installed in concrete buildings by the end of July, and disposal pits in the lava fields replaced the original Otway pit.

By August 1941 the new works had been completed, including the incinerator; the latter was, however, of such a design that it could not be kept alight and it was necessary to replace it by an improvised type of incinerator built into a lava shelf, using earth-filled petrol tins and an iron grille; this functioned satisfactorily. Further difficulties arose over the ablution huts, only one of the three being serviceable; as the essential fittings for the water supply were unobtainable, leaks developed in the service pipes and taps in one of the bath-houses and stop-cocks were defective or missing. As the river was now deemed too polluted for use as a supply for drinking water, a shallow 14-ft. well was bored in the camp, but the high iron content resulting from rusty mains made it necessary to stop using this temporarily and water from a civil source seven miles away had to be used; however, after a concentrated solution of bleach had been run through the pipes the well water became potable, although a further difficulty arose because the storage capacity of the tanks was too small and the well-pumps so weak that another more powerful pump had to be installed. The drainage system to the cesspool was also unsatisfactory, as defective joints and leaking inspection chambers in the concrete piping caused seepage into the subsoil. In time, the cesspool became too small for the increased numbers of personnel on the station and it had to be pumped out twice daily.

Rats, reduced in numbers by the regular removal of refuse, were brought under control in a vigorous campaign during the early part of 1941. In the neighbourhood of the officers' mess alone, 1,200 poison baits were taken in a week and outside the airmen's cookhouse twenty-five rats were caught in one night by a single break-back trap.

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In the early days at Kaldadarnes the provision of recreation was a serious problem. Aircrews were granted a forty-eight hours' pass in Reykjavik every four weeks, but many personnel were unable to visit the capital even as often as this, while the expense alone of civilian transport to and from Reykjavik (a 10s. bus fare) was sufficient to restrict personnel to local outdoor facilities for recreation, and these, as may be imagined, were extremely limited. On the camp skating was the chief outdoor sport during the first winter, for the small amount of football which could be played had to be stopped owing to the frequency of injuries sustained on iron-hard ground frozen to a depth of 3 ft. A recreation room, provided in January and consisting of half a Nissen hut, contained a radiogram, dart-board, shove-ha'penny board, set of draughts and chessmen and a small library, but the facilities proved quite inadequate for the number of men on the station, while a N.A.A.F.I. building erected in February was available only for the serving of 'snacks'. Organised indoor competitions and games were rare, although lectures and debates were arranged occasionally and sometimes the station was visited by an itinerant cinema unit, films being shown in a nearby barn. Three ENSA concert parties also gave performances.

It is not surprising that such conditions had an adverse effect on the personnel. The difficult nature of their work, the lack of varied diet, the absence of recreational facilities away from the camp, the climate and the depressing surroundings resulted in personnel having a pale and unhealthy appearance, with a facial expression and mental outlook striking to anyone meeting them for the first time after the winter, but in spite of this, the health of the squadron was remarkably good. Personnel of No. 269 Squadron, which replaced No. 98 Squadron at Kaldadarnes and arrived in detachments between March and September 1941, also showed a high standard of health and very little evidence of flying stress. At the end of 1941 general living conditions on the station were greatly improved and by May 1942, when the station strength was just under 1,000, they were even better.

GENERAL AND MEDICAL ARRANGEMENTS

Until the withdrawal of the Army in 1941–2, the R.A.M.C. provided base hospitals, field ambulance units, hygiene services, stores and (until late in 1941) dental treatment, all of which were available to the R.A.F. The two general hospitals at Reykjavik, the 30th* and 50th, were well

* The 330-bedded 30th General Hospital was originally at Laugarnes on the outskirts of Reykjavik, the building being a one-time leper asylum. In October 1941 it was moved to Helgafell, its original accommodation later housing No. 167 American Army Hospital. The Americans also took over the hospital at Helgafell which became No. 208 U.S. Army Hospital.

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staffed and equipped and in August 1941, provided 430 beds. No. 160 Field Ambulance at Alafoss attended to patients transferred from the Helgafell Transit Camp sick quarters during April–September 1941, and other field ambulance units rendered valuable service elsewhere.

At Reykjavik aerodrome a four-bedded sick quarters housed in Nissen huts was operating during August 1941; this was increased by another five beds in December but a proposed expansion to twenty beds was not completed until May 1942 when a properly designed building was opened. The Norwegian flying boat squadron at Corbett Camp nearby was in a more fortunate position medically than the R.A.F. unit on the station, having a six-bedded sick quarters in a Nissen hut and an establishment of two medical officers; this sick quarters also had a mobile laboratory and X-ray set.

At Kaldadarnes the six-bedded station sick quarters, which was equipped to scale Z.1 and staffed by a medical officer, one sergeant, one corporal and four nursing orderlies, was housed until October 1940 in a marquee, heating and lighting being provided by an aircraft heater, one 'Valor' stove and four hurricane lamps. Under such conditions stock mixtures froze in their bottles and the supply of drinking and washing water created a problem, but in November 1940 the situation improved, when the sick quarters was transferred to two adjacent Nissen huts; one of these, heated by a 'Valor' stove, was used as a medical officers' room, store, office and dispensary while the other accommodated the kitchen and the ward (in which an open brick-built fireplace was installed) with an 'infectious bed' partitioned off. There was no road or path to the sick quarters and it was only infrequently and with difficulty that the station ambulance was able to carry patients direct to the huts. In May 1941 a new sick quarters, comprising five Nissen and two 'half-Nissen' huts, was designed, erected and brought into use; coke stoves provided adequate heating and hot and cold water with drainage was available; the interior of the building was white-washed and decorated and hard-standing made for the ambulance. This accommodation incorporated a dental surgery and kitchen and provided for thirty beds; it was equipped to scale A.1.

At the Transit Camp at Helgafell, the sick quarters comprised little more than an inspection and dressing room, this formation and other outlying R.A.F. stations and landing grounds being dependent for medical care on local Army units and occasionally civilian medical practitioners.

THE R.A.F. HOSPITAL

The proposal to withdraw the British Army from Iceland came under discussion at the end of 1941; linked with this question was that of vacating and handing over to the U.S. Army either one or both of the

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Army General Hospitals. The sick quarters' provision at Reykjavik and Kaldadarnes was quite inadequate to deal with the rapidly increasing number of R.A.F. personnel without the assistance of a General Hospital and it was eventually decided that the R.A.F. should take over No. 50 (Army) General Hospital (100 beds), sharing the facilities, as far as practicable, with the Navy,* although the latter would provide no medical staff. (*See* Plate XXIX.)

On February 15, 1942, R.A.F. staff having been detailed for the hospital, an experienced quartermaster arrived to inspect Army accommodation, stores and equipment and to make arrangements for the handing over. With the exception of two wards with sixteen beds each, most of the 100 beds in the hospital were in small two-bedded wards; there was a reserve of 100 beds and the necessary equipment. Accommodation for the medical and nursing staff was barely adequate. There was a room for the C.O. on the first floor and another, to take four officers, on the ground floor of the hospital; two more officers were to be housed in a nearby Nissen hut, and a further hut would provide the officers' mess. Eight Nissen huts, connected with each other and with the hospital, constituted the sisters' quarters, which included sitting room, dining room and sleeping accommodation; in these dismal quarters 22 Q.A.I.M.N.S. (Army) nurses had lived with only one lavatory, washplace and bathroom at their disposal. Sergeants' and airmen's accommodation, also in Nissen huts, was satisfactory. Barrack and hospital equipment was good, though transport and office appliances were lacking and the premises in general did not show a high standard of cleanliness. Constructional improvements were put in hand at once.

The hospital was taken over on March 1, 1942. The R.A.F. establishment included:

1 Wing Commander . .	(Officer Commanding)†
3 Squadron Leaders . .	(surgeon, physician and pathologist who also acted as anaesthetist)
3 Flight Lieutenants	
12 Members of P.M.R.A.F.N.S.	
22 Male Nursing Orderlies .	(including mental nursing orderlies, operating room assistants, radiographers, special treatment orderlies, laboratory assistants, masseurs and dispensers)
37 Other Ranks (Non-medical)	

* Shipwrecked mariners were also to be admitted to the hospital.

† From April 1942 the Officer Commanding, R.A.F. Hospital, was Senior Medical Officer, Iceland.

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At the end of 1943 the establishment was:

1 Wing Commander . . (Officer Commanding)
2 Squadron Leaders
2 Flight Lieutenants
1 Flying Officer
12 Members of P.M.R.A.F.N.S.
33 Other Ranks (Medical)
44 Other Ranks (Non-medical).

The staff, though adequate, was far from large and any outbreak of illness among medical personnel would have caused considerable embarrassment, for securing replacements from the United Kingdom was a comparatively lengthy procedure.

The hospital was a self-contained unit for rations, fuel and laundry and administered by R.A.F. Station Reykjavik for equipment, accounting and pay.

By mid-April structural improvements were well in hand, though not completed, and the hospital was working smoothly, catering for R.A.F., Naval, Merchant Navy and Army personnel and a few civilians; the pathological laboratory was, however, short of equipment, and the X-ray apparatus still on loan from the Army. When, suddenly and with some secrecy, the British Army was withdrawn from Iceland, a further problem arose in the matter of disinfection and disinfestation of clothing which had previously been undertaken for both the Army and the R.A.F. by the 35th Field Hygiene Company (R.A.M.C.) and a Mobile Bath Unit; this service was taken over by the R.A.F., but, as there were no personnel at the hospital trained for such work, it was necessary to borrow a sergeant sanitary assistant from Reykjavik Headquarters and he was detailed to organise the unit. Another Army unit, the base laundry, was retained with its staff of 66 and undertook laundering for the R.A.F. hospital and the airmen on Reykjavik aerodrome; the laundry was later taken over by the R.A.F., unskilled personnel being trained by the Army staff before they left Iceland in August 1942.

The hospital had not been in R.A.F. hands long before it was felt locally that the number of equipped beds should be brought up to 200 but this was not agreed to at the time. How far the suggested change was necessary, it is difficult to say in retrospect, for this was a problem of shortage of accommodation, changing and uncertain requirements, and the conflicting claims of the many Services concerned; but as an administrative problem, likely to arise again in similar circumstances, it is considered worth recording in detail.

By March 1942 the combined R.A.F. and Naval strength in Iceland had risen to over 5,000 which, on a 2½ per cent. strength basis, gave an entitlement of 125 beds. Apart from the R.A.F. Hospital—and excluding

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the station sick quarters at Kaldadarnes, which was some distance from the centre of R.A.F. and Naval population—the only additional equipped beds which could be drawn on were the 30 at the naval sick bay at Hvalfjord and the 9 in the R.A.F. sick quarters at Reykjavik camp and neither of these establishments could provide accommodation for more than minor medical and surgical conditions. Furthermore the R.A.F. Hospital was under obligation to reserve a number of beds for ship-wrecked mariners, as had been the practice when the building was administered by the Army, and it was also felt desirable to set apart space for the treatment of in-patient V.D. and infectious cases; this latter requirement was complicated by the fact that so many of the beds in the hospital were in two-bedded wards, which meant that each case requiring isolation automatically put a second bed out of action.

At this time the 30th General Hospital at Helgafell (*see* footnote on page 350) had been rather suddenly disbanded, although there were still 100 out of 330 beds available. Thus the total in-patient provision for Naval and R.A.F. personnel and for ship-wrecked mariners was little over 200 beds, of which all but five were in fact occupied during March.

Consideration was given to equipping 100 beds at 'Stadium Camp', a site on the south-western outskirts of the town, previously occupied by a Royal Engineers works company and originally intended as possible overflow accommodation for the hospital, but the general shortage of housing in the island made the taking over of this camp a matter of some difficulty; moreover the distance of a quarter of a mile between Stadium Camp and the main R.A.F. Hospital was sufficient to necessitate an increase of staff greater than that which would be necessary if additional hutments could be erected in the grounds of the hospital itself.

The possibility of using American Army hospitals offered a partial solution and later in 1942 the authorities at No. 208 American Army Hospital at Helgafell agreed to take emergency infectious and in-patient V.D. cases, out-patient V.D. cases being treated in a clinic at the R.A.F. Hospital once a week. A second American Army Hospital (No. 167) at Laugarnes (original site of the 30th R.A.M.C. Hospital before it moved to Helgafell) was also prepared to take cases, but here, as in No. 208 American Hospital, some difficulty was expected on the administrative side in that moves of R.A.F. and Naval patients from one hospital to another, such as might occur if there was a sudden demand for beds for ship-wrecked personnel, would increase 'paper' work and complicate medical records.

During its second month (April 1942) the R.A.F. Hospital had admitted 174 cases and discharged 163 while the average daily number of cases under treatment was just under 77; the bed state was 101. Thus there appeared to be no undue congestion, and the proposal, during

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May, to extend R.N. treatment facilities by providing a 30-bedded sick-bay at Reykjavik camp promised to ease the situation still further.

During 1943 the hospital more than justified its existence and few beds were vacant for any length of time; the work of the laboratory expanded considerably, owing to the increased volume of work from the Royal Navy and outstations.

It was considered desirable to construct a small burns centre where treatment could be carried out on lines similar to those followed at East Grinstead and a room was accordingly set aside for this purpose and equipped with a bath and a hose; this arrangement proved satisfactory. Burns cases usually made good progress in Iceland.

There is little else of interest to report throughout the remaining years of the war but the following examples of admissions to the hospital will give some indication of the work carried out:

Period					
January 1, 1943 to June 30, 1943		July 1, 1943 to December 31, 1943		January 1, 1944 to June 30, 1944	
January	127	July	149	January	102
February	115	August	107	February	75
March	196	September	96	March	100
April	121	October	117	April	76
May	117	November	132	May	72
June	145	December	139	June	99
Totals	821		740		524

Admissions for 1944 also show a very great decrease when compared with the figures for 1942; in six months in 1944 there were only 200 admissions to the medical section of the hospital against 288 in four months (March–June) in 1942; similarly, there were 41 out-patients in six months in 1944 compared with 111 in four months in 1942. Twenty-two of these 41 cases were neuropsychiatric, but the majority of these were mild affective disorders of the anxiety reaction type and only five needed to be invalided home.

Finally the following summary of patients held in the R.A.F. Hospital in December 1943 gives an indication of the diversity of personnel catered for:

Patients	*Officers*	*Other Ranks*
Royal Air Force	3	66
Royal Navy	5	37
British Merchant Navy	3	8
Allied Naval Personnel	2	3
Civilians	3	—
Totals	16	114

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MEDICAL STAFF

In January 1942 (before the R.A.F. took over the military hospital) the strength of R.A.F. medical personnel on the island was 4 officers, 5 sergeants, 2 corporals and 27 nursing orderlies. The S.M.O., Iceland, of squadron leader rank, was at headquarters Reykjavik, but at that time he was without an assistant, as the medical officer of No. 612 Squadron had been lost while flying on Christmas Day; another squadron leader was officer in medical charge, Kaldadarnes, with a flying officer as squadron medical officer. Until mid-1942, when Headquarters, Iceland assumed responsibility for the outlying stations, Reykjavik and Kaldadarnes undertook the medical care of all such units, each of which had a nursing orderly and was visited regularly, sick personnel being evacuated to the Army Base Hospitals either direct or via local Army medical units.

The Norwegian squadron at Corbett Camp with its two medical officers was almost self-contained, while the Transit Camp also had its own medical officer. Headquarters Iceland and Kaldadarnes each had a sergeant sanitary assistant but the other rank medical establishment at both stations was considered to be too small for the work which had to be carried out. Staffing of the R.A.F. Hospital has already been covered in the preceding section.

DENTAL OFFICERS

A R.A.F. dental officer with equipment to Scale D.1 and D.2 arrived in Iceland in September 1941, and was based at Reykjavik; early in 1942 a further dental officer was posted to Kaldadarnes. By 1943 the Director of Dental Services was able to post further dental surgeons to the island and throughout the remainder of the R.A.F. stay in Iceland a satisfactory standard of dental treatment was maintained.

LIAISON

Liaison with military medical authorities was very good. Reliefs were provided by the R.A.M.C. when R.A.F. medical officers went on leave, while specialists were available for consultation and were members of medical boards held in the General Hospitals on R.A.F. cases.

There was excellent liaison with officers and other ranks of the American Medical Services and inter-Service visits were exchanged by both the medical and administrative staffs; the Senior Medical Officer of the U.S. Forces exhibited a readiness to give any assistance required and an exchange of medical books and papers was arranged; furthermore, in the winter of 1941 it was proposed that an 'Arctic Medical Society' should be formed, for discussions and the exchange of views. Good liaison was also maintained with medical officers of the Royal Navy although it was seldom necessary to call upon their professional services.

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There was also a very close liaison with the Norwegian and Icelandic medical authorities and by this means many difficulties were overcome with the minimum of delay. Throughout the stay of the Royal Air Force in Iceland, this co-operation was in evidence and the assistance rendered to the Royal Air Force by both Service and civilian medical personnel of each of the Allied Forces cannot be spoken of too highly.

VISITS

During the period of R.A.F. occupation, Iceland was visited at various times by medical staff of Coastal Command, including the P.M.O. The D.G.M.S., R.A.F. visited the island from August 5–7, 1941, and as his recommendations give a good insight into the general problems at that time they are recorded here. The Director-General considered that the Transit Camp should be abolished, or at least sufficiently improved—among other things, by the provision of beds—to make the living conditions suitable for the aircrew concerned. The issue of battle dress, oilskins and gumboots to all personnel to counteract the cold and damp and the lack of drying rooms was also recommended. A mobile bath unit was to be provided, lighting improved, projectors and good films obtained and a welfare officer appointed. Leave was to be at six-monthly intervals. Among other measures to be taken were a changeover from the 500-gallon-an-hour water trailers to 150-gallon water tanks with hand dosing, and the provision of a twenty-bedded sick quarters at Reykjavik; additional Neil-Robertson stretchers were to be supplied for air transport of casualties; light, high-clearance ambulances were to replace the heavy ones, and a mobile dental set was to be provided which could be used at out-stations by a dental officer shortly to be posted to Iceland.

The Consultant in Ophthalmology also visited Iceland in August 1941 and made certain recommendations for ophthalmic equipment.

In June 1943 the Director of Dental Services inspected dental arrangements at Headquarters and stations and expressed himself satisfied with the high standard of provision made for dental treatment.

TRANSPORT OF SICK

Transport of sick personnel in Iceland was not easy, as roads were poor and the heavy Albion ambulances (3 ton) were liable to be brought to a standstill, as well as being too wide to negotiate some of the bridges. The journey, for example, from Kaldadarnes to the nearest base hospital (50 miles away) was at the best of times a prolonged and trying experience over very inferior roads leading over the mountain pass; in fact, personnel at Kaldadarnes used to remark that they 'had to be pretty fit to go to hospital'! Eventually light ambulances (14 cwt.) were provided and experiments were made in slinging patients from the roof with shock

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absorber elastic to avoid jolting. The ambulance establishment was three heavy and one light vehicle at Reykjavik and one heavy and two light vehicles at Kaldadarnes, while an ambulance speed boat was also available at Reykjavik.

By 1943 the transport of patients to hospital had become considerably easier, for it had been possible to improve the roads on the island to such an extent that they were only likely to become impassable after the heaviest snowfalls such as, for instance, that recorded in 1945 when an airman was taken to the U.S.A. Hospital at Daley with great difficulty and only after a bulldozer had been used to clear 14-ft. snow-drifts. Such periods of virtual isolation caused much anxiety to medical officers.

Air Ambulances. The distance between Iceland and the United Kingdom made the use of air ambulances, *per se*, impracticable. For local journeys on and about the island, which were seldom necessary as medical attention was nearly always available at even the more isolated points, the introduction of Vega Gull aircraft was considered; this proposal, however, was eventually abandoned and it was decided to rely on machines already based in Iceland. On various occasions local flights for the transfer of casualties were made by Walrus aircraft of the Fleet Air Arm, by Tiger Moth aircraft and by Northrop float planes, the last named requiring removal of the tail armament and the use of a Neil Robertson stretcher. The Northrop aircraft were also used at times for the dropping of medical supplies; for instance, serum was dropped by parachute near an Army camp on the north of the island for a case of suspected cerebro-spinal meningitis at a time when the sea was too rough for marine craft and roads too blocked by snow and ice for other transport to reach the unit; on other occasions, the transfer of an elderly Icelander (*see* Plate XXX) and of a baby received much publicity in the British Press. Hudsons were sometimes used for the transfer of sick personnel, patients lying in the passage-way between the seats.

With the increase of air traffic created by the ferrying of aircraft to the United Kingdom it was possible later to arrange for selected patients to be flown to hospitals in England in special instances; fortunately this was rarely necessary, as the hospital facilities on the island were sufficient for most emergencies, but in 1944 such means were employed on two occasions for transferring airmen to England.

MEDICAL EQUIPMENT

Little comment is required under this heading. A.1 and Z.1 medical equipment was used, although at first the R.A.F. was dependent on the Army for urgent replenishments of stores and dressings; the Army authorities assisted whenever possible and supplied the R.A.F. with ambulances, of which in the early days there was a great shortage, and with water carts for Kaldadarnes. Disinfestation was undertaken by the

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Army, which had two mobile bath units, while at Kaldadarnes there was a portable box disinfestor. In October 1941 a portable shower bath unit and part of a hot air disinfestor arrived, but the canvas chambers of the latter were not received until August 1942. With regard to prophylactic treatment an ultra-violet lamp was supplied for No. 98 Squadron at Kaldadarnes in March 1941, having been despatched from London in December 1940; a further three ultra-violet dual purpose lamps arrived in Iceland in April 1942, and were installed at Kaldadarnes, Reykjavik and the R.A.F. Hospital. Provision of artificial sunlight was only possible for a minority of aircrew. The 500-gallon-an-hour water trailers proved unequal to the stresses of the climate and several 200-gallon tanker trucks were taken over from the Army on their departure from the island. These trucks were on short Bedford chassis with purification by hand dosage and filtration by Stella filters; they were much more suitable for the climatic and geographical conditions of Iceland than were the more elaborate and less manoeuvreable R.A.F. plants.

From 1943 the position in regard to all types of medical and sanitary equipment improved as more shipping space became available, but this increase in supply was counterbalanced by the growing numbers of personnel on the island as operations in the Battle of the Atlantic were intensified. The overall health of the R.A.F. in the island was good and no great strain was ever placed on the medical resources; on occasions when certain supplies were not immediately available the close liaison between the R.A.F. and the other medical services on the island made it possible to tide over the gap, this arrangement being in every way reciprocal.

HEALTH AND DISEASE IN ICELAND

*Notes on Iceland.** In the fifty years before the war the population of the island had increased by 70 per cent. Since the end of the last century the inhabitants have grown both healthier and taller. Endemic leprosy, hydatid disease, and tetanus in young children have now almost disappeared; enteric fever is rare and diphtheria, once a scourge, does little damage. The infantile death rate is one of the lowest in the world.

Tuberculosis, the chief medical problem in Iceland, takes a heavy toll of the population; statistics indicate that in 1930 it was responsible for 18·5 per cent. of all deaths and in 1939 for approximately 8 per cent., this high rate being due, it was considered, to the lack of immunity of the islanders. Influenza epidemics, usually lasting three months, occur every other year. Certifiable insanity (mainly manic depressive) has

* These notes were made in 1942 from the *British Medical Journal.*

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an incidence rate of 3·5, and mental deficiency of 2·0, per 1,000. Syphilis is rare and gonorrhoea is thought to be only fairly common. Rheumatism is a frequent complaint. Human parasites, such as bugs and fleas, are apparently unknown and pediculosis is rare. Mosquitoes are almost non-existent in the south of the island, though they are met with in the north and centre during the spring.

The 1939 Public Health Report for Iceland shows that in the decade ended that year the incidence of tonsillitis among the civil population was 1 in 20 per annum, the corresponding figure for respiratory catarrh being 1 in 10 per annum. Of leprosy there were in 1939 twenty-one known cases as compared with 35 in 1930. There was an average of 500 new cases of gonorrhoea and 24 of syphilis annually. Eight per cent. of all deaths were due to tuberculosis.

Health of the R.A.F. From the preceding pages it will have been seen that conditions in Iceland were bad in many respects. Accommodation difficulties in the early days were considerable; the diet, despite all attempts at improvement, was monotonous; the climate was appalling and general boredom resulted from the difficulties of obtaining leave and the long winters with short hours of daylight; all these factors mitigated against the health and well-being of the men. It is therefore surprising to find that the health record of the R.A.F. in the island was good and that although upper respiratory infections were prevalent in the early years, there was no marked increase in pulmonary disease; the island was singularly free of the common epidemic infections and in 1945 the overall sickness rate for the R.A.F. was 181 per 1,000 per annum, the lowest rate for any formation in the whole of Coastal Command.

During the first two years in Iceland minor ailments accounted for almost all the medical conditions encountered and the sickness rate was remarkably low. Most of the illness was respiratory and largely attributable to the climate, while it was noticed that practically all newcomers became infected with the common cold within a day or so of arrival in the island. A striking fact, however, was that, at any rate at Kaldadarnes, the incidence of naso-pharyngitis did not appear to be greater during any particular part of the year, nor did it seem to bear any relation in its incidence to the crude and primitive conditions in which men lived on that station during the first winter; epistaxis was an extremely common symptom of the onset of naso-pharyngitis, especially in men recently posted to the island, but no evidence was found of hypovitaminosis acting as a predisposing factor; tracheitis was common and was thought to have some connexion with the inhalation of laval dust. This dust was also partly responsible for a painful conjunctivitis in a number of people and in view of the extreme severity of the inflammation it was assumed that the conjunctivitis was chemical; the condition was

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aggravated in summer by glare from the sun, which was above the horizon for 23 hours out of the 24; the wearing of anti-gas or anti-glare goggles by airmen during the dry windy weather resulted in a considerable drop in the incidence of the condition. Considering the climatic conditions, surprisingly few cases of pneumonia were recorded but there were numerous cases of mild bronchitis; rheumatism was quite common; enteritis was encountered at Kaldadarnes and was probably attributable to the water supply. Boils and superficial inflammation of the skin were common complaints and it was noticed that these conditions, and especially eczema of the seborrheic type, were slow to heal; in contrast to this, clean operation wounds in hospital seemed to heal normally, but whether the custom of administering large doses of ascorbic acid before operation aided healing was never established. There were very few cases of scabies or pediculosis. Falls on the rough country and on the ice gave rise to numerous sprains and abrasions, particularly in the later years when more games facilities became available.

It is interesting to note that dysentery was diagnosed on several occasions during 1943, though never in epidemic proportions, as the following figures show:

Sonné Dysentery	3
Amoebic ,,	—
Shiga ,,	—
Flexner ,,	—
Bacillary ,,	19
Non-specific ,,	—
Enteritis	8

From the time that the R.A.F. entered the country, the possibility of an increased incidence of tuberculosis had been borne in mind by the medical authorities of all forces. Contrary to expectations, however, the number of cases recorded compared very favourably with the figures for the United Kingdom—for instance in 1944, when the Service population was almost at its peak, only five cases were reported; nevertheless, medical officers kept a constant watch on the situation.

Hypovitaminosis, for which the medical officers were always on the alert, proved an elusive condition to diagnose; loss of hair, periodic lassitude, minor gastric complaints and poor healing of septic conditions were observed in a number of individuals during the first eighteen months and several men complained of traces of blood in the mouth after brushing the teeth, but there was no conclusive evidence of vitamin deficiency. One case, however, was admitted to hospital with melaena and a diagnosis of scurvy was confirmed; he responded rapidly to treatment. A second patient, one of the medical officers, was clinically

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diagnosed as having scurvy, admitted to hospital and finally invalided to the United Kingdom; the case was complicated by a tumour of the ischium and despite the favourable response to ascorbic acid therapy there was some doubt as to the cause of the condition. The irony lay in the fact that the officer concerned, by way of example to others in the mess, regularly overdosed himself with Vitamin C tablets! During 1941 five officers and twelve airmen were invalided to the United Kingdom; five of these were neuropsychiatric cases.

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CHAPTER 4

TRANSPORT COMMAND

Ferry Command

In pre-war days a relatively small amount of Air Transport work had existed in the Royal Air Force. This transport by air had been mainly centred round Egypt, Iraq and India, where Bomber Transport Squadrons were stationed and had been carried out in the first instance by the Vickers Vimy, later replaced by the Vickers Valencia, and finally, just before the outbreak of war, by Bombay aircraft which were beginning to take the place of the Valencia.

As far as the medical branch was concerned, with the type of machines flown physiological problems were relatively few. Medical officers, whilst expected to take a keen interest in the welfare and fitness of aircrew and to gain as much practical experience as possible themselves, were not faced with the problems which the rapid increase in speed and complexity of aircraft present today. Nevertheless, night flying adaptation and comfort of aircrew, effects of glare and heat, desert survival, even anxiety states and psychoneurosis (under other names) were things which every station medical officer had to tackle. Casualty Air Evacuation was looked upon as an uncommon occurrence and was largely associated with improvisation, the Neil-Robertson stretcher and the Wapiti or Gordon aircraft, but it was never regarded as anything but an emergency measure.

In the old physiological laboratory at Farnborough, inter-war economy had stifled progress to a large extent, although there were physiologists there who well understood the problems in the sphere of the physiology of flight which, if war broke out, would have to be faced and solved.

It is unlikely that anyone foresaw that in a few short years whole Divisions would be transported by air from one area of operations to another as in the second Chindits' invasion of Burma and the move of the Indian Division from the Arakan in Burma to Imphal, India.

Such then was the background for the rapid development of long-distance, high-altitude transport flying which was to start with the flying of the Atlantic as a means of delivering aircraft to Britain.

In November 1940 the first massed flight of delivery aircraft—six Hudsons—under the leadership of an Air Vice-Marshal, left Newfoundland for Aldergrove in Northern Ireland. All arrived safely the following day, and this flight was succeeded by two other similar flights, but early

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in 1941, because of crew difficulties (i.e. the problem of returning the crews to Montreal), these mass crossings were given up in favour of individual flights.

There was no R.A.F. or R.C.A.F. medical organisation associated with the months preceding the formation of Ferry Command and sick personnel reported to their own medical adviser, expenses being defrayed by the Canadian Pacific Railway organisation, who were the delivery contractors.

Any applicant for ferry duties, provided that he had a licence to fly, was taken on without further medical examination nor was medical examination carried out after illness.

FORMATION OF FERRY COMMAND

The importance of the delivery of aircraft to Britain, as well as political considerations, led to the formation of R.A.F. Ferry Command on July 20, 1941, with an Air Chief Marshal as Air Officer Commanding-in-Chief; originally the Command Headquarters was in Montreal, Canada, but later moved to Dorval with the development of that Airport.

In August 1941, H.Q. No. 44 (Ferry) Group, administered by Ferry Command, was formed at Gloucester, England.

In September 1941, the A.O.C.-in-C., Ferry Command invited Dr. K. E. Dowd, the Assistant Chief Medical Officer (A.C.M.O.) to the Canadian National Railway and Trans-Canada Airlines, to act in an advisory capacity to Ferry Command in connexion with medical problems. On review, the A.C.M.O. (later honorary Wing Commander, R.C.A.F.) found that there was not, and never had been, any organised medical service; he applied to the Director of Medical Services, R.C.A.F., for aid, and it was agreed that medical services should be provided at Dorval. Two R.C.A.F. medical officers and staff were accordingly attached to the Headquarters; an M.I. room, consulting room, two-bed ward, orderly room and waiting room were allocated in the Transit Hotel at Dorval (Dorval Inn), and the R.C.A.F. provided all medical supplies. Thus began the first organised medical service of Ferry Command; under the leadership of the A.C.M.O. the medical staff were able to introduce the systematic examination of all aircrew before acceptance, to catch up on the back-log of those who had had no previous medical examination, and to begin vaccinations and inoculations and the documentation of Service personnel.

On October 2, 1941, a Squadron Leader S.M.O. was appointed to H.Q. No. 44 Group. This Group was entirely new and was independent of any Command in the U.K., growing out of the Aircraft Despatch and Reception Centre at Kemble, whose sole function had been the preparation of aircraft for despatch to Gibraltar and Malta. Crews were found from outside this organisation.

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MEDICAL ORGANISATION AND ADMINISTRATION

HEADQUARTERS, FERRY COMMAND

On January 3, 1942, a R.A.F. medical officer was attached from the Empire Air Training Scheme to Dorval, and a proper sick quarters organisation came into being, carrying out all the necessary medical examinations of aircrew, sick parades, inoculations and R.C.A.F. documentation for Service personnel (previously all Service returns had been sent to Ottawa). Civilians employed at Dorval were given emergency and first-aid treatment when necessary, and arrangements were made for the treatment and hospitalisation of Service personnel under the Department of Pensions and National Health which meant, in effect, that cases were accepted by all the major hospitals in Montreal.

On May 31, 1942, a Wing Commander, R.A.F., arrived to take up the post of Principal Medical Officer, R.A.F. Ferry Command, and from that date, all R.C.A.F. personnel were gradually replaced by R.A.F. personnel and the medical organisation and administration became a R.A.F. responsibility.

At this stage it is appropriate to pay tribute to the A.C.M.O., who received grateful thanks for his services. During the twenty months that followed the posting in of a R.A.F. P.M.O. he was always ready with help and advice on what, at that time at least, seemed extremely difficult problems; furthermore, when subsequently removed from his position, which was virtually that of P.M.O. Ferry Command, he continued to be of the greatest assistance to the Command.

The transition stage from the organisation set up by the A.C.M.O. to that required by the R.A.F. was necessarily slow and was largely dependent on the replacement of R.C.A.F. by R.A.F. personnel. All the administration was centred in Dorval throughout the existence of Ferry Command. As the P.M.O. knew nothing of R.C.A.F. administration his first logical step was to visit the R.C.A.F. H.Q. at Ottawa and see the Canadian D.M.S.; at this meeting it was agreed that the R.A.F. would supply all the returns and documentation required by Ottawa for R.C.A.F. personnel, and arrangements were made for the preparation and despatch of returns required by Air Ministry for R.A.F. and Allied personnel; in addition, a scheme of documentation for civilian aircrew had to be devised, as large numbers of civilians from the U.S.A., Canada, Air Transport Auxiliary and even ex-R.A.F. were employed as aircrew and they all had to be medically examined to an A1B* standard. Thus, purely on the documentation side, the medical administration consisted of normal R.A.F. documentation for R.A.F. personnel, R.C.A.F. documentation for R.C.A.F. and that devised for civilian aircrew personnel. When the P.M.O. arrived from the United Kingdom

* Fit for full flying duties.

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he found that all medical personnel were attached on a purely temporary basis and to regularise such appointments the following establishment was drawn up and agreed to by the Air Ministry:

1 Wing Commander (Principal Medical Officer).
1 Squadron Leader (Senior Medical Officer, Dorval).
2 Flight Lieutenants.
1 Flight Sergeant (N.C.O. in charge of Station Sick Quarters, Dorval).
1 Sergeant, 2 Corporals (Laboratory Assistants).*
1 Corporal, 2 Aircraftmen (Clerks General Duties).
1 Aircraftman Nursing Orderly.

The above establishment was gradually filled during the summer of 1942 by postings from the United Kingdom; the medical staff was later increased by the addition of a civilian clerk and a flight sergeant, posted for duties in the P.M.O's. office.

Towards the end of 1942 an additional medical officer, a corporal and two orderlies were added to the establishment to man a small sick quarters at North Bay, an aerodrome some 300 miles north-west of Montreal, which was taken over as a School of Ferry Conversion to which all crews went before flying the Atlantic. One other corporal was posted to the flying-boat base on Darrell's Island, Bermuda.

Such was the medical organisation of Ferry Command overseas.

HEADQUARTERS, NO. 44 GROUP

In England, H.Q. No. 44 Group was formed at Gloucester on August 15, 1941, as an independent Group with its Command Headquarters in Montreal. The Group was originally the Overseas Air Movement Control Unit (O.A.M.C.U.) which was located in the same building as that taken over by H.Q. No. 44 Group and dissolved on the formation of the latter. This O.A.M.C.U. came into being in September 1940, the total staff consisting of about thirty officers and other ranks; its function was the control of incoming and outgoing aircraft on the Trans-atlantic and Middle East routes, and the despatching and briefing, by despatching parties located in the Unit, of crews and aircraft leaving the United Kingdom for Gibraltar, Malta and the Middle East, from various aerodromes such as Tangmere, Portreath and Harwell. Early in 1941, the O.A.M.C.U. took over R.A.F. Station, Kemble, and No. 1 Overseas Aircraft Preparation and Despatch Unit formed there.

* These three airmen were specially trained in oxygen equipment and decompression chamber work, at the request of the P.M.O.

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When the terms of reference of No. 44 Group were fairly clearly defined it was found to be responsible for the control of all aircraft on the Transatlantic and Middle East routes, a Control Unit being opened up at Prestwick to deal with the Transatlantic route and Gloucester Control Unit dealing with the Middle East route; it would undertake the preparation of aircraft for despatch overseas, the ferry training of crews and the despatch of crews and aircraft; lastly, it was responsible for checking and delivering to the Ministry of Aircraft Production all lend-lease aircraft coming from Montreal or Bermuda.

Between the formation of H.Q. No. 44 Group in August 1941 and March 1943, when Transport Command was formed in the United Kingdom and Ferry Command became No. 45 (A.T.) Group, No. 44 Group took over control of R.A.F. Stations, Doncaster, Filton, Hendon, Kemble, Lyneham, Nutts Corner, Prestwick and St. Mawgan and had lodger units at Portreath and Hurn. The O.A.M.C.U. had had no medical service of its own, being a lodger unit for that purpose on R.A.F. Station, Innsworth, and this arrangement continued until October 1941, when a Squadron Leader Senior Medical Officer was posted to Headquarters No. 44 Group.

Separate medical administration and organisation were set up immediately this appointment was made, all returns being rendered henceforth direct to Air Ministry. Some difficulty was experienced at first owing to Command Headquarters being at such a distance, but this was overcome by referring to the P.M.O. Flying Training Command, who was able to supply all the necessary policy letters, from which a medical memorandum was immediately prepared for the Group and issued to stations as they were taken over. In all other respects the administration was carried out as for any other Command or independent Group H.Q. Problems arose at various times, chiefly because of the inexperience of unit medical officers and their staff, but these were dealt with as they occurred; perhaps it was fortunate that the first S.M.O. of the Group and his successor had come straight from station medical officer posts and were well aware of the difficulty civilian medical officers were having in adapting themselves to Service life.

STAGING POSTS IN FERRY COMMAND

It must be reiterated here that the only reason for the formation of either Ferry Command or H.Q. No. 44 Group was the delivery of aircraft to theatres of war. In the case of Ferry Command, these were lend-lease aircraft which were brought from Montreal to the United Kingdom, and in that of No. 44 Group, aircraft were distributed to Gibraltar, Malta and the Middle East, and as far as India and Burma. The changing theatres of the war led to large-scale modifications of these

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operations; late in 1941 Ferry Command set up a base in Bermuda at Darrell's Island to deal with the delivery of Catalina aircraft and early in 1942 a southern delivery route was opened through Nassau, first of all at Oake's Field, and later at Windsor Field, where a complete ferry aircraft reception, preparation and despatch organisation came into being; the route was *via* Puerto Rico, Trinidad, British Guiana, Belem, Natal (Brazil) and Ascension Island, with final delivery at Accra. Some crews continued to deliver aircraft through Kano, Maiduguri, El Fasher and Khartoum to the Middle East and later, with the defeat of Rommel in the desert, Liberators were delivered from Montreal to the Azores and India. (*See* Map 1, Ferry Command routes.)

This meant that medical arrangements had to be made for the care of static personnel in staging posts along the southern route, in Bermuda, in the Azores, in Iceland, at Goose Bay (Labrador), at Gander (Newfoundland) and throughout the North American Continent wherever transit aircrews might go. The policy adopted was for the P.M.O. to visit as many of the staging posts as possible, usually in a delivery aircraft, and make the necessary arrangements by personal contact with the commanding officers and chief medical officers at the stations concerned. To illustrate the complexity of the problem and the number of different nations concerned, the following brief account is given of some of the arrangements made.

In Bermuda, there was one British corporal nursing orderly. It was agreed that the R.A.M.C. should carry out sick parades for aircrew, the Royal Navy accept hospital cases and the United States Naval Mobile Hospital (the nearest medical unit to Darrell's Island) would take emergency work; in Goose Bay and Gander the R.C.A.F. took care of all Ferry Command personnel in station hospitals; in Iceland, Nassau, the Azores, Accra, Takoradi and Freetown the R.A.F. medical services took over; at North Bay the Royal Canadian Army Medical Corps was responsible for hospitalisation, while down the southern route in Puerto Rico, British Guiana, Natal, Belem and Ascension Island the American Army Air Corps undertook complete medical care of Ferry personnel. Throughout the U.S.A., whichever Service was responsible for medical arrangements for a particular area undertook the care and hospitalisation of Ferry Command personnel. Thus, as Elizabeth City, where there was a Staging Post, was the responsibility of the American Navy, the latter took complete medical charge there.

At no time did the P.M.O. Ferry Command meet with the slightest difficulty in making these day-to-day medical arrangements, although, as far as the administrative side was concerned, there was considerable reluctance on the part of other nations and Services to fall in with the R.A.F. paper work and the P.M.O. decided that this should be simplified as far as possible; to this end, all that was demanded was a

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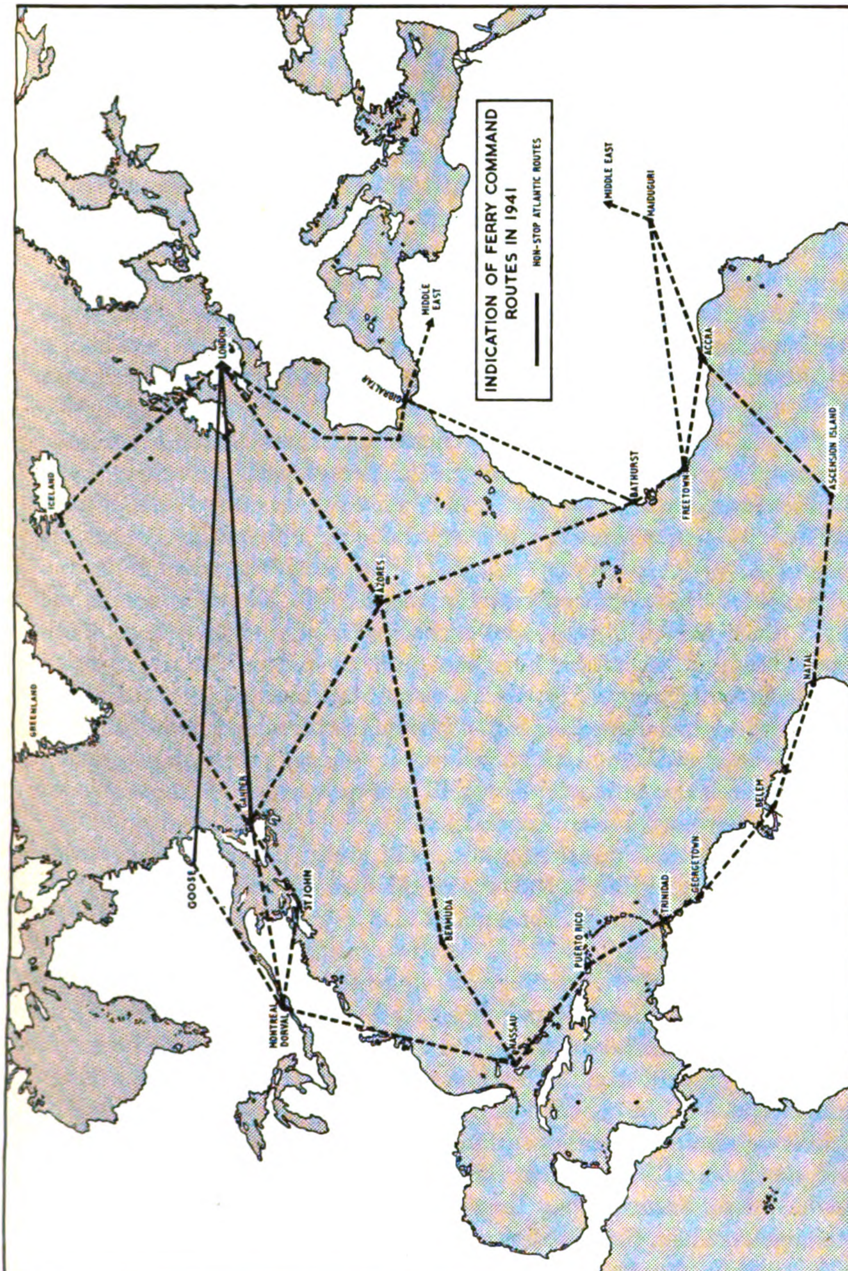

MAP 1. Indication of Ferry Command Routes in 1941.

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notification by signal to Ferry Command of any admission to hospital, stating name, diagnosis and probable length of warding; on discharge from hospital, personnel were to be returned to Montreal and a brief case history sent to the P.M.O.

In Africa, Egypt, Iraq and India, all stations to which Ferry personnel were likely to be sent had R.A.F. medical facilities and these organisations were in direct communication with Ferry Command. Generally speaking, this administration worked satisfactorily and throughout the existence of the Command there was no known instance of members of that Command failing to obtain adequate medical attention. There were occasions, however, when, from a documentary point of view, individuals became 'lost' and exhaustive enquiries had to be made concerning them; this was only to be expected in such a world-wide organisation, and certainly had no adverse effect on the overall efficiency of the Command.

The A.C.M.O. (now honorary Wing Commander, R.C.A.F.) assumed responsibility for the care of B.O.A.C. personnel and carried out all their examinations, while the R.A.F. medical services, for their part, assisted by undertaking normal station sick quarters treatment and care of B.O.A.C. personnel in the United Kingdom when requested. The closest liaison existed between the P.M.O. Ferry Command and the S.M.O. No. 44 Group, who exchanged visits, partly to resolve any administrative difficulties, but even more to discuss the physiological problems with which Ferry Command was faced on its formation. As in the United Kingdom, so at Dorval, lectures and demonstrations were given to civilian (static) personnel in first aid, air-raid precautions and other relevant subjects; first-aid posts were organised and equipped and stretcher parties were trained.

Such, in general, was the build-up and eventual medical organisation of Ferry Command up to the date of the formation of Transport Command and the former's consequent conversion into No. 45 (A.T.) Group in March 1943.

As a postscript to the above it is pointed out that although there were a large number of personnel based at Montreal and throughout the staging posts, there were also a large number of Service personnel who became known as 'one-trippers' or 'Refors crews'. These crews underwent a short conversion course and then, on posting, flew in delivery aircraft to their new units. Such personnel were true transients, and the medical branch was concerned merely with their day-to-day medical care, ensuring that they were fit and that they were properly inoculated. Their sick incidence was negligible. The majority of 'one-trippers' passed through Montreal to the United Kingdom direct from the Empire Air Training Scheme; they proved their worth and saved large sums of public money that would otherwise have been

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expended on the employment of permanent ferry crews who would have been required to maintain the same flow of aircraft deliveries.

MEDICAL PROBLEMS

On the formation of Ferry Command on July 20, 1941, flying the Atlantic had become relatively commonplace. Ferrying had been carried out by Canadian bush-pilots, barnstormers, Britons and members of the Commonwealth too old for operations, and by Americans interested in the Allied cause. These men flew under extremely adverse conditions. The first flight was completed on November 11, 1940, and from that date a steadily increasing stream of aircraft crossed the Atlantic. In those days of 1940 and early 1941 crossing the Atlantic was no easy task. Aids were limited, meteorological forecasting doubtful, and above all, during the winter, icing of wings and carburettors was an almost invariable occurrence. Such conditions tended to drive aircraft higher and higher into the safer upper air and, because of this, crews were faced with two basic physiological needs—oxygen and heating.

As has been previously stated, there was no medical supervision in the early days of ferrying and consequently little or no work had been carried out to make the aircraft physiologically safe. This situation, together with the fact that the majority of the crews had no conception of their own physiological requirements, and coupled with the diversity of types of oxygen and heating equipment in the delivery aircraft, combined to produce a most hazardous set of circumstances.

During 1941, increasing numbers of reports were received of air-crew 'passing out' (anoxic symptoms) in the air, of crews and passengers arriving at Prestwick with frostbite, and of aircraft having to descend to dangerous icing levels owing to shortage or complete exhaustion of oxygen.

To this oxygen and cold problem may be added the inauguration of the Return Ferry Service in March 1941. The original idea behind this Transatlantic passenger service was to return Ferry crews from the United Kingdom to Montreal quickly and avoid the enormous time-lag involved in a sea voyage. Such a plan created problems of long-distance and high altitude air travel, never before encountered, for both passengers and crew.

Because of the lack of information concerning, and absence of investigation into, the physiological problems of Transatlantic air travel, the Air Officer Commanding-in-Chief, Ferry Command, in September 1941 requested the A.C.M.O. to act in an advisory capacity to the Command in connexion with its problems. On reviewing the local situation, the A.C.M.O. found that he was faced with two tasks: firstly, to start a medical service and secondly, to deal with the physiological problems. In view of this he requested the Director of Medical Services,

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R.C.A.F., at Ottawa to supply a suitable staff, on a temporary basis, to the Command; this was agreed to, accommodation was found for a S.S.Q. at Dorval Inn, Dorval Airport, Montreal, and investigations began.

OXYGEN

The first and most serious problem demanding attention was the quantity of oxygen carried on the various aircraft. It was found that no one in the Command had any clear conception of the amount of oxygen required per person at given altitudes and that generally speaking the amount of oxygen carried by delivery aircraft was inadequate. In order that the problem could be dealt with at once, arrangements were made for the attachment of a South African doctor in the R.C.A.F., who had previously worked at the Clinical Investigation Unit, Toronto (the R.C.A.F. Research H.Q.) and was fully conversant with the subject of oxygen equipment, calibration of regulators and flowmeters. A technical sergeant was posted to assist this officer in his not inconsiderable task. The equipment in use was notorious for variety, and they had to check the calibration and sufficiency of oxygen in all outgoing aircraft; at this time the medical officer was the only person in the Command who was able to check the oxygen equipment satisfactorily, and it was incumbent on him to check personally the installations on all aircraft before departure; he was later assisted in this task by the two R.C.A.F. medical officers. Early in 1942, a special oxygen department was set up which reported direct to the Chief Technical Officer.

The best type of mask to be used was still under consideration and eventually the British 'G' type mask was adopted for all aircrew (*see* Aviation Medicine, Bomber Command, Chapter 1), while for passengers, the Canadian mask and canister type economiser was employed, this being considered to have the same characteristics as the British economiser, although twice as robust and only about one-quarter the price of the latter.

PHYSIOLOGICAL INSTRUCTIONS TO AIRCREW

Before the medical service to Ferry Command was inaugurated, neither aircrew nor passengers received any physiological 'briefing', which was first introduced early in 1942. All passengers were given a short lecture on the use of oxygen, the reasons for using it, the type of equipment installed, and the proper method of plugging in the oxygen line. This lecture was subsequently developed to include dinghy drill, parachute drill, emergency hatches, 'ditching' (*see* Plates XXXI to XXXIII), advice on behaviour during the twenty-four hours before take-off, emptying of fountain-pens, clearing of ears, etc. A briefing room was set aside for this purpose in Dorval Inn, and was provided,

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inter alia, with a 'wooden man' for demonstration of Mae Wests and parachutes, an oxygen mask fitting mirror, and also photographs of the Liberator emergency hatches—the Liberator being the passenger aircraft in use. Much of this briefing was non-physiological and certainly non-medical, but before the formation of Transport Command there was no one other than the medical staff competent to give such briefing. Passenger briefing was introduced at Prestwick at much the same time, when supervision of the B.O.A.C. aircraft oxygen installations was undertaken by the medical organisation at Headquarters, No. 44 Group.

As far as aircrew were concerned it was found that the majority of pilots had no clear conception of the effects of anoxia and the necessity for using oxygen at altitude, and considered that the use of oxygen was a sign of weakness. It was therefore deemed essential to lecture all aircrew on the physiological aspects of flight, with special reference to oxygen, and including a demonstration with a working model, in a cabinet, showing the various types of oxygen installations commonly in use. In addition, personnel were shown the R.C.A.F. oxygen film, in technicolour, and went through a decompression chamber, located at McGill University, Montreal. (This chamber, which was provided from funds made available by the National Research Council of Canada, was under the jurisdiction of Professor J. B. Collip, in charge of medical research at McGill University, but was loaned to Ferry Command whenever it was required.) All this instruction was eventually incorporated into the General Ground Training syllabus which had to be completed by all aircrew before they were permitted to ferry an aircraft.

By July 1942 the oxygen problem had been solved; the oxygen section was in full swing, certificates to the effect that the oxygen equipment on all departing aircraft was satisfactory were rendered to the Chief Technical Officer and the S.M.O. of the station, and there were no further serious complaints on this matter. The opening of other routes, to the Azores, and down the South Atlantic, created no new problems for oxygen equipment, and certainly no new oxygen problems.

With the settlement of this outstanding problem it became evident that the North Atlantic and world-wide ferrying and passenger service presented many other physiological and medical problems, and some of the ways in which they were dealt with are outlined in the following pages.

FLYING CLOTHING AND HEATING OF AIRCRAFT

During 1941 and well into 1942 heating for passengers in the Return Ferry Service Liberators presented a real difficulty, for although the problem of heating applied in some measure to all delivery aircraft,

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it only became acute when such aircraft carried passengers. This was because, in the majority of American aircraft being ferried to the United Kingdom, there was adequate provision of heating for the normal crew but nothing for supernumeraries, who were frequently carried in aircraft such as Hudsons, Venturas, and later, Liberators. Aircrew and passengers alike relied basically on flying clothing, but in draughty unheated aircraft this flying clothing (which consisted of a Sidcot flying suit—inner and outer—flying helmet, gauntlets and flying boots) was inadequate. In the delivery aircraft a variety of heating devices was in use—for example, Stewart Warner, glycol and hot air from exhaust mufflers. (*See* Problems of Aviation Medicine section of Bomber Command narrative.) In general these methods were adequate provided that no breakdown occurred, but failures were relatively frequent, if only for the fact that, if there was any smell of burning, the heating device was immediately suspect and the first reaction of the captain of the aircraft was to turn it off. When such delivery aircraft carried passengers, the latter were suitably briefed, warned to don additional underwear and issued with blankets as well as flying clothing; such measures, introduced in 1942, at least prevented cases of frostbite, although comfort was far from ensured.

The regular Return Ferry Passenger Service was, however, a different matter, and as this service expanded in late 1941 and during 1942, and increasing numbers of passengers were carried, it became imperative that some action should be taken. Ford's aircraft factory at Willow Run was approached to see whether modifications could be made to the Liberator to connect a pin-type muffle heater to the exhaust stacks of the inboard motors, so that the hot air would pass through the leading or trailing edge into the cockpit and so down the fuselage; the firm, however, stated that this was not possible. Meanwhile, in the autumn of 1942 the P.M.O. met, quite casually at Dorval, an American from the Alaska Highway and asked how people kept warm there; the American replied that they used Wood's Arctic Robes or sleeping bags, which were made in Montreal. The P.M.O. visited the firm concerned, borrowed one of these sleeping bags, and tested it on a Norwegian volunteer in the snow outside S.S.Q. for a night in sub-zero weather; the result being successful, he suggested to the A.O.C.-in-C. that the sleeping bags would probably provide the answer, at least for the time being, to the complaints on the Return Ferry Service; accordingly a number were obtained and tried out over the Atlantic under extremely cold conditions. The first experiments were very disappointing, until it was realised that the passenger Liberators were extremely draughty; mattresses were then placed in the aircraft, covered with blankets, pillows provided, and passengers placed head to toe in the passenger compartment. This solved, temporarily, the cold problem

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in the aircraft, and sufficient sleeping bags were obtained to provide for the whole of the Return Ferry Service, and also for passengers travelling in delivery aircraft.

Meanwhile, Scottish Aviation, who carried out all the modifications to Liberators destined for the Return Ferry Service, agreed to undertake the necessary modifications to utilise the exhaust heat, and the first aircraft was duly modified early in 1943. In the first instance, the exhaust heat from the inner port motor was employed, the hot air being passed down the port side of the fuselage, but on trial across the Atlantic, owing to the unlagged skin of the aircraft dissipating heat, it was found that those passengers on the port side were too hot, whilst those on the starboard side were eagerly grabbing the discarded clothing of their neighbours across the gangway. Once this drawback was rectified and all the aircraft were modified, the heating problem was solved in so far as the prevention of cold was concerned—in fact, complaints of being too hot became frequent! These complaints, however, had to be ignored. Throughout these investigations the executive and medical branches worked in the closest harmony and medical officers carried out frequent trial flights across the Atlantic during 1942 and 1943 to test the practicability of any new ideas conceived by either branch.

CRASH AND SURVIVAL

As soon as a medical service for Ferry Command was started the medical aspect of survival was another matter which had to be given prompt attention. Accidents within Ferry Command (including No. 44 Group) were fairly infrequent, and those that did occur usually fell into one of three categories—aircraft missing and never found, accident immediately fatal to all concerned, or accident on or near an aerodrome.

The system of issuing first-aid kits was overhauled and medical crash arrangements drawn up for Ferry Command stations at home and overseas. At Dorval and North Bay ambulances were fitted with two-way radios, while emergency equipment was held in the sick quarters at Dorval, so that a medical officer could be despatched at a moment's notice by air to the scene of a crash, although no arrangements were made for the parachuting of a medical team. As far as aircrew personnel themselves were concerned, their chief interest was naturally in their own emergency equipment and the medical staff and accident prevention branch combined in an effort to improve and standardise such equipment. The first move, late in 1942, was an attempt to persuade the American authorities to standardise their basic aircraft emergency equipment in the delivery aircraft with that of the R.A.F., but in practice this proved to be impossible and the equipment supplied with the aircraft had to be accepted. The survival equipment for the Return Ferry Service and Ferry Command Communication Squadron was

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standardised, however, and an attempt was made to design a personal pack; the finally selected packs were of two types—Arctic and Tropical—and differed chiefly in their water, heating and first-aid content; they were designed to fit on the knee, attached to the parachute harness, and a booklet giving hints on survival was included in the pack. Arctic kits were issued to all aircrew personnel on the North Atlantic route, and tropical kits to those on the Southern route (Nassau–Brazil–Africa). The design and production of this kit took some eighteen months, so that the packs were not in circulation until well into 1943.

In the United Kingdom, standardised emergency equipment, including first-aid materials, was installed in all aircraft and medical crash arrangements were the same as those at all R.A.F. aerodromes in the United Kingdom.

AIRCRAFT SANITATION

When dealing with passenger carrying aircraft, or for that matter, any aircraft likely to be airborne for a considerable number of hours at a time, it is essential to provide a urinal and a lavatory. This problem had already arisen in Bomber and Coastal Commands and applied to all aircraft in Ferry Command, although in the latter difficulties were increased by the fact that some types of aircraft, such as the Boston, Mitchell and Marauder, often airborne for six to eight hours, could only carry a urine tube. This problem automatically became a medical one, although there was unfortunately very little that could be done; as far as the fighter-bomber with long-range tanks was concerned, the only action that could be taken was to include a warning, in the series of lectures to aircrew, to ensure that both bladder and bowels were emptied before take-off. In the multi-passenger carrying aircraft the Elsan closet had to be employed and strict instructions issued to all staging posts within Ferry Command on the cleaning of such Elsans at any stop *en route*. These instructions were issued by the Passenger and Freight Section to all Ferry Command stations. It was found necessary, in 1942, to carry Elsan fluid in the aircraft, as this was unobtainable at many of the staging posts. In the passenger briefing, carried out by the medical officer, passengers were asked to use the Elsan as little as possible. The problem of plumbing for aircraft was never adequately solved during the life of Ferry Command, chiefly because the Liberator was never intended to be used as a passenger-carrying aircraft, and sealing and ventilation of the lavatory compartment was never satisfactory.

FOOD—BEFORE, DURING AND AFTER FLIGHT

When considering the question of food in flight it must be remembered that the Royal Air Force as a whole had never had to consider

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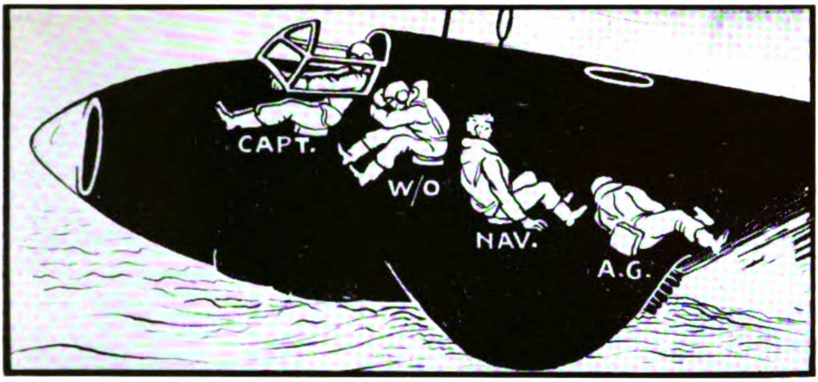

PLATE XXXI: Aircrew in Positions of Greatest Safety prior to 'Ditching'

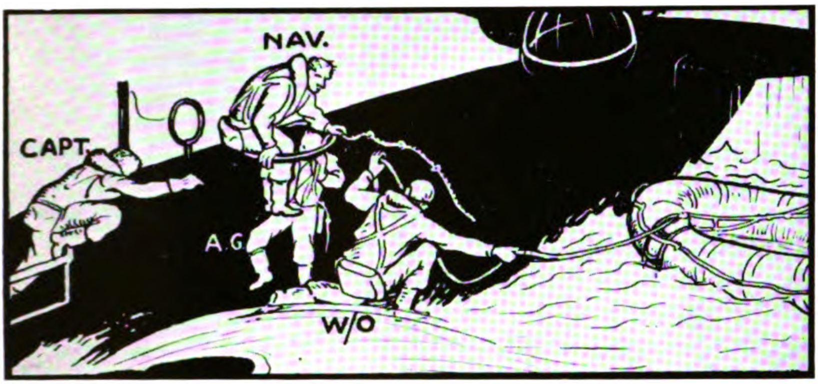

PLATE XXXII: Abandoning Aircraft. Note Dinghy still attached to the Aircraft by a Rope

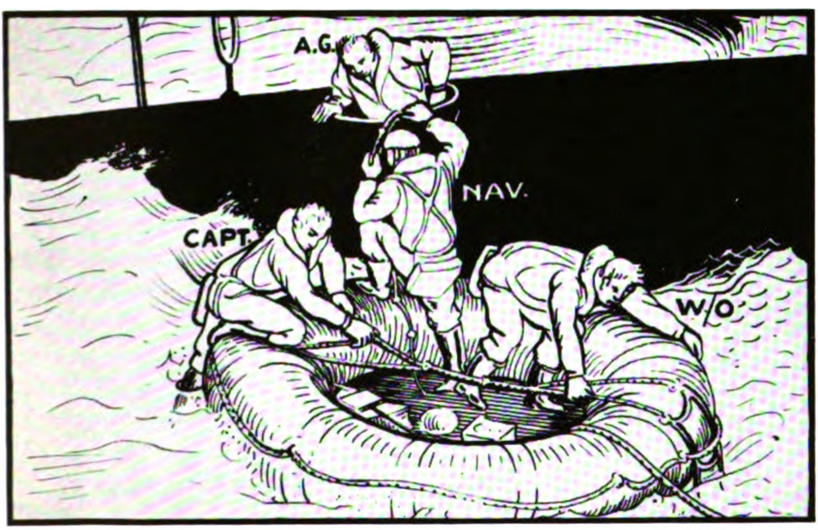

PLATE XXXIII: Taking up Positions in Dinghy

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the question of food in flight on the scale that was now necessary. Coastal Command carried and cooked their own rations in galleys aboard certain aircraft; Bomber Command could not afford either the space or the payload for such equipment (apart from the fire risk involved) and various attempts were made throughout the war years to solve the problem of providing a meal or meals in flight, but no entirely satisfactory solution was found. In pre-war air transport in the Royal Air Force, the question of meals during flight did not arise; flights were of short duration, usually between permanent stations, and crews and passengers alike carried their own rations, or not, as they wished. The respective messes provided pre-, post- and inter-flight meals as required, but it should be noted that the meals on the ground, in the messes, were the same for crews and passengers as for all members of the mess, which meant that personnel might fly all day, with stops at two- or three-hour intervals, reach their destination at tea-time, and therefore be given only tea on arrival.

With the crossing of the Atlantic as a regular occurrence and the opening up of the South Atlantic route, R.A.F. Air Transport underwent a complete metamorphosis, and feeding in flight and attention to meals before and after flight, became imperative. As far as aircrew were concerned this had an actual nutritional background, especially, as will be shown, on the South Atlantic route which was opened up as a delivery route with its own Return Ferry Service in mid-1942.

Delivery aircraft, as a general rule, carried long-range tanks, thus considerably increasing their range. A normal delivery trip across the North Atlantic consisted of a four- to six-hour flight from Montreal to Goose or Gander, six or eight hours from there to Iceland, and four hours more to the U.K., or eight or twelve hours direct from Goose or Gander to the U.K. depending on the type of aircraft. Crews usually arrived at Prestwick shortly before or soon after midday, handed over their aircraft, and might well be on the Return Ferry Service that night back to Montreal. Weather and serviceability permitting, the delivery flight was completed during the twenty-four-hour cycle. On the South Atlantic route from Nassau to Accra, taking a Dakota as an example, the times were: Nassau to Trinidad—8½ hours, Trinidad to Belem—8 hours, Belem to Natal—6½ hours, Natal to Ascension Island—8½ hours, the outward journey being completed in 5 days, and the return trip in 8 days. As 1942 progressed, many of the same crews were extending their delivery flights to Egypt and India.

Along both routes excellent arrangements existed for food on the ground; at Goose and Gander, and at most of the American stations, food was provided on the cafeteria system and at Prestwick on a restaurant principle with a round-the-clock service. The only *rationale* that could be adopted for food in flight was that of sandwiches, fruit

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and sweet pack-up with thermos flasks for fluids. As the above schedule shows, the delivery aircrews might fly daily for a week or more, starting each day after an early breakfast, and not landing till late afternoon, and throughout this time they would miss their normal meals. This type of cycle applied equally to No. 44 Group in the United Kingdom except that as a general rule ferrying to the Middle East and India was undertaken by personnel who were proceeding, on posting, to a particular theatre. For the regular ferry crews, the cycle was repeated after a short rest on return to Nassau or Montreal.

As far as the sandwich materials were concerned, supply was never a problem. Crews were asked to vote on their preference for sandwich fillings, and from this a list of contents for such sandwiches, in flight pack-ups, was drawn up. The P.M.O. and the Passenger and Freight Section found early in 1942 that complaints of aircrew personnel were not as a rule directed against the quality or quantity of the sandwiches, but rather against the inadequacy of packing or the type of pack used, resulting in the sandwich content becoming inedible at altitude, because of drying out. The P.M.O. accordingly visited the Clinical Investigation Unit of the R.C.A.F. at Toronto and asked that unit to investigate methods of packing sandwiches to prevent deterioration, using cold and decompression chambers for experimenting. Even with such assistance, however, results were never really satisfactory and the best that could be done was to seal the sandwiches, as far as possible, with greaseproof paper and cellophane wrappings, and to obtain suitable compartmented boxes of cardboard for the sandwiches. Although regulations were carefully laid down, even to the thickness of the bread slices to be used, it was found almost impossible to keep an adequate check on all the bases responsible for the preparation of pack-ups, and once an overall system had been agreed and instructions issued, complaints could usually be found on investigation to arise from faulty preparation, or to be due to shortage of boxes, greaseproof paper or cellophane wrappers. From the point of view of aircrew health, no case of dyspepsia or malnutrition was ever traced to inadequate feeding in the air.

In the United Kingdom, as far as No. 44 Group was concerned, early in 1942 this problem became centred largely round Prestwick and Lyneham; the Group was faced with a supply situation which served to increase the difficulties and the evolution of a standard type box was slow, little progress being made after the beginning of 1943.

The Return Ferry Service across the North Atlantic, down the South Atlantic route, and that of 5th Transport Squadron, U.S.A.A.F., formed at Lyneham late in 1941, offered a somewhat different problem in so far as both aircrew and passengers had to be catered for. On the South Atlantic route refrigerators (to carry rations for the return trip) and galleys were installed, but the latter were not a success, chiefly because

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there was no establishment for a cook-steward in these aircraft, and usually the flight-engineer had to 'cope' with the cooking. Passengers, however, were as a rule making a one-way journey only and the medical problem of feeding them in the air was therefore negligible. During 1942, various types of hot boxes were tried out, but these were not a success. Improvements in in-flight feeding were very gradual and experiments were still going on when Transport Command was formed. (For further information, *see* section on 'Feeding of Aircrews in Flight' in Coastal Command, Chapter 3.)

VACCINATION AND INOCULATION

Before the formation of an organised medical service little or nothing was done in Ferry Command about vaccination and inoculation. The civilian aircrews were advised to be vaccinated and inoculated against typhoid, but there was no compulsion; in the United Kingdom aircrews, who were all members of the R.A.F., were automatically vaccinated and inoculated with T.A.B. and tetanus toxoid. All aircrew of No. 1425 Flight, which late in 1941 was formed into No. 511 Long Distance Communication Squadron, were in addition inoculated against yellow fever, as this unit's routes touched Egypt and India; the regulations governing passengers on this route were laid down by Air Ministry, and would-be travellers were notified of the requirements by the Air Movements branch. Passengers were responsible for their own vaccination and inoculation and, as 1942 progressed, could be turned off aircraft or refused a passage if they could not produce certificates to the prescribed requirements. As experience was gained, a highly organised quarantine section came into being at Lyneham for the purpose of checking incoming and outgoing crews and passengers, and this system eventually became world-wide.

With the opening of the South Atlantic route and the routes across Africa to Cairo and India it was decided to inoculate all Ferry Command aircrew against typhoid, paratyphoid, tetanus and yellow fever, and to vaccinate them against smallpox. The reason for this policy, which became effective early in 1942, was that any of the permanent ferry crews were liable to be sent at a moment's notice to any area of operations. No special action was taken regarding passengers on the North Atlantic Return Ferry Service, and the crews of this service, who comprised B.O.A.C. and seconded R.A.F. personnel and were relatively static in that service, were vaccinated and inoculated with T.A.B. and tetanus toxoid only. Records of inoculations were kept in the usual way, each aircrew member being given a certificate showing the necessary details. That Ferry Command, including No. 44 Group, had no incidence of any of the diseases against which aircrews had been protected points to the efficiency of these precautionary measures.

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Crews on the South Atlantic route or travelling to India were given suppressive mepacrine and instructed to take one tablet a day on the trip and for fourteen days afterwards; consequently, crews on the South Atlantic route were on mepacrine virtually the whole time they were on this service. The incidence of malaria in the personnel of Ferry Command was very small, doubtless owing to these measures.

In addition to the arrangements which were made for inoculation and vaccination, all aircrew personnel were given a lecture on personal hygiene in the Tropics, and were issued with a pamphlet prepared in the P.M.O's. office giving advice on precautions to be taken to avoid contracting tropical diseases.

Aircraft Spraying. Aircraft spraying as a preventive measure against the carriage of disease by infected insects was never a problem in Ferry Command, for such spraying was carried out at individual stations according to the requirements of the country concerned and was therefore undertaken by personnel of these stations and not by Ferry Command staging post personnel. It was not until Transport Command was formed that a detailed organisation, to ensure adequate spraying of aircraft, came into being.

FATIGUE

The war-time Service C.O. of the Physiological Laboratory at Farnborough once stated that all aviation medicine was directed towards the prevention of fatigue, with its allied dangers, and that anything either directly or indirectly producing fatigue in aircrew automatically became a physiological problem and therefore one for the R.A.F. medical branch to investigate.

Between September 1941 and March 1943 the medical branch in Ferry Command and No. 44 Group put this into practice by dealing with oxygen problems, heating and clothing and feeding arrangements and by making recommendations about transit accommodation and allied subjects. One further matter which both the P.M.O. Ferry Command and the S.M.O. No. 44 Group endeavoured to deal with was that of acute fatigue in aircrew, due to continuous flying for long hours, and during 1942, in the course of their investigations, these officers undertook many long-distance flights across the North and South Atlantic and to Egypt in an attempt to assess their own reactions to such flights and the rest periods necessary.

An arbitrary ruling on a matter such as this is always the target for considerable criticism, because fatigue is an indefinite complaint and varies so much with each individual; it was therefore only after many experimental trips had been carried out by medical officers, and after large numbers of aircrew personnel had been asked for their opinions, that the Air Officer Commanding-in-Chief, Ferry Command,

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on the advice of the medical staff, issued regulations concerning the periods of rest to be taken by aircrew following a delivery flight and return.

The periods laid down were as follows:

(*a*) For a delivery flight across the North Atlantic—on return, three days off; fourth day—briefing; fifth day—start of next delivery flight.

(*b*) For a delivery on the South Atlantic route—on return, five days off; sixth day—briefing; seventh day, start of next delivery flight.

(*c*) For the Return Ferry Service—on completion of the double trip, five days off; after every three completed double trips, ten days off.

Headquarters No. 44 Group and No. 511 Squadron worked on similar lines.

These figures were adhered to as the minimum rest periods and the formula appeared to operate well, although very often bad weather, unserviceability of aircraft or other factors might result in the rest period becoming considerably longer.

By the introduction of these measures, chronic flying fatigue was avoided, although immediate rest was still the only effective remedy for acute flying fatigue.

TRANSIT FACILITIES

Ferry Command as a whole was well served in this respect. On the North Atlantic route excellent accommodation had been constructed at Goose and Gander, while Dorval Inn served transients at Dorval itself. Messing at these places was on cafeteria lines, and the food excellent. On the other hand, at Reykjavik, the R.A.F. Station in Iceland,* messing was indifferent, and remained so throughout the life of Ferry Command. At Prestwick, as its importance as a terminal airport increased, so the transit facilities improved, until in early 1943, good accommodation was available and an excellent restaurant was functioning. In Bermuda, a luxury hotel, the Belmont, was used, and on the Southern route, mostly American, all accommodation and food were extremely good. H.Q. No. 44 Group, with the exception of Prestwick, was not so fortunate, and the Senior Medical Officer spent a considerable amount of time trying to obtain improved transit facilities. This applied particularly to Lyneham which, during 1942, was gradually assuming a rôle in the despatch of aircraft to the Middle East similar

* *See* Coastal Command, Chapter 3, Iceland Section.

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to that already held by Dorval in the despatch of aircraft to the United Kingdom. The main fault at Lyneham lay in the overcrowding and underheating of sleeping accommodation and the equally poor messing facilities, and even after the war had ended this unit still presented a problem from the accommodation angle. Neither Ferry Command nor No. 44 Group had any control over conditions at staging posts on the routes to Middle East and India, which, in some instances, left much to be desired.

The S.M.O. No. 44 Group submitted detailed reports on all the stations within this Group from the time of its formation in 1941 until the formation of Transport Command in 1943, but although he drew attention to the deficiencies in transit accommodation and messing facilities, only minor improvements resulted. The difficulty lay in the order of priorities, and priority for this type of accommodation was quite rightly not high on the list; it was only later, after the formation of Transport Command, when Air Transport as opposed to Air Delivery became the important operational requirement, that transit accommodation and allied facilities were studied seriously and the necessary financial and works services priority obtained.

The importance of good transit accommodation for flying personnel cannot be stressed too strongly. Aircrew flying all day do suffer from acute fatigue at the end of the day, and a good night's sleep is essential for their own safety and that of their passengers and the aircraft they fly.

THE WOMEN'S AUXILIARY AIR FORCE

The small number of W.A.A.F. personnel in Ferry Command were all officers and presented no medical problems. They were stationed at Dorval, Bermuda, Elizabeth City, Gander and Nassau; at the first three of these places they drew living-out allowances and made their own accommodation arrangements, while at Gander and Nassau they lived in the Officers' Mess. In the United Kingdom, W.A.A.F. personnel were distributed throughout No. 44 Group as in other home units and did not undertake any specialised duties that were not carried out by women in other commands.

CASUALTY AIR EVACUATION

Occasionally special requests were received for Ferry Command to repatriate individuals and in all such instances the P.M.O. was consulted as to the advisability or otherwise of flying the patient, but the Command was never called upon to organise Casualty Air Evacuation on a large scale; it was not until some time after the formation of Transport Command that the need for a clear-cut policy in this matter became apparent.

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CONCLUSION

Ferry Command was in existence for only one year and ten months before Transport Command was formed, the transition being quite natural as air transport tended to become the major operational function of the Command. During the life of Ferry Command, the Medical Branch, starting with the R.C.A.F. under Wing Commander Dowd from September 1941 to June 1942 and from then to the formation of Transport Command under a P.M.O. with R.A.F. staff, had brought into being a medical administrative organisation which ensured that personnel of the Command and passengers received adequate medical attention in whatever part of the world they might find themselves.

On the administrative side, the P.M.O. at Montreal was notified from all parts of the world of sickness among Ferry Command personnel and the S.M.O. No. 44 Group had set up a similar organisation, although the majority of aircrew personnel delivering aircraft ceased to be his responsibility once they had left the United Kingdom.

In addition, the Medical Branch, with the assistance of the Institute of Aviation Medicine, Farnborough, and the Clinical Investigation Unit in Toronto, had played a major part in solving the oxygen problem for both delivery and passenger-carrying aircraft; had started a course for aircrew in the physiological aspects of flight; had made themselves responsible for the introduction of physiological briefing of passengers on long-distance and high-altitude flights and lastly, had given invaluable assistance in the investigation of problems of heating, food in flight, and the prevention of fatigue in aircrew.

In conclusion, therefore, it may be said that the Medical Branch of Ferry Command provided very practical proof of the fact that the work of a doctor in the R.A.F. consists of a great deal more than conducting sick parades and attending to the paper work connected with them. A doctor in Ferry Command had to be well acquainted with aircrew members and to understand and seek to solve all the problems connected with the duties of flying personnel, for without this knowledge and understanding he could not hope to fulfil adequately his function as an R.A.F. medical officer. This is perhaps the most important lesson to be learnt from this short medical history of Ferry Command.

Transport Command

FERRY Command was, as has been seen, established to meet the American requirements that lend-lease ferrying should be dealt with by a Service organisation. Its United Kingdom component, No. 44 Group, increasingly developed the additional rôle of organising and operating air transport services both within its own area and to other Commands overseas. No. 216 Group, M.E.A.F., established later to

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deal with the ferrying of lend-lease aircraft over the Southern Atlantic route, similarly initiated and developed an air transport rôle.

This was natural and inevitable. As the importance of this additional function grew, however, it called for co-ordination and control and Ferry Command, situated far from the main source of activities and with no power over No. 216 Group, was unable to exert this satisfactorily. It was therefore agreed to establish a formation in the United Kingdom to control all aspects of ferrying and air transport activities. Headquarters, Transport Command was formed in the London area on March 25, 1943, and was, after a short period at Bush House, accommodated at Harrow. A medical staff—initially a Group Captain Principal Medical Officer—was established on May 1, 1943.

The conception was of a global organisation handling and directing air transport throughout the world and providing, among other things, a series of air stations (known as staging posts) through which air transport would be operated on a standard system. This would ensure the most economical use of all available transport aircraft, with the maximum of efficiency and safety, while the Command would remain in a position to meet the operational requirements of tactical forces in the battle areas.

The scope and responsibilities of the newly formed Transport Command may be summarised as follows:

(*a*) Maintenance of a freight and passenger service to and from any area where Allied Forces might be disposed.

(*b*) Air transport support—i.e. carriage of paratroops and supplies, glider towing and casualty evacuation.

(*c*) Ferrying of replacement aircraft from the source of production to wherever they were required.

(*d*) Provision of an air taxi service for important personages who might require an aircraft to take them quickly and safely to any part of the world. (The most notable aircraft in this category was Liberator AL 504, which flew all classes of important personages, including the Prime Minister, but was finally lost with all hands off the Azores.)

(*e*) The operational conversion of aircrews to man the Command's aircraft and the provision of the necessary ground crews.

There were obvious problems to be faced: catering and sanitation for crews and passengers in the air and on the ground, security, immigration and customs control, health control as required by the International Sanitary Convention for Aerial Navigation, and the standards of medical fitness of crews and passengers were among the items requiring special consideration.

The varying rôles to be filled by the Command made specialised training of personnel and easy adaptation of aircraft a necessity, and

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this was insisted upon from the outset. As the result of high policy decisions, aircraft specifically designed for transport purposes were of American manufacture and had to be ferried to the United Kingdom or to other theatres of war; these were supplemented by the conversion to transport purposes of obsolete bomber types which, while naturally not as satisfactory as specially designed aircraft, were employed increasingly and served a useful purpose. A further difficulty was the large extent to which the Command had to make use of lodger unit facilities at home and overseas.* This produced administrative and operational complications which are referred to later.

FORMATION OF THE COMMAND

As was the common experience with newly formed Command Headquarters the initial medical establishment proved inadequate for the task involved. It was necessary to obtain additional clerical assistance and to make provision for the normal medical care of Headquarters personnel—a task which initially fell on the Principal Medical Officer as the only doctor available. The delay in the provision of a Warrant Officer Chief Clerk was a source of especial difficulty—this N.C.O. is the keystone of Headquarters' medical administration and should be available from the outset.

The completion of the initial office organisation took approximately one month and it was made abundantly clear during this period that it is a very bad principle to launch a formation of this nature with such a small nucleus establishment; possibly the most important lesson learnt was that the Warrant Officer Nursing Orderly, who is to be the P.M.O's. clerk of the future, should always be one of the first to be posted to a new formation, in order that he may be familiar with the office organisation from the start.

Medical Care of W.A.A.F. Personnel. A considerable number of W.A.A.F. personnel were on the strength of both the Headquarters unit and home stations in the Command, and it was necessary to cater for their welfare by appointing a Woman Medical Officer. The proposal that the latter should also undertake the duties of unit M.O. at Headquarters was approved and a suitable officer was posted in July 1943 to fill the dual appointment.

Dental Care. Before the formation of the Command the dental care of personnel in the area was supervised by the Inspecting Dental Officer of Maintenance Command. It was agreed that, in view of the small commitment at the time, this officer should undertake similar duties for the new Command, while unit dental work would be carried out by a

* The Command at its peak operated over 300 staging posts scattered throughout the world, including some on Royal Australian Air Force stations in Australia.

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dental officer stationed nearby at a balloon unit at Stanmore. This arrangement was left open to review.

DEVELOPMENT OF THE COMMAND

The absorption of Ferry Command (which then became known as No. 45 Air Transport Group), No. 44 Group and No. 216 Group* into the structure of Transport Command was undertaken with little difficulty. There were, as might be expected, some teething troubles due to the transfer of administration from the higher formations previously controlling these groups, but no major problems were encountered. No. 46 and No. 229 Groups were added to the Command early in 1944, the former to cater for transport demands on the Continent in connexion with operation 'Overlord' and the latter to handle the increasing commitments in India and Burma. No. 116 Wing (later No. 47 Group) was also formed in January 1944 to undertake the responsibilities associated with the scheduled passenger services on the long-distance trunk routes. No. 114 Wing was formed at the end of 1943 to take over the West African section of the Command.

Following this early organisation and expansion of the Command, further commitments demanded the formation, within the Groups, of many subsidiary Wings, which are discussed in other sections of this narrative. Decentralised Wing medical organisations were essential in maintaining an efficient and flexible service.

The further development of the Command Headquarters followed a course which might have been expected, in a formation expanding from a comparatively small complement into one of the most extensive Commands ever known in the Royal Air Force. Staffs of the various departments were increased as expansion took place, posts were up-graded and accommodation became strained to the limit. Before 'Overlord' it was found necessary to establish a second Flying Personnel Medical Officer to deal with the planning and organisation of Casualty Evacuation for that operation.

The post of Principal Medical Officer was up-graded to Air Commodore in March 1945 and shortly afterwards to Air Vice-Marshal.

FUNCTIONS OF THE COMMAND

These have already been outlined but it is useful, at this stage, to consider in more detail three groups of problems.

Firstly, the operation and maintenance of air passenger and freight services wherever they might be required. Included in this group were the long-distance airlines maintaining scheduled services between the United Kingdom and overseas; the internal airlines providing scheduled

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* *See* Map 2.

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Map 2. No. 216 Group Routes to June 30, 1943.

services within the United Kingdom and within the transport Groups (or independent Wings) overseas; the Air Ambulance Service in the United Kingdom, control of which was taken over from Coastal Command in 1944; and the Air Taxi Service for the use of V.I.Ps.

Secondly, the ferrying of replacement aircraft from the place of production to the Command overseas. These aircraft were flown along the routes used by the first group and use was made of the facilities provided for that group. Two sets of crews were employed—the regular ferry crews who remained with Transport Command, returning to their bases after they had completed delivery, and 'Refors' crews* or 'one trippers', as they were called in No. 45 Group, who were absorbed into the local commands as reinforcements on arrival at their destination.

Thirdly, the supply of air transport support for all three Services engaged in active operations against the enemy. This embraced glider towing, carriage of paratroops and supplies for dropping, maintenance of air freight and passenger services to the Tactical Forces which they were supporting and Casualty Air Evacuation. It should, perhaps, be mentioned that crews engaged in this branch of the Command's activities were more in contact with the enemy than were those in the first two groups, and medical officers were here liable to be presented with more acute examples of operational flying fatigue.

Trooping was a subdivision of the first group, being no more than the intensive operation of an airline between the concentration of troops and the new operational area. No large-scale trooping was undertaken until the end of the war with Japan, when previously prepared plans were put into operation to bring personnel due for early demobilisation back from S.E.A.C.; this involved the provision of extra aircraft—a difficult problem as it proved—and additions to the existing facilities at the staging posts along the trunk routes to deal with the increased flow.

GENERAL MEDICAL IMPLICATIONS

The problems surrounding the medical organisation of Transport Command can aptly be described by the term 'global'. There was no precedent for this type of formation wherein units, most of them small by ordinary R.A.F. standards, were scattered throughout the world. Also, as stated earlier, any scheme of control inevitably cut across that of the local commands who nevertheless, because of their responsibility for day-to-day matters in their own particular area, had to be provided with information concerning the Transport Command units

* 'Refors' crews flying operational aircraft such as Beaufighters normally flew in daylight and were, of course, fully armed, as they occasionally met enemy opposition when crossing the Bay of Biscay *en route* for Gibraltar or Rabat.

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which had been opened within the area. This requirement was comparatively easy to meet, as most local commands were content to receive copies of various returns, reports, etc., in which they were specially interested, but many unavoidable difficulties were created by the fact that the majority of this very large number of units were 'lodgers' on units of the local Command. One such problem arose out of the variation of living standards among the many units. Most of the commands through which the air lines were operated were living under strict active service conditions, but, in Transport Command, when passengers were deplaned during servicing and refuelling, they needed facilities such as canteens serving good, clean food, adequate cloakroom accommodation, rest-rooms and bedrooms or dormitories for overnight halts. If these facilities were not available (and many units did not have them until late in the war) considerable criticism was received, the blame being placed on Transport Command.

It was even more necessary that adequate provision should be made for the aircrews engaged in transport operations, for these highly trained personnel were flying valuable aircraft in short supply and carrying passengers and precious freight; all of these would be endangered if, through insufficient rest or unsuitable food, the crews were unfit for maximum effort; the Command therefore endeavoured to secure for flying personnel the best of whatever facilities were available, including good rooms, comfortable beds and well-prepared food.

DUAL CONTROL AND DECENTRALISATION

With the exception of No. 45 (A.T.) Group in Canada and the transport units in the United Kingdom, there was a system of dual control which placed the responsibility for day-to-day administration on the local commands whilst Transport Command was responsible, through Groups or independent Wings, for everything else. In the larger Groups further delegation of control to subsidiary Wings became necessary, as, for example, in No. 216 Group where all detailed control was passed to the Wings (Nos. 115, 151, 249, 282 and 284) early in 1944. Under the resultant medical organisation, the P.M.O. Transport Command was represented in each area by the S.M.O. of the appropriate Transport Group, the latter being represented by the S.M.O. of the subsidiary Wing if further decentralisation had taken place. The S.M.Os., while acting for the P.M.O. Transport Command, were also answerable to the Competent Medical Authority of the area on any matters which came within the latter's sphere of responsibility and it was therefore essential that they should maintain full and free liaison with the local P.M.Os. or S.M.Os., as the case might be, supplying them with all the information they required and taking every step in their power to implement the general local health policy.

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For the most part these arrangements worked satisfactorily, although, as might be expected in such a large organisation, there were exceptions. The idea of two independent command organisations existing and operating side by side overseas was completely new, and in some instances transport units were regarded at first as interlopers, local commanders-in-chief and their subordinates resenting the infiltration into their areas of formations controlled from the United Kingdom. Headquarters Transport Command, however, insisted that without such control of its staging posts an efficient air transport organisation would be impossible.

MEDICAL RETURNS

It will be appreciated that the very nature of Transport Command's activities made it essential that the P.M.O. and his staff officers should be provided with accurate, up-to-date information, and to ensure this a weekly summary of sickness was introduced and a rigid policy laid down for the rendition of the monthly narrative (Form 540). The weekly sickness summary, which was forwarded direct by the unit medical officer to the P.M.O., with copies to S.M.O. Group and, where applicable, to S.M.O. Wing, not only gave vital information concerning the types of sickness and the details of personnel on the unit, but also included sections where the medical officer could report briefly on various medical matters affecting the station; while another section required the medical officer to report on any officer of the rank of Wing Commander or above who became non-effective.

Forms 540 were forwarded by units to wings or groups as appropriate and here they were consolidated for the Medical Historical Branch at Air Ministry, a copy being sent to the P.M.O. At all levels medical officers compiling these narratives were urged to include too much detail rather than too little and to make liberal use of important papers, reports and minutes in the appendices. There is no doubt that these reports provided S.M.Os. and the P.M.O. with very useful information on which it was often possible to take immediate positive action; they also did much to ensure a uniform approach to the numerous problems met at various staff levels.

ESTABLISHMENTS

The question of establishments caused little difficulty in units stationed in the United Kingdom, where the Command dealt direct with the Air Ministry, or in No. 45 Group, where few alterations were necessary. Elsewhere problems arose continually, as all queries had to be raised by the controlling Group or independent Wing with the local Establishments Committee and the latter, unless specifically directed

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by the Air Ministry, were autonomous in their own area and were governed by a rigid code of rules.

In the medical branch this often resulted in posts being established in ranks lower than would have been acceptable in other commands, and although this did not usually lead to inefficiency, many officers were placed at a disadvantage when dealing with their opposite numbers in other Commands.

POSTINGS AND MOVEMENTS

Medical Officers. The postings and movements of medical officers throughout the Command were controlled by the S.P.S.O., acting on the advice of the P.M.O., which meant in effect that the P.M.O. Transport Command had power to move a medical officer to or from any part of the world, irrespective of the regulations normally governing tours of duty in the area concerned; such postings, however, although relatively simple, were the exception rather than the rule, the general policy being to adhere to the normal system of overseas tours and to leave an officer in the Group to which he was originally posted until he was due home tour-expired.

It will be appreciated that indiscriminate use of the P.M.O's. exceptional powers would have led to discontent among medical officers of other Commands, but there were occasions when its use was fully justified and a great asset, especially in reinforcing weak points—as for example when the Deputy S.M.O. of No. 216 Group was moved to No. 229 Group in order to assist the hard-pressed S.M.O. there in organising Casualty Air Evacuation in the Burma theatre.

Airmen (Medical). Arrangements for the movement and posting of airmen overseas (except to Canada) differed slightly from those for officers, all postings to Transport Command units being included in block postings to the local Command; thus, Groups notified their requirements to the B.P.S.O. of the local Command and he made the necessary demand for reinforcements on the R.A.F. Record Office in England. On paper this may appear to have been an excellent arrangement but in practice it was often found that transport units received only those personnel who, when they arrived, were surplus to the requirements of the local Command at that time, and the insistent demands of the latter, together with the rapid rate of expansion of Transport Command, made it impossible for the B.P.S.O. and the R.A.F. Record Office to keep pace with the ever-increasing establishments of transport units.

The S.M.Os. of Groups and Independent Wings controlled airmen personnel within their own sphere of activity but in the interests of the airmen's careers arrangements were made whereby opportunities for promotion were pooled with those of the local Command. Thus, by

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friendly liaison with the P.M.O. of the local Command it was often possible to exchange airmen in order that acting promotions could be awarded, other things being equal, in order of seniority. This was quite an important point in view of the feeling, at least in the early days, that promotion prospects for those serving in Transport Command were more favourable than for personnel in the local commands.

PROBLEMS INVOLVED IN PROVIDING MEDICAL COVER

In dealing with the policy governing medical staffing of Transport Command, it is well to draw attention to the fact that the staging posts far outnumbered the other formations and provided problems which were peculiar to the Command.

Possibly the best way of describing the staging post system is to liken the airlines of Transport Command to the British railways. There were small stations, called minor staging posts, where the larger transport aircraft did not normally land but which had to be maintained for the refuelling of small short-range aircraft; larger stations, or major staging posts, at which the majority of aircraft stopped to refuel, and the very big terminal stations known as terminal staging posts which, as the name implies, were the end of a section. In addition there were a number of small mobile formations denominated Aircraft Despatch and Reception Units (A.D.R.Us.) which were designed to follow the line of advance in the battle area and which, in the early days of the war, undertook the evacuation of casualties.

The permanent establishment of these staging posts varied from about 20–30 personnel at the smallest to over 2,000 at the largest; the problem of medical cover in the former was complicated by the fact that it was never possible to predict when the number at a particular post might be increased by personnel staying overnight because of aircraft failure or unfavourable weather—quite apart from crashes on landing or take-off.

It was quite obvious that most staging posts required one or more medical officers and a nursing orderly staff commensurate with the size and importance of the individual post; this policy was followed and, except in the very small posts, at least one medical officer was established. At the units which were too small to justify a medical officer post an experienced nursing orderly was established and every effort was made to see that the medical officer from the controlling Group made regular and frequent visits. Where a medical officer was stationed within reasonable distance arrangements were made to use his services. Wherever possible two nursing orderlies were posted to allow of reliefs. In many instances, however, a single nursing orderly had to carry out the duties involved to the best of his ability. With the small numbers of personnel on these units the likelihood of serious incident was slight ;

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nevertheless these men carried a considerable responsibility and it is greatly to their credit that, in the main, it was admirably discharged.

MEDICAL RESPONSIBILITY OF THE R.A.F. TO B.O.A.C.

Before leaving the subject of medical organisation, mention must be made of the Command's relationship to the British Overseas Airways Corporation (B.O.A.C.) as defined in a 'White Paper' issued during the first half of 1943. In general this provided for a system of mutual aid, but although this may have been possible in 1943, in the later years of the war Transport Command had outgrown B.O.A.C. to such a large extent that the aid was almost invariably supplied from R.A.F. sources.

The first medical difficulty arose over the seconding of aircrews to B.O.A.C. from Transport Command (which at that time was the only source of supply), for these personnel were still members of the Royal Air Force and the P.M.O. Transport Command retained full responsibility for their medical welfare and administration; Royal Air Force Station Filton (primarily occupied by seconded crews) was accordingly selected as their base unit for R.A.F. purposes and the S.M.O. of that station was made responsible for their medical documentation. The difficulties with which this unfortunate officer had to contend may well be imagined. In spite of every possible effort to impress upon seconded aircrew that in the event of illness they should report to a R.A.F. medical officer, individuals persisted in consulting civilian medical practitioners, sometimes because a R.A.F. medical officer was not readily available, but more often because the alternative course was less trouble; when sick aircrew did report to R.A.F. medical officers little difficulty was experienced, except that it was not always realised that the patient belonged to Filton, but where a C.M.P. was involved documentation unavoidably became complicated, inaccurate and slow.

Arrangements were made with B.O.A.C. for their local managers or station superintendents to notify cases of sickness to Filton, preferably on Form 41 (case history), but in practice it was often found that the forms were not received or that they arrived a considerable time after the occurrence. The major problem was to ensure, particularly in the instance of those falling sick at B.O.A.C. stations miles distant from a R.A.F. establishment, that all patients were seen by a R.A.F. medical officer at the end of their period of non-effectiveness in order that, if necessary, a properly constituted medical board could be held; in certain circumstances even this requirement had to be waived, but always and without exception a certificate from a recognised medical practitioner was insisted upon and regarded as valid until the holder reached the nearest R.A.F. station where a suitable examination could be arranged. As might have been expected the worst area in this respect was in and

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around Bristol, where large numbers of aircrew personnel were located as they were passing through R.A.F. Station Whitchurch (a satellite of Filton, though in effect a B.O.A.C. aerodrome). It was unfortunate that no R.A.F. medical orderly was attached to this station to ensure that correct documentation was carried out, as this would have lightened the load of the S.M.O. Filton.

Turning briefly to the general medical arrangements of B.O.A.C., it will be realised that the Corporation had extreme difficulty during the war in providing its staff and employees with adequate medical attention and the R.A.F. therefore made available all possible amenities. A very happy and pleasant liaison was maintained throughout the war years between the P.M.O. Transport Command and the Chief Medical Officer B.O.A.C. and through a mutual understanding of each other's problems it was possible to remedy any difficulties amicably and promptly.

GENERAL ACCOMMODATION

Accommodation problems generally within the Command were similar to those of other commands and have been dealt with at length in the first volume of this History; it is therefore proposed to mention here only those problems specifically affecting Transport Command and these are outlined briefly in the following paragraphs.

In the United Kingdom and other areas where transport units were well-established, apart from a certain amount of overcrowding, the main problem arose from the use of airfields which were often not only in a poor state of repair but also basically unsuitable for transport purposes, lacking any specialised facilities for the handling of passengers and freight. On the other hand, for lodger units on stations of other commands, particularly overseas, accommodation was a very real problem; usually only the quarters not required by the parent stations were made available and commanding officers, especially of staging posts, had great difficulty in maintaining reasonable standards.

Stations in the Persian Gulf presented special problems arising from their isolation and the effects of the climate; two examples are given to illustrate the main points and the lessons learnt. In September 1943 the S.M.O. No. 216 Group reported that, in the previous two months, eighty-eight airmen out of the one hundred and fourteen stationed at Bahrein had been admitted to hospital, this high rate of sickness being in large measure due to the excessive heat and high humidity during the four worst months of the hot season (roughly May to August inclusive) and the lack of cool quarters; it was consequently decided that suitable air-conditioning, at least for the sleeping quarters, was necessary and a plant was installed at the end of 1943. In the hot season of 1944, however, the airmen complained that the plant was not

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functioning effectively and most of them continued to sleep in the old *barusti** huts. When a staff inspection of the plant was carried out, the air in the huts was found to be musty and stale and further alterations were put in hand. Conditions at Sharjah, another station with similar climatic conditions, were found to be, if anything, worse, but air-conditioning was not installed until later, as the necessary plant was in very short supply during this period of the war and priority was quite rightly given to hospital wards.

The lesson to be learnt from these two stations and others in similar climates is, that efficient air-conditioning of living and sleeping quarters is essential if wastage of man-power is to be avoided.

SICK QUARTERS AND HOSPITALS

Immediate medical cover in the Command was provided by station sick quarters, but when hospital treatment was required, arrangements were made for patients to be accepted by other commands, as no hospitals were administered by Transport Command. When transfer to hospital was necessary, evacuation was in most instances comparatively easy, but the problems presented at some of the small, very isolated units were considerable and might have had serious results if evacuation by air had not been carried out.

Sick quarters at home were equipped, whenever possible, to the normal scale for the United Kingdom, but elsewhere the policy was to provide beds on a basis of 3 per cent. of establishment, while it was endeavoured to obtain the use of a similar proportion of beds for lodger units on stations of other commands. Throughout the war years, however, this standard was seldom reached or else it was achieved too late to be of use, as happened, for instance, at the eastern end of the North Africa route, from Biskra to Rabat. Here, by the time that good sick quarters became available, the tide of war had caused the virtual abandonment of the route in favour of that across France.

Perhaps the most interesting development of sick quarters in Transport Command was in connexion with the trunk route to India, which, as has already been mentioned (*see* 'Functions of the Command') was used for a large scale trooping operation from India to the United Kingdom at the end of hostilities. Originally it was planned to move, at the peak of the operation, some 35,000 troops each month in approximately 600 aircraft of different types, but this figure was never attained owing to lack of aircraft and the unsuitability of many of those which were available. In addition to this flow it was expected that Transport Command would be responsible for part, or the whole, of the invalid traffic from India, for which the total figures for all three Services were

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* Native type.

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estimated at approximately 1,600 per month in 1945, increasing in 1946 to approximately 3,000 per month—a daily flow of between 50 and 100 personnel.

From these figures it will be readily appreciated that the provision of adequate sick quarters accommodation, not only for personnel staffing the staging posts but also for transient personnel and invalids, was a vital necessity, even though it was probable that the vast majority of the latter would be able to use specially reserved ordinary transit accommodation. There was also the problem of providing facilities for victims of aircraft crashes which, with the anticipated increase of aircraft movements through the various staging posts, might be expected to occur and might involve comparatively large numbers of personnel at the same time.

The main area affected by this requirement was that administered by No. 216 Group in the Middle East, where, from the very earliest days of the opening up of the trunk route across North Africa, the S.M.O. had been pressing for sick quarters at the various staging posts to be brought up to scale, not only in those areas from which the enemy had recently been cleared but also in the eastern half of the Group's domain. In view of the probable heavy increase in traffic with which these posts would have to deal, the P.M.O. Transport Command held a conference in February 1944, at which it was decided to redouble efforts to bring existing sick quarters up to scale and to endeavour to secure additional accommodation for officers, women and isolation cases. It was also decided that each sick quarters would need an additional room, over and above those required on the 3 per cent. basis, in which eight stretchers could be placed on trestles and which would serve as an emergency crashroom or as temporary accommodation for stretcher cases awaiting treatment and sorting. By June of that year the S.M.O. No. 216 Group, in conjunction with the Group's Works Adviser, had evolved a suitable plan for all staging post sick quarters and had reached agreement in principle with the P.M.O. of M.A.A.F.

There was still, however, little development, partly owing to the low priority allotted to the work in view of commitments in Germany but also owing to some lack of clear direction by Air Ministry to the local commands. The latter problem was finally resolved by H.Q. Transport Command approaching Air Ministry, who in July 1944 promulgated to H.Q.'s M.A.A.F., M.E. and A.C.S.E.A. definite instructions concerning the medical facilities required (*See* Appendix A); this order not only hastened action on the project but also helped to remove certain difficulties with local commands.

Lessons learnt from the Rabat Sale Sick Quarters. After the victory in North Africa and the return of the aircraft from the Far East to the North African route, which had been closed since the fall of France in

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1940, Rabat Sale rapidly became a very important staging post and by 1943 practically all aircraft passed through there *en route* from the United Kingdom. Later, with the opening up of the staging post in the Azores, Rabat Sale also received traffic from the American Continent. This resulted in a large increase in both permanent personnel and transients and by early 1944 the former had exceeded 2,000.*

To meet the medical requirements of this fluctuating population there was only a poorly designed sick quarters with a capacity of twelve beds, while the nearest hospital was at Casablanca some 60 miles distant, although in emergency two Service hospitals, at Gibraltar (R.A.M.C.) and Algiers (R.A.F.) respectively, could be reached by air. Expansion had in fact outrun facilities almost to danger point. The S.M.O. of No. 216 Group submitted a report suggesting that the need could best be met by the provision of a 60-bedded hospital equipped with a small laboratory and X-ray plant and other facilities. He further pointed out that under the existing arrangement patients who were flown from the East in comfort were then taken to Casablanca over 60 miles of rough road, thus losing any benefit gained by air transport; similar discomfort was experienced by station personnel who required hospital treatment. Headquarters M.A.A.F., however, which administered works services for the area, did not share the view that a hospital of the proposed size was necessary, the opinion being that Rabat Sale was a dying commitment and that the facilities offered by the 56th U.S. Hospital at Casablanca were adequate in the circumstances. After considerable discussion a compromise was reached and in September 1944 building commenced on a 30-bedded hospital which would be capable of rapid expansion to 60 beds if the need should arise; the target date for completion was December of the same year but it was finally opened in March 1945.

As it happened, subsequent events, governed largely by the sudden capitulation of Japan, proved Headquarters M.A.A.F. to have been correct and Rabat was gradually reduced to a small staging post, practically all air traffic now taking the shorter route across France. Thus the new station sick quarters became ready to receive patients some twelve months after it was required, and almost at the same time the need for its services ceased to exist. Much may be learnt from this incident, however, the chief lessons being that treatment for the sick must keep pace with all other station facilities and that the question of medical attention at isolated staging posts such as Rabat should receive

* As late as January 1945, the Administrative Plans section at Transport Command Headquarters forecast that there would be a monthly flow through Rabat, in Stage II (i.e. after the defeat of Germany and transfer of effort to the Japanese theatre), of 750 aircraft, all making transient stops. This would mean a continuous station population of approximately 1,500.

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special consideration, provision being made not only for the permanent personnel but also for transients passing through each day. In transport work and planning the 'Pubit'* should never be forgotten. He, or she, is just as likely to fall sick as a member of the permanent staff, but, unlike the latter, is not shown on the establishment and therefore, in theory, is not provided with medical cover under existing scales.

MEDICAL AND ALLIED PROBLEMS

OXYGEN AND ANOXIA

The dangers of anoxia and the principles of the use of oxygen to combat its effect during flight have been dealt with fully in the 'Problems of Aviation Medicine' section of the Bomber Command narrative and it is therefore proposed to refer here only to those problems which were peculiar to Ferry and Transport Commands.

The whole question of oxygen and anoxia had received close attention from Ferry Command and it was relatively simple to ensure that this important aspect of flying was kept continually in the foreground by all concerned in the operation of Transport Command aircraft. Fortunately, by the time Transport Command was formed the majority of ferry crews were 'oxygen conscious' while those who entered the Command on its formation had either had operational experience or received a good grounding during their flying and operational training; there were, as always, a few sceptics but efforts were made to place them where they could not influence the younger and more enlightened crews.

In approaching the problems of oxygen instruction it was realised that the most suitable place for this was the Operational Training Units and accordingly lectures, given by S.M.Os. and later F.P.M.Os., and film demonstrations were arranged within the routine training syllabus. Practical demonstration was by far the most dramatic and effective method of teaching, but unfortunately Transport Command did not possess a decompression chamber, nor was Air Ministry able to allocate one for the exclusive use of the Command; by arrangement with other commands, however, it was possible to include such a demonstration and ensure that each pupil experienced at least one 'run' in the decompression chamber.

The course at ferry training units was very short, lasting only 2–3 weeks, and little more could be done than ensure that crews were familiar with the type of aircraft they were to ferry; it was possible, however, to organise for each course two brief lectures, each of one hour's duration, on medical aspects of transport work.

Thus by various means crews graduating to passenger-carrying aircraft were made aware of the dangers and implications of anoxia and

* During the war an American at a staging post, when asked what he was doing, replied quite casually 'I am a PUBIT—a poor unwanted blighter in transit'.

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became competent to deal with them on their own behalf and that of their passengers. Nevertheless the oxygen equipment of the aircraft was always a matter of considerable concern and constant vigilance was necessary, because the apparatus was used so little that it tended to deteriorate or become unserviceable.

It was officially laid down that passengers were to conform to the same rules as aircrew with regard to oxygen technique, but it was difficult to enforce this policy at low oxygen heights such as below 15,000 ft., which was, generally speaking, as high as most of the aircraft flew. Nevertheless there were occasions when oxygen was absolutely essential and then it was available as a routine. One instance of note arose when a passenger on a B.O.A.C. ferry aircraft travelling from Russia to Prestwick refused to take oxygen and, as a result, caused many anxious moments to the crew by alternately collapsing and exhibiting fits of violence on 'coming round' after the administration of oxygen through the standard mask; this cycle of events was repeated six times during the flight.

Oxygen Equipment. The policy that British oxygen masks and economisers should be used in all aircraft of the Command, as being more satisfactory than the American mask which operated on the 'demand' system, necessitated the modification of all aircraft received from American sources; at times the shortage of vital materials and of manpower resulted in very little attention being paid to the installations for passengers in these aircraft or in the converted bomber aircraft which were pressed into service towards the end of hostilities. Although this state of affairs was unavoidable, and while it was realised that during warfare some risks must be taken, the problem was a serious one, as flight plans could not be altered to cater for those passengers who were not supplied with oxygen.

Another problem of interest was the method by which oxygen equipment was installed in ordinary transport aircraft where passenger seats were usually removable and in some instances of the 'nesting' type; it had always been possible to stow the passengers' oxygen equipment, including the Mark II economiser, in pockets under the seats but with the introduction of the 'nesting' type of seat no such stowage was practicable and the equipment had to be stored in any convenient free space, much of it becoming damaged and unserviceable. Although representation was made to Air Ministry in September 1944, no solution to this problem was found.

HEATING AND COOLING OF AIRCRAFT

Throughout the war period, problems relating to the heating of aircraft were very similar to those already described in the Ferry Command narrative. Heating arrangements were unsatisfactory in all types of

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aircraft except those specially designed for the carriage of passengers and even in some of the latter difficulties were encountered, as in the Dakota, where, if the passengers were kept reasonably warm, the crew were subject to gross over-heating. When the Command was required to use obsolescent bomber aircraft, such as Stirlings and Halifaxes, for passenger flying, the only possible way of overcoming heating problems was for passengers to wear full flying clothing, as had been done in the early days of the Atlantic Ferry. There arose the difficulty of maintaining everywhere sufficient stocks of flying clothing. The most satisfactory solution would have been the provision of electrically heated sleeping bags but this was impossible as the aircraft electric installation would not have been able to supply the necessary power.

The cooling of aircraft and their passengers presented an equal and insoluble problem in tropical countries. Temperatures inside an aircraft exposed to the full tropical sun quickly rose to very high levels and although these fell rapidly after take-off, severe and possibly dangerous discomfort could be caused during the period between loading and take-off.* Cooling apparatus was being investigated at the end of the war but nothing concrete had been evolved and passengers and crew had to accept the conditions.

SURVIVAL

The problem of survival after forced landings or crashes was more complex in Transport Command than elsewhere in the Royal Air Force. This was mainly due to the fact that transport aircraft might be called upon to fly, in the same trip, in conditions ranging from arctic cold to tropical heat and over vastly different types of terrain and also that they usually carried more personnel than did aircraft of other commands.

The medical 'survival' equipment was in most instances based on the normal First-Aid Aircraft Outfit (Scale 9/c 1. A.P. 132) although in larger aircraft, including those on trooping duties, a Scale 9/c 3 First-Aid Outfit (weighing 55 lb.) was carried. This equipment, with slight alterations to suit individual areas, was found to be satisfactory.

The main problem was to prevent this emergency equipment from being used for trivial ailments, as the kits were frequently found, on inspection, to have been rifled of their contents and thereby rendered useless for emergency purposes. To deal with this, a closer system of checking was instituted and a small first-aid kit, known as the 'Daily Use' (9/c 2) outfit, was provided to meet day to day requirements of such items as bandages, aspirins and air sickness tablets.

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* Disinsectisation of aircraft was one of the common and unavoidable causes of passengers being detained for periods which to them appeared unnecessarily long. (*See* Immunisation, Vaccination and Health Regulations.)

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SPECIAL CREW EQUIPMENT FOR LONG FLIGHTS

As mentioned under the previous heading, the operation of transport aircraft often entailed the crews flying in greatly varying climatic conditions within a matter of a few hours; these relatively sudden changes created special problems of clothing and equipment, particularly as aircraft were more exposed to, and affected by, changes of temperature than were ground installations.

No special clothing was normally used in Transport Command, crews flying in standard uniform or battle dress and donning or removing garments as the situation demanded. The main problem was not so much to provide sufficient clothing as to ensure that the appropriate apparel for each stage of the journey was readily accessible; there was, for example, frequent carelessness over arranging that when landing in malarious areas the appropriate tropical kit for wear after sundown was available.

To obviate these difficulties lectures on personal equipment were given during training, clothing was specially mentioned in briefing before departure and at all staging posts particular emphasis was placed on the hygiene regulations in force. Despite these measures, however, many crews were incapacitated through failure to carry out elementary precautions; this was particularly serious in the instance of 'Refors' aircrews for it meant that either the aircraft had to be held back until the crew member was fit again or a relief crew had to be found, either course resulting in late delivery of the machine.

Considerable improvement was noted after the introduction of suppressive mepacrine in May 1944, but even this was ineffective if crews did not allow time for a sufficient concentration to be built up in the blood before flight.

Protective spectacles to overcome glare were one of the standard pieces of equipment and were used extensively during long flights over sea, cloud, snow or desert. Goggles were not popular, however, for several reasons, chief of which were their weight and the general discomfort of wearing them in hot weather, and of the many types devised the American 'Rayban' pattern, fitted with large oval lenses and side pieces, was the most universally accepted.

FEEDING IN FLIGHT AND AT STAGING POSTS

Some reference to this problem has been made in the Ferry Command section. In general the only satisfactory solution would appear to lie in the provision of galleys in all large transport aircraft, with a steward to prepare the food; in this connexion it is stressed that the employment of the flight engineer as a steward was a complete failure, as much more was required than a casual acquaintance with the art of cooking. With regard to small aircraft it would appear, from experience gained, that

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the best method of feeding was a combination of small dry pre-packed rations for use in flight and the provision of hot meals on the ground at re-fuelling points.

In passing, mention must be made of the wastage of food that inevitably occurred in Transport Command, as in other commands, where the main reliance was placed on sandwiches. The Overseas Aircraft Despatch Units, at which aircraft were collected in the United Kingdom in readiness for delivery overseas, were the worst offenders in this respect, as flights were frequently but unavoidably delayed or cancelled. The considerable quantities of sandwiches prepared by the catering staff were consequently no longer required and, as they were unfit for issue the following day, would be completely wasted. This wastage eventually ceased, however, for two reasons: firstly, the numbers of aircraft being delivered as the tempo of the war increased, made it impossible for the airfield catering staffs to provide sufficient sandwiches and secondly, investigation by the M.R.C. suggested that the problem could best be dealt with by the provision of some type of 'dry pack-up' which if not used, because of cancellation of flights, could be returned to the ration store. An example of this type of ration was one which contained 16 sweetened biscuits, 1 fruit bar, 2 fudge bars and 4 boiled sweets ; it proved a great success and was particularly popular with the aircrews concerned.

Beverages. The provision of beverages in aircraft was of even greater importance than the supply of solid food and the problems created were quite distinct; for this reason the question is dealt with separately. Many passengers and crews, particularly those who though not actually airsick had a tendency to queasiness, were disinclined to eat during flight, but practically all personnel were glad to drink suitable beverages; also in the tropics fluid is essential to health, and temperature conditions in the aircraft were often hotter than on the ground. Tea, coffee, cocoa and some kind of fruit drink (cold) were the requirements varied to suit the taste of individuals.

Drinks were usually carried in standard 1-gallon thermos flasks but although the latter were comparatively efficient from the thermal point of view, pouring out from the large mouth of the flask was very difficult in a moving aircraft; experience suggested that the most suitable modification would have been a large thermos container fitted with a tap and fixed in a suitable rack; this would have lessened the risk of breakage and prevented the spilling and waste of liquid.

As with all other food containers, the maintenance and correct use of these flasks produced considerable problems, for it was essential that the flasks should be cleaned out regularly and that they should be heated or cooled, as appropriate, before being refilled, the beverage itself being at maximum or minimum temperature as required. All this demanded

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considerable ground organisation and, in tropical areas, constant supervision, as the danger of contaminated water being used was very real, particularly if natives were employed.

The provision of suitable drinking receptacles was a problem which was never satisfactorily overcome. Most Service personnel overseas, irrespective of rank, carried their own mugs, but difficulty often arose in providing sufficient mugs or cups for civilian passengers. It is considered that routine installation of American automatic-delivery paper cup machines in aircraft normally used for personnel transport would have solved the problem.

SANITARY ACCOMMODATION PROBLEMS

The provision of latrines and urinals on aircraft was a constant problem. The International Sanitary Convention for Aerial Navigation permitted the use of urinals opening into the external air but forbade the jettisoning of faeces; thus while trough urinals could be and were fitted in most transport aircraft, closets for the collection of faeces had also to be included as standard equipment.

The urinals gave little trouble, provided that they were kept clean and free of scale, but the closets presented a difficult problem, particularly in their cleaning and maintenance. Elsan closets were usually employed and used 'dry', with facilities for the provision of clean containers at each staging post, but these proved too flimsy for general Service use. Some difficulty was also encountered in the organisation of a 'round the clock' service, especially when native gangs were used, and strict supervision was essential.

It will be realised, moreover, that during the brief stop at the staging post, passengers and crew had to be deplaned and re-emplaned, freight removed and loaded and maintenance work carried out, leaving little time for the procedure outlined above, and it was therefore essential to devise a new scheme if delay to aircraft and inconvenience to passengers and crew were to be avoided. The first absolute necessity was a simple and strong type of closet with standard containers which could be easily replaced when full by clean containers held at all staging posts; the other essential requirement was an efficient ground organisation, with an adequate establishment of labourers, under the direction of a competent airman, available at any time in the twenty-four hours; also necessary were an adequate store of empty containers, materials and facilities for cleaning soiled containers, and possibly a vehicle reserved for transporting the latter.

IMMUNISATION, VACCINATION AND HEALTH REGULATIONS

The immunisation procedure for personnel of Transport Command followed normal Air Ministry policy except in the instance of staff

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officers and aircrew; personnel in either of these categories might be called upon to fly, at a moment's notice, to any country in which the Command operated and their immunity was therefore not only medically desirable but an operational necessity. It was accordingly laid down that all such personnel were to be immunised against all the commoner tropical diseases, such as smallpox, typhoid, typhus, tetanus and yellow fever.

In attaining this objective two difficulties had to be overcome—the provision of a readily accessible record which would be acceptable to the health authorities of the various countries, and secondly, a method of ensuring that immunisations were kept up to date. (The first problem was solved by the introduction of the inoculation record card, in October 1943.)

With regard to passengers, all persons wishing to travel in Transport Command aircraft were requested to produce evidence of satisfactory immunisation before being allotted passages. Some difficulty was encountered in this respect over V.I.Ps. who often presented themselves for flight unprotected, but after a few classic hold-ups, notably by the Indian Medical Authorities for the non-production of yellow fever certificates, the majority of passengers did adhere to the instructions. It should be emphasised that the hold-up of passengers was almost as serious as that of aircrew, as it resulted in valuable seats in the aircraft being wasted at a time when the demand was invariably greater than the supply.

Yellow Fever Control. Parallel to the question of immunisation was that of preventing the carriage, by air, from one country to another, of endemic diseases, of which yellow fever was by far the most important. It will be remembered that, before the Mediterranean route re-opened, there was an extremely heavy flow of transport aircraft from West Africa through the Sudan to Cairo and India—that is, from an area in which yellow fever was endemic to one in which it was non-endemic. There was also a constant flow of aircraft from the South of Africa flying North through the endemic area, and also from the East flying West, from or through Abyssinia and Eritrea to destinations in Egypt. Finally there were aircraft coming across the South Atlantic from the yellow fever areas in South America* to West Africa and through the Sudan, from whence some went North to the non-endemic areas around Cairo while others continued East through Asmara to non-endemic Aden and India. From this sketch of air movements through yellow fever areas, it will be readily appreciated why two countries at least, India and Egypt, took such pains to tighten up existing regulations to prevent the introduction of the disease to their territories.

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* *See* Map 3.

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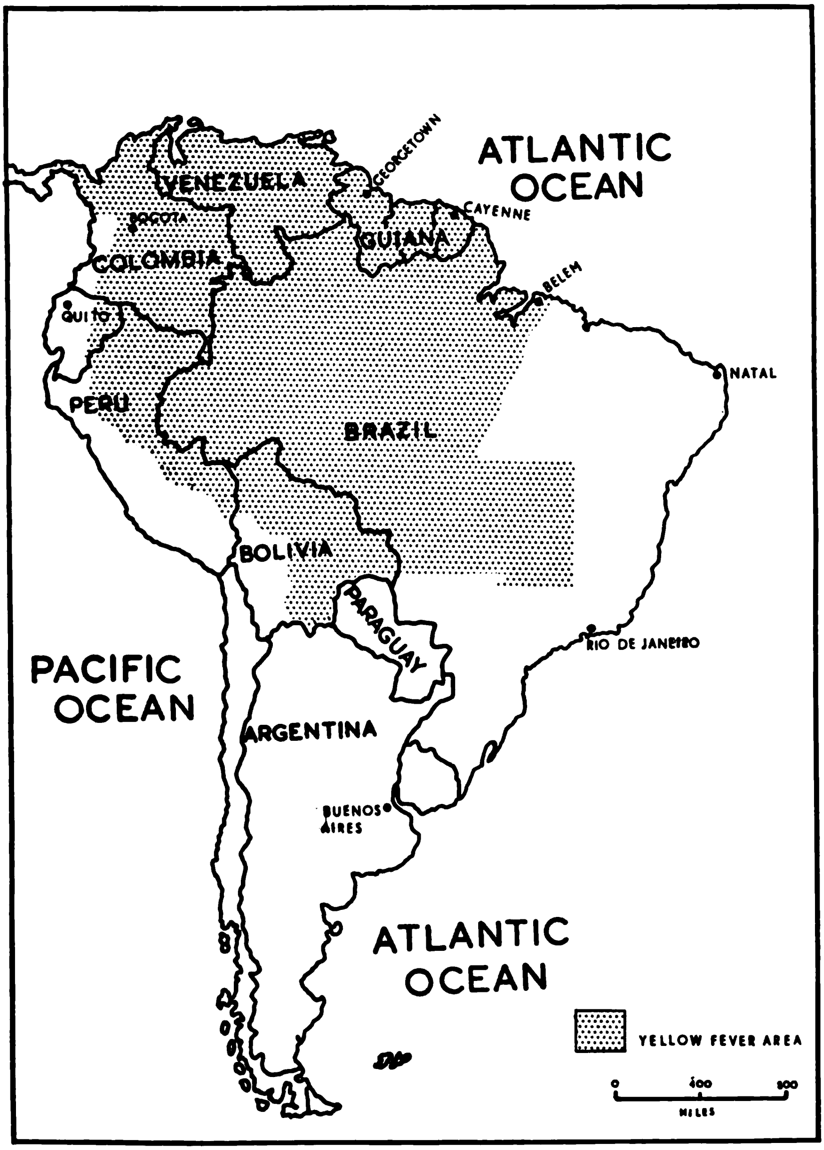

MAP 3. South American Yellow Fever Area delineated by Expert Commission on Quarantine.

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The drafting of adequate regulations was primarily the responsibility of the local competent medical authority, and Transport Command had simply to carry out instructions. Possibly the most efficient organisation in this respect was that of No. 216 Group, whose regulations, produced in accordance with instructions from Headquarters M.E.A.F., are summarised below:

(*A*) Personnel.

1. Inoculation against yellow fever.
2. Re-inoculation every two years.
3. No entry into endemic areas less than ten days or more than two years after inoculation.
4. No exit from endemic areas for the balance of the fifteen days from date of inoculation.
5. Form 1256* endorsed that all crew and passengers had been inoculated.

(*B*) Disinsectisation.

All aircraft coming from an infected area were to be sprayed:

1. Immediately before their last take-off, after the aircraft was loaded, in the infected zone.
2. In transport aircraft, after the ventilation had been turned off, and during the flight, the cabin was to be well 'Flitted'. This was the captain's responsibility and was to be entered in his Form 1256.
3. Immediately after the first landing outside the zone before baggage was off-loaded. The passengers and crew were to be disemplaned through a mist of insecticide. Aircraft were then to be closed up for ten minutes.
4. All aircraft entering from the South were to be sprayed immediately after their first arrival on Egyptian territory.

In order to carry out the above requirements Yellow Fever Control Units were formed, squads consisting of one British corporal and three native labourers, equipped with suitable power sprayers and insecticide, being stationed at each of the following staging posts in No. 216 Group:

El Geneina	2 Squads.	Luxor	2 Squads.
El Fasher	2 ,,	Cairo West	2 ,,
Wadi Seidna	2 ,,	El Obeid	1 ,,
Wadi Halfa	1 ,,		

(*C*) Mosquito Control.

There were to be no breeding grounds within half a mile of the periphery of the airfield. In endemic areas all airfield buildings were to

*Aircraft Crew and Passenger List.

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be mosquito proofed and situated at least a quarter of a mile from the nearest civilian habitation. (In the Sudan this control was carried out by the Sudan Medical Service.)

(*D*) Inoculation.

All personnel, including natives, stationed at Yellow Fever Control Units were to be inoculated. In infected areas all natives residing within one mile received inoculations.

Enforcement of Control. It was easier, however, to make these rules than to enforce them, for in warfare circumstances often made their observance impracticable on purely operational grounds.

The very hot areas provided the greatest problem, particularly the larger aerodromes such as Khartoum, where numbers of aircraft might arrive simultaneously. With temperatures around 160° F. inside the aircraft, it was difficult to prevent crews and passengers from deplaning if the arrival of the spray gangs was delayed, as inevitably occurred when several aircraft landed at the same time; in these circumstances too the spray gangs tended to carry out their duties with an eye to speed rather than to efficient disinsectisation.

The most satisfactory solution to the problem would appear to be the efficient internal spraying of aircraft while in flight, using such applian ces as the 'Aerosol Bomb' (unfortunately in short supply) which was ideal for the purpose. This would not, of course, abolish the need for ground squads, but it would allow passengers and crew to alight from the aircraft instead of being 'cooked' inside it. A further point of importance was the provision of adequate anti-amaryl quarters on all aerodromes where planes from endemic areas were liable to land; although this was an essential requirement, as laid down in the International Sanitary Convention for Aerial Navigation, not all aerodromes during the war conformed to the regulations in this respect.

PROVISIONS AGAINST TRANSMISSION OF DISEASES IN GENERAL

While conceding the particular importance of yellow fever control, it is considered appropriate to include in this narrative a few details of the general methods of minimising the risk of transmitting diseases by aircraft. In Transport Command the problems of control were mainly centred in the United Kingdom, where considerable numbers of airports created during the war had been added to those existing in peace-time; many of these airports were under the dual control of civilian and Royal Air Force medical authorities and in some instances this divided control amounted to virtually no effective control.

On the formation of the Command the only guidance available was that contained in 'Public Health (England) Aircraft Regulations 1938—Statutory Rules and Orders 1938 No. 299'. Copies of these regulations were supplied to the S.M.Os. at Hendon, Lyneham and Prestwick, but,

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although the medical officers concerned worked out reasonably satisfactory schemes of their own, based on these rules, no official directive to the commanding officers of the stations concerned had been promulgated.

One of the early tasks of the Command was, therefore, to draw up suitable regulations and in August 1943, suggested rules of procedure were submitted to Headquarters No. 44 Group, the Group most concerned at the time, for comment; three months later the proposals, amended to some extent, were forwarded to Air Ministry and the latter in April 1944 issued a memorandum (Appendices B and C) setting out the precautionary measures to be taken against the introduction of infectious diseases by aircraft. In addition, arrangements were made for the distribution of R.A.F. Form 2753—'Declaration of Origin and Health' (Appendix D) to be completed by all incoming passengers.

Matters were considerably improved by the steps taken but, in view of the impending liberation of Europe and the possibility of having to deal suddenly with large numbers of personnel recently liberated from internment camps, where epidemic diseases might well be rife, the Command felt that further regulations might be desirable; accordingly, another approach was made to Air Ministry in August 1944, with a view to the issuing of an Air Ministry Order on the subject, but the reply indicated that the Department was in complete agreement with the Ministry of Health that the instructions issued in April were adequate.

By 1945 it was found that the system was working reasonably smoothly, but certain minor adjustments were necessary to meet specific conditions—for example, to speed up clearance at airports Forms 2753 were filled in by passengers while in flight and for the benefit of Continental passengers the form was printed in several languages. In 1945, W.A.A.F. N.C.O. nursing orderlies were employed as quarantine clerks, the innovation being a great success, especially in view of the increasing numbers of female passengers; the orderlies proved to be efficient, reliable and firm in dealing with difficult passengers, and their employment on these duties was a considerable help to the medical officers concerned.

It had been laid down that all passengers arriving from declared areas of risk should be seen by the medical officer at the airport of entry, but this was not easy to organise in practice; the difficulties were mainly due to the effects of demobilisation which not only resulted in a shortage of medical officers, but meant that those remaining in the Service were over-burdened with large numbers of release medical examinations which had to be conducted in addition to normal sick quarters duties. The problem was aggravated by lack of transport, the distance of many sick quarters from the reception centres and the fact that aircraft were

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arriving at all hours of the day and night with little or no warning, so that the medical officer was torn between haunting the reception centre and thereby neglecting his sick quarters duties and remaining in his sick quarters and thus causing delay to incoming passengers.

When air trooping was fully organised it was found that individual Forms 2753 were unnecessary and it was agreed by Air Ministry, in October 1945, that trooping was a 'special circumstance' within the meaning of the current regulations and that the requirement for the form could be waived; all passengers were in organised drafts and it was considered that the nominal roll would serve in lieu of Forms 2753 and be adequate in the event of a passenger having to be traced.

FACILITIES AND CONDITIONS DURING TRANSIT

How was reasonable accommodation, food and amusement to be provided for the personnel who poured into staging posts, in large or small numbers, at any hour of the day or night? This was the problem which faced Transport Command at its inception and dogged it throughout the war. It might be thought that a parallel would be found in the normal transit camps provided for personnel proceeding to operational or static units, but this was not so, firstly because a large proportion of the Command's transients were aircrew, either ferrying operational aircraft or carrying full loads of passengers, and secondly because the remainder of the transients—the passengers—expected, rightly or wrongly, a higher standard than ordinary active service conditions.

The problems met with in tropical and sub-tropical staging posts were, of course, those to be expected in such regions and well known to medical officers, but the large flow of transients, who might be widely scattered over the United Kingdom and Overseas Commands within a short time, made prevention of disease even more essential than in the case of units with static populations. The standard of care in health precautions among transients tended, naturally perhaps, to be below that found among the permanent personnel.

Next to dysentery and other bowel infections, malaria was perhaps the most important disease, which many personnel were found to contract while bathing; the ablution block on staging posts was usually some distance from the changing-rooms or bedrooms and it was quite common for personnel to stroll over to the showers in the evening wearing nothing but a towel, thus presenting a perfect target for any mosquito. These facts stress the importance of mosquito-proof bathing blocks and the need for them to be connected with the sleeping quarters.

A further point of importance was the rôle which the staging posts had to fill in providing transients with equipment and clothes which they had forgotten or lost. To maintain health, correct clothing was essential

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—in particular the wearing during the evening of long trousers and long-sleeved shirts in malarious districts—and arrangements were made for these items to be issued on loan or sold to personnel requiring them. Perhaps of even more importance was the provision of mosquito nets, as there were few proofed sleeping quarters; this created a considerable problem, particularly as nets were in short supply during most of the war; also, unless carefully treated they were liable to be torn and to become traps for mosquitos rather than protection against them.

HEALTH OF THE COMMAND

As has been stressed throughout this narrative, the interests of Transport Command were 'global', and it follows that the personnel of the Command tended to be spread out with less concentration than in other commands. Thus the diseases which affected the Command, as far as epidemics were concerned, were those of the commands in whose areas transport personnel were serving and the sickness rates were in some respects a reflection of the general sickness incidence of the Royal Air Force as a whole.

During the war years no outbreaks of major disease occurred and the attention and energies of those responsible for the health of the Command were directed largely to medicine of a prophylactic nature; these measures, which ranged from accommodation to prevention of infection and health hints in the tropics, have been discussed in the sections of the narrative most appropriate to them.

The most important medical problems are shown in graph form at Appendix E. For a Command of such size, the rates compare favourably with other commands whose medical problems, considerable as they may have been, were never on such a large scale. It will be noted that the incidence of notifiable disease and, to a smaller extent, venereal disease increased from 1943 onwards reaching a peak in the early months of 1944. This rise was the direct result of the increased commitments of the Command in the Near and Far East and had its parallel in other commands similarly situated.

APPENDIX A

PRECIS OF INSTRUCTIONS ISSUED BY THE AIR MINISTRY IN JULY 1944 TO HQS. M.A.A.F., M.E., AND A.C.S.E.A.

Air Ministry,

14th July, 1944.

Although basic principles for the development of reinforcement and trunk air routes were promulgated in an Air Ministry instruction of the 24th March, it appears that there is still some misunderstanding concerning the requirements for medical facilities.

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2. The provision of adequate medical facilities is essential in order to deal with the permanent staff of Staging Posts, casualties which have been evacuated along the route and personnel in transit, particularly aircrews.

3. Within the limits of available labour and materials it is considered that:

(*a*) All major Staging Posts and minor ones which are isolated should be provided with sick quarters built and equipped to at least that standard required for a war-time Home Sick Quarters.

(*b*) The design should afford the necessary protection against the effect of climatic conditions and insect-borne diseases and where required, anti-amaryl quarters should be provided.

(*c*) The design should take into consideration the need for the provision of medical facilities for females and V.I.Ps.

(*d*) Amenities normally required should be provided. This includes, where possible, electric light, fans and water-borne sewage. In addition, where necessary, air-conditioning and heat-stroke quarters should be provided.

(*e*) For general guidance, beds should be installed on the basis of 3 per cent. of permanent establishment with a minimum of 12 beds. The spacing of beds should be arranged according to local R.A.F. Hospital scales.

4. It is considered that a Station Hospital of sixty beds is needed at Rabat Sale because of the lack of hospital facilities locally.

5. Your comments on the above are requested. If you are in agreement, please arrange for estimates to be submitted.

APPENDIX B

Precautions against the Introduction of infectious disease by aircraft

1. Individuals who have contracted plague, cholera, typhus or smallpox while abroad may arrive in this country by air before the symptoms are apparent.

2. It is essential that fellow passengers of such individuals are placed under medical surveillance as soon as possible after a diagnosis has been made.

3. Arrangements have been made for the issue of a card (copy attached) to each individual on arrival in this country from abroad by air. This card records the airport of arrival and, in the event of any illness developing within 3 weeks of arrival from abroad, should be shown to a doctor. These cards will be issued to all passengers by the Immigration Officer.

4. Registers of all arrivals and their destination addresses are to be kept at airports. Registers for Service passengers in civil aircraft and for all civilian passengers will be kept by the Immigration Officer. Registers for Service passengers in Service aircraft will be kept by the R.A.F. Senior Medical Officer.

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5. In the event of the non-attendance of the Immigration or Security Control Officer at the arrival of a civil aircraft or a Service aircraft containing civilian passengers, the R.A.F. Senior Medical Officer will be responsible for:

(*a*) the completion, with the name of the airfield and the date of arrival of the aircraft, of the cards and their issue to all passengers, civilian or Service.

(*b*) the recording of the particulars of all passengers, civilian or Service. The Immigration Officer will require a copy of these particulars.

6. The action which is required of R.A.F. authorities is detailed below:

(i) *Action to be taken by an R.A.F. Medical Officer who suspects plague, cholera, typhus or smallpox in a patient who has recently arrived from abroad by air.*

(*a*) If time permits and there is doubt of the diagnosis, the opinion of a medical officer with experience of the disease in question should be obtained.

(*b*) He is to notify immediately, by telephone or signal, the Medical Officer in Charge at the airfield, Service or civil, where the patient landed; or, if the airfield is in Northern Ireland, he is to notify the Chief Medical Officer, Ministry of Home Affairs, Belfast, giving the name of the airfield. The particulars to be notified must include the patient's name, rank and number, Service, Regiment or Corps, diagnosis and date of arrival at the airfield.

(*c*) He is to inform immediately, by telephone or personally, the Medical Officer of Health of the area in which the patient is residing, of the diagnosis he has made.

(*d*) He is to confirm both these notifications by letter or postagram with copies to Air Ministry (Dept. M.A.4.a).

(ii) *Action to be taken by the Senior Medical Officer at a R.A.F. airfield on receiving a notification required by para.* 6(i)(*b*).

(*a*) He is to inform immediately the local Medical Officer of Health of the area in which the airfield is situated of the notification and at the same time ask the Immigration Officer to furnish the Medical Officer of Health with the names and destination addresses of any civilian passengers who arrived on the aircraft.

(*b*) He is to inform the Air Ministry (Dept. M.A.4.a) immediately by signal or telephone of the particulars of all Service passengers in the aircraft concerned. The particulars of Service passengers in civil aircraft can be obtained from the Immigration Officer.

(iii) *Action which will be taken by Air Ministry, Dept. M.A.4.a.*

(*a*) Immediate contact will be made with the Admiralty and War Office concerning any naval or military personnel who were passengers in the aircraft.

(*b*) The addresses of all R.A.F. passengers will be verified and the Medical Officer of the R.A.F. Station nearest to each contact will be notified by signal of the latter's address. The signal will instruct the Medical Officer:

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(i) to make immediate arrangements for the medical examination, and quarantine if necessary, of the contact and

(ii) to inform the local Medical Officer of Health of the area in which the contact is residing, of the circumstances and his findings. When personnel are on leave the Medical Officer of Health will usually undertake the necessary surveillance.

A copy of these signalled instructions will be sent to the Principal Medical Officer of the Command concerned.

(iv) *Action to be taken by the P.M.O. of the Command concerned.*
He is to confirm that all necessary action has been taken by the R.A.F. Medical Officer mentioned in para. (iii) (*b*) and is to inform Air Ministry (Dept. M.A.4.a) by signal of the results of such action.

APPENDIX C

MINISTRY OF HEALTH AND DEPARTMENT OF HEALTH FOR SCOTLAND

Important Notice to all Persons Arriving by Air from Abroad

While abroad you may have been in contact, without knowing it, with some dangerous epidemic disease prevalent in other countries.

You are therefore strongly urged, in your own interests, to act on the following advice:

If, during the next 21 days, you fall ill, consult a Doctor immediately and give him this card so that he may see the notice printed overleaf.

Avis Important à toute Personne Venant de L'étranger par Voie D'air.

Pendant votre séjour à l'étranger vous avez pu, à votre insu, être en contact avec des sujets atteints d'une dangereuse maladie épidémique. En conséquence vous êtes instamment invité et ce dans votre propre intérêt d'observer rigoureusement la préscription suivante :

Si durant des 21 jours qui suivent votre arrivée vous tombez malade consultez immédiatement un médicin et remettez-lui cette carte afin qu'il puisse consulter la notice au verso.

(*Reverse side of card*)

Notice to Medical Practitioner Attending a Person Recently Arrived by Air from Abroad

The person holding this card arrived in this country by air

AT..Air Station (Royal Naval or R.A.F.)

.... Airport (Civil)

ON.. 194 .

It is consequently possible that the holder of this card may be suffering from some acute notifiable infectious disease (possibly one not normally present in this country), having arrived before the end of the period of incubation. If you find or suspect such a disease, will you please at once

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notify the Medical Officer of Health of the Borough or District (in Scotland, the County or Large Burgh) in which you are attending the patient, stating also the date and airport of the patient's arrival as shown by this card.

WILSON JAMESON, Chief Medical Officer, Ministry of Health.
ANDREW DAVIDSON, Chief Medical Officer, Department of Health for Scotland.

APPENDIX D

International Sanitary Convention for Aerial Navigation, 1944

PERSONAL DECLARATION OF ORIGIN AND HEALTH

(International Form)

(For passengers on aircraft)

Port of Arrival:

1. Name in full..
(BLOCK LETTERS, Surname first)
2. Nationality:
3. Passport number:
4. Permanent (home) address:
5. Precise address to which immediately proceeding:
6. State where you spent the fourteen nights prior to arrival in this country:

Last night..	8 nights ago....................................
2 nights ago....................................	9 nights ago....................................
3 nights ago....................................	10 nights ago....................................
4 nights ago....................................	11 nights ago....................................
5 nights ago....................................	12 nights ago....................................
6 nights ago....................................	13 nights ago....................................
7 nights ago....................................	14 nights ago....................................

7. I am in possession of a certificate of inoculation or vaccination against:

Cholera
Yellow fever
Typhus
Smallpox

8. I declare that I have had no illness within the past fourteen days except as follows:

I declare that the information given above is correct to the best of my knowledge and belief.

Signature: ....

Date: ....

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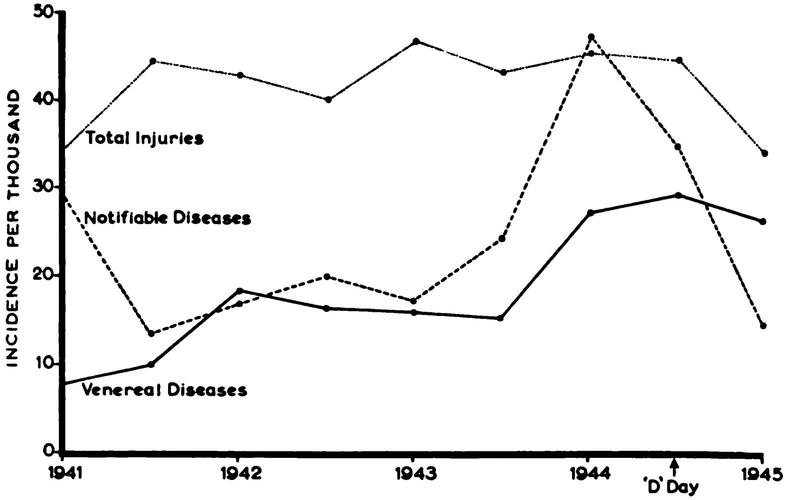
APPENDIX E



Graph showing sickness rate, Ferry and Transport Command.

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CHAPTER 5

BALLOON COMMAND

During the period between the two world wars the necessity did not arise for considering any special medical problems connected with the flying of captive balloons in large numbers until 1936 and this account is therefore concerned with development from 1936 onwards.

In 1936, a balloon training unit was formed at R.A.F. Station Cardington, and the following year a second unit was formed there, but it was not until the formation of No. 30 Balloon Barrage Group (also in 1937) for the purpose of recruiting, administering and training personnel for balloon squadrons in the Greater London area that medical problems, either administrative or, to a lesser extent, technical, began to present themselves.

By this time the principle had been accepted that passive defence against enemy air attack of certain special targets and areas would be augmented by flying captive balloons at strategic points in and around those areas, and the implementation of this policy necessitated the setting up within the Royal Air Force of a new organisation, later to become Balloon Command.

For reasons with which the Medical History of Balloon Command is not concerned it was decided that during peace-time the officers and airmen of the balloon squadrons should consist of Auxiliary Air Force personnel, but to train and administer these squadrons a nucleus of regular Royal Air Force officers and airmen was required and the necessary administrative formations were accordingly set up, being modelled on the existing organisation for flying squadrons.

GENERAL PRE-WAR HISTORY OF BALLOON UNITS

As stated above, No. 30 Balloon Barrage Group came into being in 1937 to administer four balloon centres located in the London area—at Kidbrooke, Hook, Stanmore and Chigwell. No. 30 Group Headquarters was located at Kelvin House, Cleveland Street, London, W.1., but as Balloon Command had not yet been formed, the Group was attached to Fighter Command and administered from the Headquarters of that Command. (*See* sketch map opposite.)

In structure No. 30 Group conformed to other R.A.F. Groups in the United Kingdom and therefore had no establishment at the Group Headquarters for a medical officer or other medical personnel to undertake administrative duties. These duties were therefore carried out by

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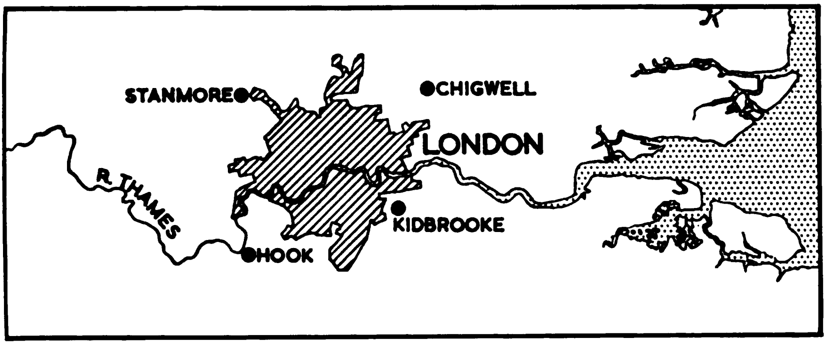

Sketch Map showing Defence of Greater London.

the Principal Medical Officer, Fighter Command, who dealt either direct with the balloon centre or squadron concerned, keeping the Balloon Group Headquarters informed, or direct with the Group Headquarters itself, as circumstances dictated. The decision to extend the scope of passive defence to other areas in the United Kingdom necessitated a larger operational and administrative organisation.

FORMATION OF BALLOON COMMAND

On November 1, 1938, Balloon Command was formed, taking over from that date the administration of No. 30 Group. Immediate steps were then taken by Command Headquarters to hasten the formation of balloon centres and squadrons in the provinces, and to administer these units Nos. 31, 32 and 33 Group Headquarters were formed in March 1939, No. 34 Group being added later.

On the formation of Balloon Command the geographical pattern of the units in the Command rapidly began to take shape. The squadrons in the London area and later the South Eastern area of England, including the Thames Estuary, comprised No. 30 Group, and by the time that this Group was transferred from Fighter Command very considerable progress had been made in the construction of the balloon centres at Kidbrooke, Hook, Stanmore and Chigwell, both recruiting and basic training proceeding well. With the formation of the provincial squadrons the geographical areas assigned to the new groups were as follows:

Group	Headquarters	Area
31	Southampton	South and South-west of England and South Wales
32	Birmingham	Midlands and North-west England
33	Newcastle	North-east England
34	Edinburgh	Scotland and Northern Ireland

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In addition to balloon sites on land many balloons in later months were flown from boats of various kinds such as dumb barges, small fishing craft and drifters, while balloons were also provided for ships in convoy, particularly, in the earlier period of the war, those passing through the English Channel; all these balloons were manned by Auxiliary Air Force personnel from Balloon Command. The Command was further responsible for training and equipping mobile squadrons for service overseas, the first of these being sent to Calais early in 1940 while others at a later date served in the Middle East; such squadrons, however, were not part of Balloon Command while serving overseas and they are not therefore referred to again in this narrative. Finally there was one large R.A.F. station in the Command, R.A.F. Station, Cardington, which was a permanent R.A.F. station manned by regular R.A.F. personnel and administered direct by Headquarters, Balloon Command; this was the only regular station in the Command. It was at Cardington, which already had large hangars, etc., used earlier in connexion with airships, that during the mid-1930s development and training in the handling of barrage balloons took place.

The function of the Command in peace-time was rather more complex than might be imagined. Its primary duties were, of course, to train balloon crews to fly and operate captive balloons over or near vulnerable targets. Each balloon was connected by a cable to its individual power winch, the latter being mounted either on a motor truck chassis or on a trailer; the balloons and, to a greater extent, the cables, were intended to present an obstruction to low-flying or dive-bombing aircraft which would either be destroyed or crippled on impact or driven to altitudes at which anti-aircraft defences would be more effective.

ORGANISATION AND ADMINISTRATION—GENERAL

The organisation of Balloon Command followed the lines of other R.A.F. commands at home. An Air Officer Commanding, later Air Officer Commanding-in-Chief, was in command and was located with his staff at Command Headquarters. The Command was divided into Groups, each with its Air Officer Commanding and his headquarters staff. Each group headquarters administered and controlled a certain number of balloon centres, each centre having a commanding officer and headquarters staff to administer the balloon squadrons established on the centre. All these higher formations were initially manned by R.A.F. or R.A.F.O. (Reserve of Air Force Officers) officers and airmen of the regular Air Force. The squadrons, however, were composed entirely of Auxiliary Air Force (A.A.F.) officers and airmen specially selected or recruited for each individual squadron.

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RECRUITMENT FOR BALLOON SQUADRONS

The members of the squadrons were recruited under special regulations, each airman being enlisted for the particular squadron which he selected, and from which he could not be posted, even in the event of mobilisation, unless he consented to the move; as squadrons were originally raised to defend specific districts, they were usually manned by local people.

The responsibility for recruiting personnel for the balloon squadrons rested in the first place with the Territorial and Auxiliary Forces Associations (T.A.F.A.), the local branches of which took the initiative in manning the squadrons established in their respective districts. Nevertheless, a considerable amount of work connected with recruiting had to be dealt with by R.A.F. personnel in the Command, and it will be appreciated that the R.A.F. Medical Branch was implicated to no small extent in ensuring as far as possible that proper medical examination, correct medical grading and accurate medical documentation of recruits was carried out. When the Command was formed No. 30 Group was fairly well advanced in filling the vacancies but the extension of the balloon barrage to the provinces necessitated a great deal of additional work, and in order to lose no time in recruiting, suitable premises were acquired in cities and towns where squadrons were being raised. A junior R.A.F. officer and a nucleus of R.A.F. clerks and administrative personnel, including one nursing orderly, were drafted to these Town Centres to undertake documentation and administration in connexion with the recruits accepted and also to give a certain amount of elementary instruction in Service matters, pending the completion of the balloon centre buildings. Officers for the squadrons were recommended by the local T.A.F.A. branch and then referred, through the usual Command organisation, to the Air Ministry for consideration, those selected being gazetted to the squadron concerned.

This then was the framework on which the organisation and administration was built and on which it operated throughout its existence. As soon as war was declared all recruiting to the Auxiliary Air Force ceased, and vacancies in establishments, both for officers and airmen, were filled from normal R.A.F. or R.A.F.V.R. sources.

ORGANISATION AND ADMINISTRATION—MEDICAL

When the Command was first formed in 1938 the medical organisation conformed in outline to that of other R.A.F. operational commands at home, where the Principal Medical Officer at Command Headquarters was the adviser on medical matters to the Air Officer Commanding-in-Chief and was also responsible for the medical administration of the Command and the implementation of Air Ministry directives on policy

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concerning medical matters. But a Principal Medical Officer was not appointed to Headquarters, Balloon Command until June 1939, and until that date the P.M.O., Fighter Command continued to act as competent medical authority for the Command. At this period, however, there was no establishment for administrative medical personnel at Group Headquarters and consequently all items of medical administrative detail had to be undertaken by the P.M.O. Command, dealing direct with the unit medical officers. The Group Headquarters was notified, where necessary, of action taken in this way, but as much of the 'personnel' staff work and all the detailed administration of the units was the responsibility of the Group Headquarters, it will be realised that this arrangement left much to be desired in obtaining satisfactory and close co-operation between the formations concerned.

In Balloon Command difficulties were increased by the fact that no R.A.F. medical officers were stationed at balloon centres and, although each balloon squadron had one Auxiliary Air Force medical officer on its establishment, these officers were only obliged to do the same training periods as other officers in the squadrons—that is, a minimum number of hours of non-continuous training and fourteen days of continuous training in the year. At the balloon centres medical attention for the relatively small number of regular R.A.F. personnel was provided by the employment of a nearby civilian medical practitioner.

At this time—and indeed until after the outbreak of war—the establishment of nursing orderlies was also meagre. The Principal Medical Officer had one L.A.C. nursing orderly as a clerk and no other staff while the next nursing orderly was to be found on the centre establishment, where there was one corporal and two aircraftmen, R.A.F. Each squadron also had an establishment of one corporal and two aircraftmen nursing orderlies, A.A.F. In a Command with mainly regular personnel and where the station medical officer was a regular officer (with some Service experience), such an arrangement might have been reasonably satisfactory, but applied to Balloon Command, where there were no regular medical officers at all below Command level, it was bound to be inefficient, particularly as regards the training of the auxiliary medical officers and airmen. In connexion with this latter point it should be noted that several Auxiliary Air Force medical officers, particularly in the London area, did in fact obtain some experience in R.A.F. medical administration before the war, as they were employed as civilian medical practitioners to give medical attention to the regular airmen of their respective centres.

In September 1939, when war was declared, the call-up of auxiliary medical officers for full-time service relieved the situation to some extent in that there were now, at squadron level, a number of responsible medical officers who although relatively untrained in Service procedure,

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quickly obtained a grasp of the elements of R.A.F. medical administration. Difficulties still arose from the lack of a medical officer at the Group or centres, for it was from the latter units that the squadrons received instructions on all other matters. Before the war repeated applications had been made for the establishment of regular medical officers on certain of the balloon centres, to be available for training Auxiliary Air Force medical personnel, and for the supervision of recruiting procedure, but Air Ministry approval of the proposal had not been obtained. In consequence, when mobilisation was ordered, the Air Officer Commanding agreed that all squadron medical officers should be attached to the appropriate balloon centres, the most senior of these medical officers becoming senior medical officer of the centre and responsible to the centre commander for squadron medical arrangements and the direction of other auxiliary medical officers at the centre; by this means some sort of reasonable medical administrative channels would be established. This arrangement, as might be supposed, met with considerable opposition from many of the squadron commanders, and some of the group commanders, but such measures were necessary in order to provide any sort of medical organisation in the Command at all and the objections were overruled.

A very short time before war was declared the medical staff at Command Headquarters was increased by the addition of a squadron leader as Deputy Principal Medical Officer, but with the rapid increase in the size of the Command and the absence of trained medical officers at lower formations, knowledge at Command Headquarters of what was happening on the new units was negligible; shortly after the declaration of war, therefore, a very strong request was made to Air Ministry for four R.A.F. medical officers, one for each of the four groups, to be attached to Command Headquarters. This was finally approved, but, when the four medical officers arrived, it was found that they had only four weeks service among them, yet these were the officers who, with such scant Service knowledge, were to be the backbone of the organisation which it was hoped to build up out of the chaos then existing. No suitable officers with more experience were available, however, so the best use had to be made of these four. For a week they underwent a very intensive course, purely theoretical, of R.A.F. medical administration, sanitation and hygiene; then each was given a large manifold book, a list of subjects on which information was urgently needed at Command Headquarters, together with a reference number for each subject, and sent out to the groups with instructions to write a report under the appropriate heading for each unit visited every day and despatch the report at once to Command Headquarters. The results of this scheme exceeded expectations; a considerable amount of valuable information was obtained, and appropriate action could be taken as necessary.

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In October 1939, approval was given for the establishment of a Senior Medical Officer at each group headquarters in the rank of squadron leader, later raised to wing commander. The filling of these posts immediately brought about a great improvement in the medical organisation with a consequent increase in the efficiency of the medical facilities at the centres and squadrons. In November of that year the appointment of P.M.O. was upgraded to group captain and in late 1940, to air commodore. When, in 1942, the size of the Command began to decrease, the post was downgraded to group captain and remained of that rank until the Command was disbanded.

PROBLEMS OF IMMEDIATE PRE-WAR AND WAR EXPANSION

During the formation of No. 30 Group in Fighter Command certain medical administrative difficulties had arisen and one of the earliest problems was encountered in the organisation of medical examinations for recruits. Although this was the responsibility of the local T.A.F.A. branch, the R.A.F. Balloon Centre Adjutant did in fact, in co-operation with the squadron commanding officers, arrange for these examinations to be carried out by local civilian medical practitioners at the rate of 2s. per examination. Where an A.A.F. squadron medical officer had been appointed, he, of course, as a civilian practitioner, undertook as many medical examinations as his civilian commitments allowed, but when, as during the Munich crisis and again during the summer of 1939, recruiting was very brisk, it was necessary to obtain the services of every local practitioner who could spare the time; most of the recruiting was done in the evenings and at one time it was not unusual for up to one hundred examinations to have to be carried out during one evening at a centre. To add to the difficulties a rumour, which was quite unfounded, circulated to the effect that standards could be low. The age limits for acceptance were between 35 and 50 years, and this increased the possibility of pathological conditions being present, although frequently overlooked in the unavoidably hurried examination of recruits. A copy of the regulations relating to the medical standards required was available at each recruiting centre but some auxiliary airmen were accepted who were subsequently found to be medically below standard and unsuitable for balloon duties.

While No. 30 Group was still in Fighter Command, the P.M.O. of that Command was not officially responsible for the examination of recruits, but he had taken steps to provide medical equipment at the town centres and balloon centres when these were sufficiently far advanced in construction to provide suitable accommodation; without this provision very few medical examinations could have taken place. In order to ensure correct medical documentation of these recruits the P.M.O. also arranged for a nursing orderly, who would eventually be

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absorbed into the balloon centre's establishment, to be posted to each town centre for recruiting duties.

When the duplicate records of the examinations began to arrive at Fighter Command Headquarters, it soon became evident that many of the documents would have to be returned for amendment and reconsideration of the recruit's medical category and many were so returned. But the numbers of documents being received weekly at the end of 1938 and in early 1939 were so great that the task of scrutinising each one was entirely beyond the capacity of the small medical staff at Command Headquarters and some 10,000 card records had to be forwarded to higher authority unchecked. This undoubtedly added to the number of auxiliary airmen retained who might, on re-examination, have been rejected as unfit. As far as the checking of acceptance of low category recruits was concerned, the transfer of medical administration to the P.M.O. Balloon Command on his appointment in June 1939 made no difference whatever, as the recruiting rate was now higher than ever, and more and more squadrons were being formed. The Principal Medical Officer was the only regular medical officer in the Command, and it was therefore unavoidable that all medical documents relating to recruits' medical examinations should have to be passed on for retention without being checked.

PARTIAL EMBODIMENT

At this time, further demands were made on the slender resources of the medical branch of the Command by the decision to call up one quarter of each of the London squadrons at a time for one month's training and to fly balloons on the war sites. Very briefly this meant that 120 men had to be fully medically examined and categorised before each month's call up. If a man was passed fit up to his grade, he received a bounty of £5 and then went on to do his month's training on the full pay and allowances of his rank and trade; if he was unfit, he was not called up and did not of course receive a bounty.

The call-up programme allowed only 30 minutes for the examination of these 120 men. This period was too short and representations were therefore made to the Air Ministry that the regulations should be amended to allow personnel to be called up after a brief medical inspection, provided that no obvious or acute infection or disablement was revealed, and full examination and grading to be carried out during their period of training; the scheme was eventually approved.

During the period June to August 1939, very valuable experience was gained by this partial mobilisation of the London squadrons, although the lack of medical officers with any Service training created a serious problem. The auxiliary squadron medical officers were not called up for a month's training, as they could not leave their practices for that length

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of time, but they agreed to do part-time work over the whole period, being paid full rates of pay and allowances for one month only. This was the best compromise that could be made until approval was given for the provision of four R.A.F. medical officers to be attached to the Command for medical duties and medical training duties with the squadrons; agreement to this proposal was eventually received after further representations later in the year (*see* 'Organisation and Administration—Medical'). The overworked auxiliary medical officers did what they could, but in most instances this amounted to dealing with day-to-day sick personnel, cursory sanitary rounds and a few medical examinations when these could be fitted in. Consequently little opportunity could be found during this period immediately before the outbreak of war to weed out unfit or unsuitable personnel.

REMOVAL OF NON-EFFECTIVE PERSONNEL

It will be convenient here to follow up the result of this unsatisfactory organisation for the medical examination of recruits and their re-examination on mobilisation. When all the balloon squadrons were mobilised on the declaration of war, it was realised that a number of airmen would be unfit for service and would require invaliding from the Service—a rather lengthy procedure; unit medical officers had first to prepare invaliding papers in duplicate for each of the personnel concerned; the papers were then submitted to the competent medical authority—at this time the P.M.O. Balloon Command—and referred by him, if approved, to the nearest R.A.F. hospital, the commanding officer of which convened a medical board. After the patient had appeared before the board, the papers, together with the board's recommendation, were again sent to the competent medical authority for approval, and passed to the airman's unit for invaliding action to be taken with the appropriate branch of the R.A.F. Record Office.

It need hardly be said that, with the increasing number of auxiliary airmen whose condition necessitated consideration by a medical board, delays in boarding became steadily longer so that by October 1939, about 400 cases were awaiting disposal. Hospitals were unable to assist, owing to their other commitments. Authority was therefore obtained for an invaliding medical board to be established within the Command, and a medical officer of the rank of wing commander was posted to Command Headquarters to act as president of this board. Except for a few teething troubles, due mainly to postings, invaliding of these airmen was henceforth carried out with no difficulty and little delay, while after a few months the normal invaliding procedure, which was introduced soon after the establishments for senior medical officers at Group Headquarters were filled, sufficed to keep abreast of the cases submitted for consideration.

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The experiences of these months, however, showed clearly that if a medical examination is to be effective, the examining medical officer must be allowed a reasonable amount of time to make the examination, he must be fully aware of the standard of fitness which is acceptable, and lastly, this standard should not lightly be lowered in order to allow vacancies to be filled. Perhaps, however, in the circumstances obtaining at the time the price paid was not too high, approximately 500 personnel being rejected as unfit out of over 10,000 recruits.

BALLOON SQUADRON AUXILIARY MEDICAL OFFICERS

The procedure for selecting officers for the balloon squadrons (*see* 'Organisation and Administration—General') applied also to medical officers. For most of the squadrons raised before the outbreak of war, the initial selection of the squadron medical officer was made by the squadron commanding officer, the doctor chosen being a local practitioner and in all probability well known to the C.O. both professionally and socially. This method of selection, with no interview by a selection committee, may be thought unusual, but in practice results were excellent; most of the auxiliary medical officers were practitioners of considerable standing and experience, used to taking responsibility for their cases and having sound clinical judgment, and it was they who, during the few months before the war and the immediate period after war was declared, prevented a breakdown in the medical services of Balloon Command.

When general mobilisation was ordered and recruiting for the Auxiliary Air Force ceased, it was some time before gaps in the medical establishments of balloon units could be filled from recruits being called to the colours under the conscription scheme. The auxiliary medical officers were short of medical staffs with Service experience and lacked medical stores, although in many instances they remedied this latter deficiency by drawing from the stocks in their own surgeries, as a temporary measure until supplies could be obtained from R.A.F. sources or by local purchase.

It was entirely due to the devotion to duty of these auxiliary medical officers of Balloon Command that during the latter part of 1939 and the early days of 1940 treatment of the sick and injured remained at a high standard, in spite of the poor accommodation which was often all that was available; proof of this was given by the remarkably few complaints received during this period of neglect or inefficiency in medical treatment.

MEDICAL AIRMEN

The medical branch was seldom the first choice of new entrants to the R.A.F., and Balloon Command had to face the problem of unfilled

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establishments and of airmen insufficiently trained for the posts they had to fill. This situation was common to most R.A.F. Commands in 1938 and 1939 but was particularly serious in Balloon Command owing to the absence of regular medical officers in formations below Command Headquarters. Nevertheless, sterling work was done during the early days of the Command by junior nursing orderlies, not only in dealing with the day-to-day routine paper work but also in coping with the rush of recruiting examinations for auxiliary airmen; at many centres, in addition to arranging lists of men, testing urines etc., a single nursing orderly undertook all the typing of recruiting medical documents. Most of these nursing orderlies worked hard and conscientiously with no complaint, but it was unfortunately impossible at this period, owing to the size of the Command and the paucity of medical staff at Command Headquarters, to provide adequately for their training or supervision; it was not until November 1939, when S.M.Os. were established at groups, that the man-power position improved and more medical airmen became available so that the meagre establishments began to be brought up to strength.

The medical branch was no more popular with auxiliary airmen than it was with regular personnel and, on the formation of a squadron, it was often some time before the establishment of one corporal and two aircraftmen nursing orderlies could be filled. Even greater difficulty was experienced, before the war, in arranging proper training for these men, for although the auxiliary medical officers could and did give instruction in first aid and nursing, little or no training could be given in Service administrative methods, documentation, and hygiene. In 1938 therefore, while the medical administration of No. 30 Group was still in the hands of the P.M.O. Fighter Command, the latter arranged that auxiliary airmen in the medical trade group, instead of carrying out 14 days continuous training with their squadrons, should attend a special course for that period at the R.A.F. Medical Training Establishment. This was an excellent scheme, and through the whole-hearted co-operation of the Commandant of the Medical Training Establishment it was possible to make similar arrangements in 1939, the medical airmen of the London squadrons undergoing a month's course that year coinciding with the one month's embodiment of the remainder of the squadron personnel for training. Again, however, it must be put on record that these auxiliary medical airmen made up by their keenness and devotion to duty for much of the lack of knowledge due to inadequate training.

It is appropriate to mention here that immediately after the declaration of war considerable stress was laid on the necessity for efficiency in simple and practical 'first aid'; this was considered essential, as most of the balloon personnel were employed in potential target areas and the squadrons were widely scattered. As soon as medical personnel were

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established at Group H.Qs. therefore, a sergeant nursing orderly was made available in each group for instructional duties at units; these nursing orderlies supervised the first-aid training not only of medical personnel but also of as many members of balloon crews as possible, some of the personnel reaching a high standard of efficiency, which undoubtedly assisted in maintaining the morale of the units.

SITES AND LIVING CONDITIONS

As previously stated, a balloon centre was equivalent to a R.A.F. station, but as the majority of personnel on the centres were non-regular officers and airmen, only a limited amount of living accommodation was provided; in peace-time this created no difficulties, but as soon as the squadrons were mobilised overcrowding was inevitable. In most instances the squadron commander with his headquarters staff and each flight commander with his officers were accommodated in requisitioned premises within the area covered by their balloon sites, but before these arrangements could be made, and particularly in the early days of the war, it was indeed fortunate that most of the balloon personnel had been recruited in the district and were able to sleep at home.

The sites for balloons varied tremendously, from slag heaps outside towns to green fields in the depths of the country, and from small open spaces in a slum to barges anchored in a harbour (*see* Plate XXXIV), while later in the war bombed sites, cleared of rubble, were also taken into use; it will be realised that living accommodation for the crews varied in a similar manner—from a bell tent to a mansion, and from a sordid room in a slum to a stuffy cabin in a boat.

The deployment of balloon crews, each consisting of up to 12 airmen or 18 airwomen, covered a wide area, for each squadron comprised between 16 and 45 balloons. No site could be considered permanent, nor, for that matter, could the retention of balloons in any one area be considered definite. Nevertheless, it was obvious that many hundreds of sites, once selected, would remain in use for a considerable time, and plans had to be made accordingly.

HOUSING ON BALLOON SITES

Housing of balloon crews on the sites was given a high priority. It was the aim that, wherever reasonable accommodation for a balloon crew could not be procured by the winter of 1939, a standard pre-fabricated wooden hut should be provided, but this, owing to the rapid expansion of the Command and delay in the delivery of huts, proved to be little more than a pious hope, and although every effort was made to obtain quarters for all crews in some kind of permanent building, in several instances there was no alternative to accommodating personnel in tents.

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Where the wooden huts mentioned above were introduced, they had to suffice for eating, recreation while on 'stand-by' duty and sleeping, and were barely adequate for the purpose. When, under the W.A.A.F. Substitution Scheme, airwomen took over balloon sites, an extra hut was allowed to accommodate the larger crews and to give a little more space per airwoman.

Except in requisitioned premises already supplied with electricity, the lighting of barrack accommodation for balloon crews was always a problem, unless electric power could be provided easily and cheaply; hurricane lamps were issued to sites in the early days of the war, but this was most unsatisfactory in the long winter evenings, and improved paraffin lamps and later pressure lamps were obtained to ameliorate these conditions. Authority was also received in 1939 for a sum of £10 per site to be spent on amenities; where necessary part of this amount was used to improve the lighting but the winter of 1939 was indeed a gloomy one for many airmen in Balloon Command—in more ways than one!

Living conditions generally, and those for personnel under canvas in particular, were a cause of much anxiety to the squadron medical officers and they, together with C.Os. and other officers of the squadrons, worked unceasingly to obtain for the men the best conditions possible in the circumstances; the airmen realised this and, although some of the older personnel in particular suffered much hardship, there was remarkably little grumbling and morale remained good even in the worst situations.

WATER SUPPLIES AND BATHING AND LAUNDRY FACILITIES

The provision of drinking and washing water on sites required considerable organisation. Where no safe tapped supply was reasonably available a tank was provided and kept filled as required by a visiting water trailer; as each balloon was attached to a prime mover or a trailer, there was no difficulty in getting the water trailer to the sites. In the autumn of 1939 a small transportable water steriliser, known as the 'Bell' or 'Ten Gallon' Steriliser, was sent to the Command for field trials and gave such a satisfactory performance that fifty were demanded for use in Balloon Command; they proved particularly useful on sites where a source of water was readily available but was either of doubtful purity or known to be contaminated.

It was often difficult to provide laundry and bathing facilities, although local inhabitants were usually helpful regarding the latter and provided baths for crews stationed in the neighbourhood; where this help was not available arrangements were made by squadrons for airmen to visit the nearest public baths at least once, and if possible twice, a week.

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SANITATION AND LATRINES

Disposal of night soil and sullage water sometimes presented serious problems. In built-up areas it was often possible to arrange for flush closets to be available, or alternatively for bucket latrines to be emptied and washed into a foul drain man-hole, while in some instances, where it was obvious that the site would be in use for a long time, water-borne sanitation was provided for the use of the crew, this applying particularly to W.A.A.F. crews in the substitution scheme.

In rural areas, strangely enough, disposal sometimes caused more difficulty than in towns, especially when there was a high sub-soil water level, and it was in such areas that the ingenuity of the medical officer concerned and the co-operation of the unit officers proved most valuable. Where the medical officer had had previous training or taken a special interest in the subject of sanitation, this was immediately apparent in the results achieved, thus proving the necessity for medical officers to receive full practical training in field service hygiene and for C.Os. and other officers to be aware of their responsibility for taking action on the M.O.'s recommendations; this lesson had been learned in the 1914–18 War, but had not, unfortunately, received sufficient attention in the early days of Balloon Command.

The use of 'Elsan' closets on sites had been strongly recommended by the medical branch at Command Headquarters, but squadron medical officers rapidly came to the conclusion that chemical closets were unsuitable for this purpose. The prefabricated wooden huts previously referred to were designed with two small rooms, one on either side of the entrance, for wash basins and an Elsan closet respectively, but the airmen, without exception, objected to the offensive smell and this, coupled with the difficulties of obtaining sufficient chemical fluid, meant that the closets were, in fact, very rarely used; wherever possible, if buckets had to be used, the men themselves built outside latrines and used dry buckets which were emptied at least once daily and more often if necessary.

MESSING

Before the formation of the Command considerable thought had been given by squadron officers and the headquarters staff of No. 30 Group to the best scheme for feeding airmen on balloon sites; the not inconsiderable problem to be solved was that of supplying hot food at least twice a day to a number of crews (each consisting of 12 men) spread over a wide area. On the formation of the Command the question was pursued with even more vigour, and it was eventually decided that the best method would be to establish kitchens with cooking apparatus and cooks, on a flight basis, at each flight headquarters, the food to be

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issued from there, cooked and ready to eat, in insulated containers. At that time, although there had been little experience of the scheme in operation, there were from a medical point of view two main reasons for supporting this decision—firstly, it would enable better use to be made of the food than if it was issued to each site dry and uncooked and at the same time lessen the amount of waste when food rationing was introduced and the inevitable war-time shortages occurred; and secondly, it would make it possible for a higher general standard of cooking to be maintained. Special insulated containers were approved for the issue of cooked food to the sites; these were fitted with tins for holding solid food, while hot liquids—soup and tea—were carried in 'Thermos' flasks; containers and flasks fastened securely into brackets on special bicycles, one of which was issued to each balloon site. The flight kitchens were issued with the usual cooking utensils and cooking was done on petrol pressure stoves, known as 'minor formation stoves'.

In the early days of the war none of this equipment was available and each site was responsible for its own cooking; although this was often done in very primitive conditions, it must be admitted that the arrangement was very popular and did not give rise to any complaints. There never seemed to be any difficulty in finding at least one member of the crew who could provide good meals even with only a primus stove, and on many sites excellent meals were prepared in small improvised camp kitchens. The new system of large scale cooking by flights, on the other hand, was never favoured by the balloon crews for by the time the food reached them it was more often than not cold, 'messed up' and unappetising—sometimes almost uneatable. In any except the flattest of country the cycles were heavy and in winter when the roads were greasy or icy, spills were not infrequent. Further, the minor formation stoves were not a success, for although they worked well on high octane petrol this was not obtainable in Balloon Command and the lower octane fuel issued for mechanical transport quickly carboned up the burners, which then smoked and turned whatever premises were being used into a veritable 'hell's kitchen'.

However, as the cooking staffs at flights became more experienced in the use of the stoves and certain modifications were made, matters improved and the flight kitchens continued to function, doing good work in feeding flight headquarters staff and nearby balloon crews, although the more distant sites and squadrons, in areas not easy of access by road, always preferred 'site' cooking; where the latter was not allowed and the crews on these distant sites were fed from flight kitchens, it soon became evident that the special cycles were not suitable for distributing the food and mechanical transport, although in very short supply, had to be used.

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CLOTHING

Immediately war was declared the issue of clothing to airmen was reduced to the war scale, which included only two shirts, and it was discovered that on several of the very dirty sites, such as those on slag tips in South Wales, some of the airmen would not leave the site as they never had a sufficiently clean shirt to wear; in such squadrons morale was undoubtedly beginning to deteriorate. On representation being made to Air Ministry the matter was immediately rectified by authority being given for the issue of a third shirt where this was considered necessary. Attention to such points as this by the unit and headquarters officers of Balloon Command did much to maintain the spirit of the Command at a high level throughout its existence, in circumstances which varied from weeks or months of weary boredom to periods of severe and prolonged bombing attacks.

MEDICAL ARRANGEMENTS

SICK QUARTERS AT BALLOON CENTRES

Before the war, when the balloon centres were used only for training Auxiliary Air Force personnel, the number of regular airmen on each centre was small and there was no need for a large sick quarters. The scale of beds for station sick quarters allowed 1 per cent. of the establishment, with a minimum of four; as the establishment of regular airmen on balloon centres was much less than 400 in peace-time, four-bedded sick quarters were the largest usually approved, while the rest of the accommodation, such as the dispensary, medical officer's consulting room, waiting room and office, was on a similar small scale. Unfortunately, when these buildings were approved, no consideration appears to have been given to the question of expansion in the event of mobilisation nor, indeed, to the accommodation required in peace-time to deal efficiently and rapidly with medical examinations for members of the A.A.F. This lack of foresight in planning became very evident when personnel of the London squadrons were called up for training during the summer of 1939; the tiny sick quarters on each centre was swamped, and medical examinations had to be carried out in a variety of uncongenial and draughty places. On full mobilisation at the outbreak of war, matters became even worse, as each centre was so full that it was practically impossible for medical officers to obtain additional sick quarters' accommodation, unless there was an epidemic such as the influenza wave in 1939, when barrack blocks had to be used temporarily as wards. It was during this period that the skill and experience of the auxiliary medical officers were tested to the uttermost and so well withstood the strain.

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In 1939 very strong representations were made to Air Ministry on this question of inadequate sick quarters at balloon centres, particularly as it was obvious that, if reasonable facilities were to be provided, including special diets, bathing and laundry facilities and close medical supervision, it would be impracticable and wasteful of both medical personnel and stores to establish sick quarters on a squadron basis, except in very special circumstances; the objection raised by squadron medical officers was that they would be unable to supervise treatment of their own patients, but nevertheless they co-operated loyally in the scheme.

Designs for a very simple type of sick quarters, which would allow for ward extensions as necessary, submitted to the Air Ministry by the Chief Engineer's Department at Balloon Command were not accepted, but approval was eventually given for the construction of sick quarters of a much more elaborate design; although very few of these were ready by the end of 1940, the problem of medical accommodation gradually lessened as the new sick quarters were completed.

The question of in-patient treatment for W.A.A.F. personnel is dealt with later under the heading of 'W.A.A.F. Substitution'.

MEDICAL STORES

It is appropriate to mention here the difficulties experienced in obtaining sufficient medical stores for the sick quarters just before, and during the first few months after, the outbreak of war, for perhaps in no other Command was the influx of personnel so rapid and accommodation so incomplete. In the London area, where squadrons at the outbreak of war were at almost full strength, the difficulty in obtaining replacements of medical stores was particularly noticeable, and, as mentioned earlier, squadron medical officers often used stocks from their own surgeries. Finally, however, a directive was issued by Command Headquarters stating that, where urgent demands for medical stores could not be met by the Medical Stores Depot, the minimum requirements should be obtained by local purchase; this tided over the critical period at the end of 1939 and beginning of 1940, until demands could be met from Service sources. No instances came to light of this system of local purchase being abused in any way and, in fact, the total cost thus incurred was only a few hundred pounds—a further tribute to the sound judgment and common sense of the Auxiliary Air Force squadron medical officers.

MEDICAL CARE ON BALLOON SITES

Considerable difficulty was experienced in securing the mobility of squadron medical officers, particularly when it was decided that they should all be attached to their appropriate balloon centre. The establishment of mechanical transport vehicles for each squadron was such that

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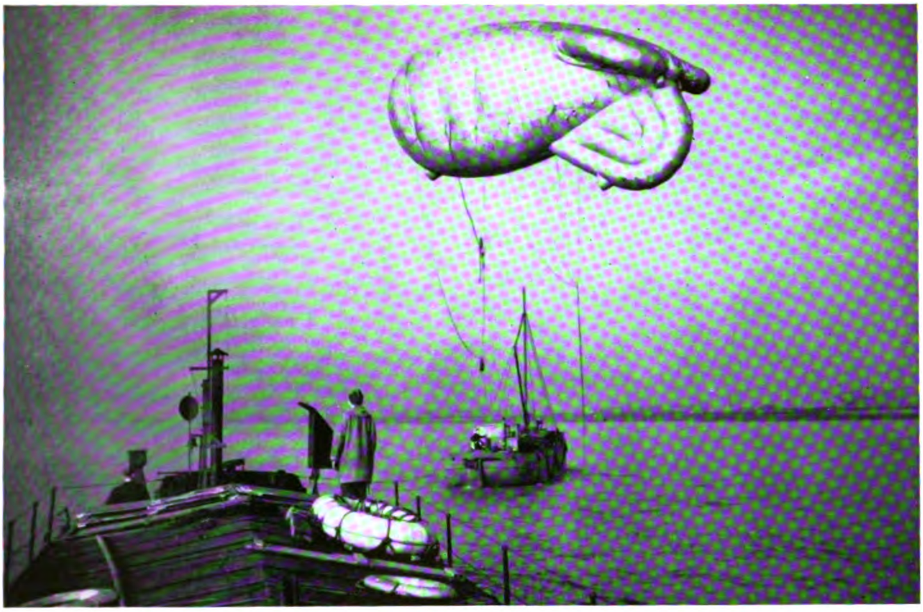

PLATE XXXIV: Barrage Balloon moored to a Barge which provided Living Accommodation for the Crew

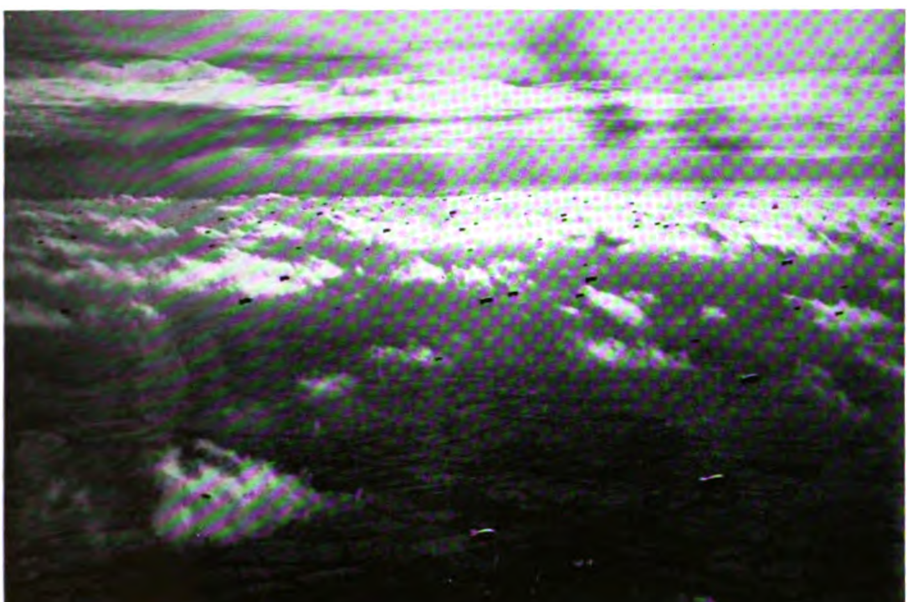

PLATE XXXV: Part of Protective Balloon Screen for the London Area

[facing p. 432

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PLATE XXXVI: Illustrating the Hazard to Balloon Crews in Operation 'Diver'. The Crater caused by a Flying Bomb can be seen just to the right of the Moored Balloon, and the Damage to a Farm Building on the right of the Crew Tent

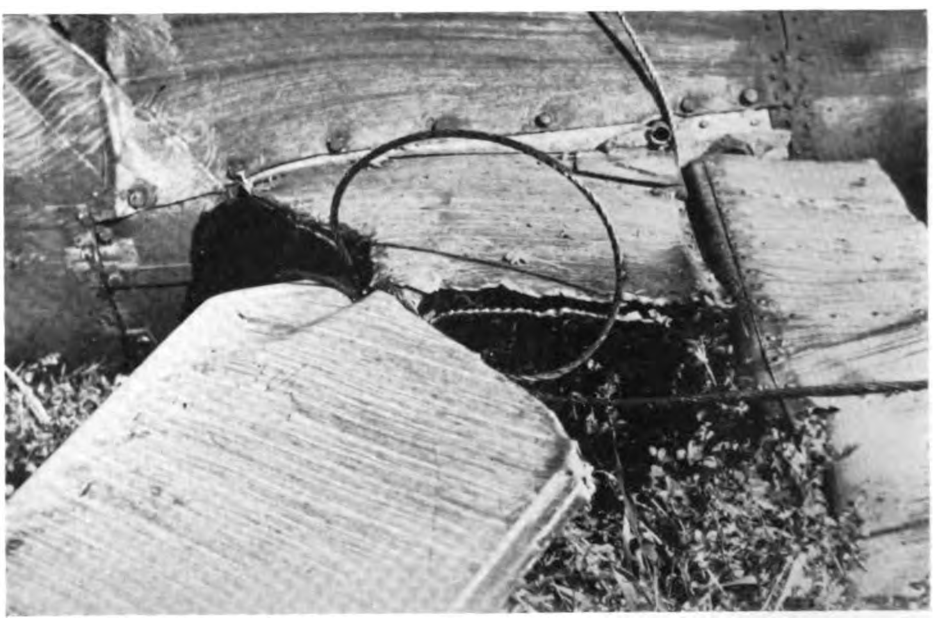

PLATE XXXVII: A Balloon Cable entangling and partly severing the Wing of a Flying Bomb (V.1)

facing p. 433

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the C.O. could not detail a car or van for the medical officer's sole use and although a heavy ambulance was allocated to each squadron and was under the direction of the medical officer, it proved uneconomic to use such a large vehicle for visiting small groups of airmen on widely separated sites, apart from the fact that it could only be used when it was not required for the transport of personnel to or from sick quarters or hospital. Shortly after the outbreak of war, therefore, representations were made by Command Headquarters, personally supported by the Air Officer Commanding-in-Chief, for a small vehicle to be established on each squadron for the use of the squadron medical officer; approval was then given for the establishment of a 5-cwt. van for this purpose.

Attention was next turned to the matter of providing suitable equipment for the use of the medical officer on his 'rounds', so that simple and trivial conditions could be dealt with on the spot and the patient be able to remain on duty; the equipment finally decided upon was a surgical haversack containing a few instruments, ligatures, dressings, etc., and a medical companion equipped with the more common medicaments.

Experience soon showed, however, that more adequate medical attention and better facilities were required than could be provided in this way and squadron medical inspection rooms were therefore established as necessary and daily sick parades and out-patient treatments carried out there, all personnel requiring in-patient treatment being sent to the centre sick quarters. This in no way lessened the need for the full mobility of the squadron medical officer, who often had to supervise at more than one M.I. room each day and still visited sites for hygiene purposes, while it was imperative that he should be able to attend urgent cases of illness or injury at any of the balloon sites without delay.

The introduction of squadron M.I. rooms was undoubtedly a wise move as it not only increased the capacity and sphere of action of each medical officer, thereby reducing the number required without in any way lowering the standard of treatment, but, by providing readily available attention, assisted greatly in maintaining high morale among the crews.

HOSPITAL ACCOMMODATION

During the period of the Munich crisis some consideration had been given to the question of the hospital facilities which would be available for balloon crews if the need should arise, but, in view of the low recruiting figures at that time, the matter had not been of great urgency. In the early summer of 1939, with the rapid expansion of the Command planned and well under way, this problem demanded further attention.

The problem applied not only to the casualties which might be expected in war-time but also to cases of acute illness which, until the

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introduction of the E.M.S. Scheme and the completion of the large balloon centre sick quarters, always presented a problem to the medical officer. The local hospitals, however, had proved most helpful, the local contacts and position of the auxiliary medical officers proving useful in securing their co-operation. Here again, in the early days, the fact that most of the airmen were local inhabitants and the majority of them married, was an advantage, as the medical officer could treat them in their homes or arrange for their own doctor to do so.

AIR RAID PRECAUTIONS—COLLECTION OF CASUALTIES

Closely linked with the question of hospital accommodation was that of air raid precautions, with particular reference, so far as the medical branch was concerned, to the collection of casualties. Little thought had been given to this problem before the outbreak of war and the matter had certainly not been taken fully into account by those responsible for the pre-war medical establishment of Balloon Command units.

Balloon crews were scattered throughout areas where intensive bombing was almost inevitable and it was expected that casualties would be high. Where crews were located in thickly populated districts, the collection of casualties would be undertaken largely by the civil A.R.P. organisation, but the extent to which such co-operation might be expected was not clear and plans were therefore made to utilise Service personnel and equipment as far as possible in the collection of severe casualties. Increased numbers of nursing orderlies were not available for this purpose but, as stated previously, airmen of balloon crews were given simple first-aid instruction and each crew knew the whereabouts of the nearest civilian first-aid posts; a further provision was the fitting of Flint stretcher gear to a certain number of the squadron motor vehicles, as an addition to the squadron ambulance.

As the civil A.R.P. organisation was built up, exercises were held in which R.A.F. balloon personnel took part; many valuable lessons were learned from such exercises and differences of opinion and questions of procedure, which had sometimes caused friction between the A.R.P. officers* in Balloon Command and their colleagues in the civil organisation, were ironed out. A particularly interesting and instructive exercise held in the Portsmouth area towards the end of 1939 was followed by a conference at Headquarters, Balloon Command, attended by senior officials of the civil A.R.P. organisation. It was agreed at this meeting that much remained to be done by both Service and civil authorities to improve the casualty collecting arrangements and that, during this

* The equivalent of the Station Defence Officer on a normal station.

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building-up stage, as much use as possible should be made of the limited R.A.F. resources, if the necessity arose; at the same time it was recognised that R.A.F. casualties would, in the main, be dealt with by the civil organisation, an arrangement which worked satisfactorily in practice.

AIR RAIDS

The maintenance of a high morale throughout the Command was essential. This was fully appreciated by squadron C.Os. and other officers who gave a high priority to this aspect of their duties, achieving considerable success by keeping in close personal touch with their men at all times. The task was not altogether easy. The long periods of inactivity during the 'phoney' war in 1939 and 1940; the very cold winter of that year, when the Command was expanding rapidly and accommodation was often very poor; the fact that the average age of the men was higher than in other operational commands and the acceptable standard of fitness lower; all these were factors calculated to lead to discontent and despondency, and yet morale remained good in spite of them.

There followed the Battle of Britain and for Balloon Command the worst period of the night 'blitz', starting with London and spreading to other large provincial centres. This was indeed a time of strain for balloon crews, particularly those of the London squadrons during the autumn and winter of 1940–41, when attacks were continous and prolonged. Inevitably, living conditions became worse; suitable air-raid shelters were not always available, while those originally provided were intended only for occupation for short periods and now had to be used for sleeping; personnel obtained insufficient sleep when on duty on the sites and frequently when off duty at home; in addition, many of the men were anxious about the safety of their families, who were often facing similar conditions. During this period it was sometimes possible to exchange crews from the badly bombed areas with those from quieter districts and in some instances a large house, a short distance outside London, was taken over by the squadron and put in the charge of the medical officer, so that a limited number of men could be sent there for a twenty-four hour leave period, or in special cases for a longer time, for rest and sleep.

The number of casualties due to enemy action was fortunately extremely low and by May 1941 the worst of the danger was over, so that apart from an occasional raid there was little further enemy activity until the attack by flying bombs commenced in 1944. In the face of this latter assault on London and the provinces, morale remained high and cases of nervous illness few—a further tribute to the quality of leadership among the officers and the spirit of the men.

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DANGERS IN OPERATION AND MAINTENANCE OF BALLOONS

Personnel in balloon squadrons were exposed to certain risks which, owing to the nature of the equipment used, were peculiar to the Command; by strict supervision and careful observance of instructions, however, the number of casualties occurring was reduced to a minimum, although there was an inevitably high figure for hand injuries and, to a lesser extent, leg injuries, caused by the manipulation of guy ropes in heavy winds.

As the balloons were filled with hydrogen it was feared that there would be a considerable danger of explosion and fire during 'topping up' with consequent risk of injury to the crew, but this fear proved to be unfounded. There were several cases of electrocution due either to static charge from the balloon cable or, more often, to the cable fouling high tension grid wires; at a later date rubber gloves became available and were issued to personnel faced with these risks, and accidents were thereby reduced considerably.

Balloons, in common with most air-containing, rubber fabric envelopes, lost a certain amount of gas by seepage; at times, particularly in the early days of the war when replacements were difficult to obtain, if a balloon was losing gas more quickly than was normal, it was necessary to deflate the balloon on the site, pump it full of air, inspect the envelope from the inside and patch any holes discovered, the latter necessitating the use of patching material and rubber solution in a very confined space. On one occasion, when two airmen were working in a balloon, a N.C.O. outside happened to notice that they were very quiet and on investigation it was found that both men were unconscious and that the tin of rubber solution had been upset; this rubber solution, which was used for cementing on patches, was at that time made up in benzol and it was the latter which had been responsible for the men's collapse.

The danger of the use of benzol was also shown by a similar occurrence in the balloon repair shop at R.A.F. Station, Cardington; the Balloon Development Unit located there employed, in addition to R.A.F. personnel, about 300 civilians, mostly female, for repairing balloon envelopes and other maintenance work. Towards the end of 1939, the sudden illness of six of these women with faintness and dizziness brought to light the fact that many of them were exposed to considerable risk of both acute and chronic benzol poisoning and also that the workshop routine for supervision of personnel working in the confined space of a balloon needed improvement.

The help and co-operation of the Medical Department of the Board of Trade was sought and willingly given and after careful investigation it was decided to change the solvent for the rubber cement to petrol, as

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being less dangerous than benzol. Ventilation of the Cardington workshops was improved and arrangements made for regular medical examination of the workers. At the same time, regulations were introduced and strictly enforced to ensure the adequate supervision of personnel working inside balloons; these regulations provided that, whenever work was going on inside a balloon, someone should be stationed outside the envelope and keep in continual verbal touch with the personnel inside.

One curious accident occurred, with fatal results, in connexion with the repair of balloons on sites. Each balloon winch was fitted with an air pump which was used to fill the deflated balloon with air for inspection of the envelope. Two airmen working in a balloon which was being inflated were noted to have become inactive and when steps were taken to bring them out one of the men was found to be dead; his death was established as being due to carbon monoxide poisoning and it was then discovered that the exhaust of the winch petrol engine was broken and, as the inlet of the air pump was near this break, the pump had been introducing a large quantity of engine exhaust gas (carbon monoxide) into the balloon envelope. Instructions were issued for modification of the apparatus and no further accidents of this type were reported.

The usual precautions as to proper ventilation when using dope were insisted upon, as also were the installation of proper facilities for washing and extra rations for personnel engaged daily on such work. The question of first-aid kits for balloon crews was given early consideration and agreement reached on the scale of simple equipment which should be provided, complete with haversack, for each balloon site.

W.A.A.F. SUBSTITUTION

SICK QUARTERS ACCOMMODATION

W.A.A.F. personnel were being recruited and undergoing non-continuous training at balloon centres before the war, so that airwomen were employed at many centres as clerks, telephonists, cooks, etc., even before the policy of full substitution for R.A.F. officers and airmen was introduced and it was essential that suitable medical cover should be provided for these women. The main medical problems created by the mobilisation of the W.A.A.F. were the provision of adequate sick quarters accommodation with reasonable privacy and segregation for both in-patient and out-patient treatment and the provision of adequately trained attendants in the category of nursing orderly.

As previously stated, sick quarters facilities for airmen were inadequate at the beginning of the war, but for the W.A.A.F. such facilities were non-existent. Hospitals usually could not accept relatively trivial cases, such as mild pyrexial upper respiratory infection, but such

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patients were often too ill to remain ambulatory and the medical officer had therefore to treat them in their barrack room or billet or send them home if they lived in the vicinity and could be looked after there. The design of sick quarters eventually provided four beds for W.A.A.F. personnel at units where they were employed.

In spite of difficulties unit medical officers, by arranging admission of patients to civil hospitals, by treating personnel in billets and barrack rooms and by misappropriation of other accommodation, managed to provide reasonable medical treatment until the worst of the omissions were made good towards the end of 1940 and during 1941. No serious complaints of inefficiency of medical attention were received during the period.

MEDICAL AIRWOMEN

During this early period of the war the other serious obstacle to efficiency in the medical care of airwomen was the organisation of the trade of sick quarters attendant, aircraftwoman 2nd class. There was no proper standard of training nor trade testing for these airwomen and no clear outlet for promotion. The women who had volunteered for this work, many of them intelligent, well educated and keen to do nursing, soon found that the branch was a dead end and applied for transfer to another trade. During 1940, this matter was rectified and the medical airwomen were put on the same footing as airmen in the medical trade group. At the beginning of 1941 a Royal Air Force Woman Medical Officer was made available for medical supervision of W.A.A.F. personnel in the Command, and in July of that year a woman medical officer was established for Balloon Command to carry out medical inspections of W.A.A.F. personnel and give lectures to airwomen. The work of these officers among the W.A.A.F. was of inestimable value both to the airwomen themselves and to the Medical Branch as a whole.

W.A.A.F. BALLOON OPERATORS—MEDICAL STANDARDS

Early in 1941, consequent upon instructions from Air Ministry that consideration should be given to substituting airwomen balloon operators for airmen in certain circumstances, a test was carried out at No. 3 Balloon Centre, Stanmore, to estimate the physical capabilities of airwomen for such duties. An empirical standard of physical fitness was laid down but only 40 per cent. of those who volunteered as balloon operators reached this standard; a test carried out in April of the same year on a number of those accepted indicated that these duties were not beyond their capacity and the following medical standard was accordingly agreed:

Height . . Not less than 62 in.

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Physical condition: Grade I. Robust in all respects and capable of lifting weights (minimum 40 lb.) and hauling upon ropes.
Vision and hearing not less than Standard II.
Normal menstruation.

A careful medical check was kept on the first contingent of airwomen balloon operators, including records of pulse rate, blood pressure and weight at the beginning and end of their course of instruction. No deterioration in health was observed; a number of overweights lost weight and underweights gained in weight, while an improvement in health was noted in personnel in each of these categories. Only 6 out of 200 were taken off the first course, all for different medical reasons. As a result of observation, however, it was recommended that the following medical requirements should be added to the standard already advised:

(*a*) No abnormality of bones or joints;
(*b*) No incipient hernia nor genital prolapse;
(*c*) No pregnancy past or present;
(*d*) Weight to be under 140 lb.;
(*e*) Systolic blood pressure to be not over 120 mm. Hg.

Subsequent experience did not indicate that W.A.A.F. balloon operators as a whole suffered any illness which might be regarded as due to the nature of their duties. (*see* Volume I, Chapter 9.)

OPERATION 'DIVER'

This operation was part of the plan to meet a new form of attack by pilotless missiles which the enemy was known to have been preparing for some time; the plan, as far as Balloon Command was concerned, consisted of flying a curtain balloon barrage along the North Downs roughly from Gravesend to Tonbridge (*see* Plate XXXV). At the end of 1943, reconnaissance was carried out to select sites for the 'Apron', after which two new balloon centres were opened, No. 22 at Biggin Hill and No. 23 at Gravesend, while a third centre opened later at Redhill, Surrey. The original scheme envisaged the employment of 480 balloons, and the first phase for the deployment of this number commenced on June 17, 1944, being completed four days later; the second phase, to increase the number from 480 to 1,000, took place between June 24 and July 1, while the third phase, which commenced on July 11, and was completed by July 22, brought the number of balloons up to 1,750.

A chart showing the number of flying bombs entering the curtain area and the number destroyed between June and September, 1944 will be found in the Appendix.

By this stage in the history of the Command, much experience had been gained in the medical and hygiene requirements for units, but the

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medical administrative work necessary to cover this new operation was very considerable and was undertaken by Headquarters, No. 30 Group. Sick quarters with beds for R.A.F. and W.A.A.F. personnel were set up at each of the balloon centres referred to above, beds were made available at R.A.F. Stations Kenley and West Malling and an E.M.S. hospital set aside wards containing a further 150 beds. Each centre had a squadron leader senior medical officer who visited the deployed squadrons' medical inspection rooms, while certain squadrons had medical officers permanently on their strength, the aim being that no individual in any unit should be more than five miles from a medical inspection room and that personnel requiring in-patient treatment could be picked up at the unit or medical inspection room and taken by ambulance to the nearest sick quarters or hospital.

Hygiene and sanitation for such a large number of balloon sites in a relatively small area, presented a formidable problem and were supervised by sanitary assistants established at the balloon centres. In the first phase the early arrivals on the sites had to dig their own disposal pits but later on sites were prepared before the crews arrived. Great care was taken to see that there was no risk to local water supplies, and to this end the local medical officer of health of each of the areas concerned, and a total of seven water companies, were visited. In one small area the disposal of night-soil by burial was prohibited for fear of contaminating wells but fortunately this area contained only 21 balloon sites. When a piped supply of water to a site was not available, water was taken there by water tanker, but the mobile water purification plants were not required, as the water was obtained from purified sources. Cooking was done on the sites on 'Valor Perfection' stoves and proved satisfactory.

Common ailments among balloon personnel engaged on Operation 'Diver' were bronchitis, lumbar fibrositis and recurrent dyspepsia, the last no doubt due to the employment of men with dyspeptic history who had previously been stationed where they could obtain a suitable diet, not available in field service conditions. But sickness rates remained low and there were no outbreaks of disease attributable to faulty field hygiene, a tribute to the thorough manner in which the problems were tackled and to the standard of discipline maintained in this sphere.

The number of casualties due to V.1s. brought down by balloons was not high, amounting to 20 deaths and 84 injured. The hazards from this cause are illustrated in Plates XXXVI and XXXVII. Several deaths were caused by balloon cables fouling electricity cables, but, as mentioned, the provision of heavier rubber gloves of sufficient thickness to withstand high voltages helped to prevent such accidents. There were remarkably few cases of nervous illness and the morale of the personnel remained high throughout the whole period of the Operation

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—indeed the transfer of some of the squadrons from areas where there had been no enemy action for a considerable time improved the spirit of the men and women.

DENTAL STATE OF AUXILIARY AIRMAN RECRUITS

While recruiting for the Auxiliary Air Force was in progress a perusal of the medical examination records of recruits revealed a very poor dental condition in many of those passed as fit for service; this was confirmed by the examining medical officers and it was expected that, in the event of mobilisation, much dental treatment would be required. This proved to be the case, for many men, on being called up for active service, were awaiting dentures, but although these personnel should not, strictly speaking, have been embodied until they were dentally fit, their services were so urgently required that they were accepted. Authority was obtained in such instances for the individual's National Health Scheme contribution in respect of the dentures to be paid from public funds. When there were insufficient facilities available from Service sources, personnel requiring urgent dental attention were treated by civilian dental surgeons in order that they might remain fit for duty with their units.

HEALTH OF THE COMMAND

Circumstances in Balloon Command were similar to those which prevailed in other commands of the Royal Air Force in the early days of the war and to some extent throughout its course; the authorities responsible had to adapt their arrangements to conditions that were recognised to be medically undesirable and had to hope for the best when poor accommodation had to be accepted and, later, when provision had to be made for the women taking the place of men in operating the balloons.

It is thus interesting to note that the Command as a whole had an excellent health record and that diseases, where they did arise, reflected the position in other commands or among the civil population, so that little could be truly blamed on the type of work or the conditions.

Epidemics were few and those that did occur were in the nature of upper respiratory infection occurring in the winter months, when they were equally common among Service and non-Service personnel. Gastro-intestinal upset was recorded from time to time but never in epidemic proportions. No industrial risks appeared, apart from those mentioned in the appropriate section of this account.

Injuries of a minor nature were perhaps more frequent than in other commands, but this was mainly due to the obvious hazards of guy ropes and other equipment peculiar to a balloon site; these injuries, however, showed only a small percentage of fractures, although it was noticeable

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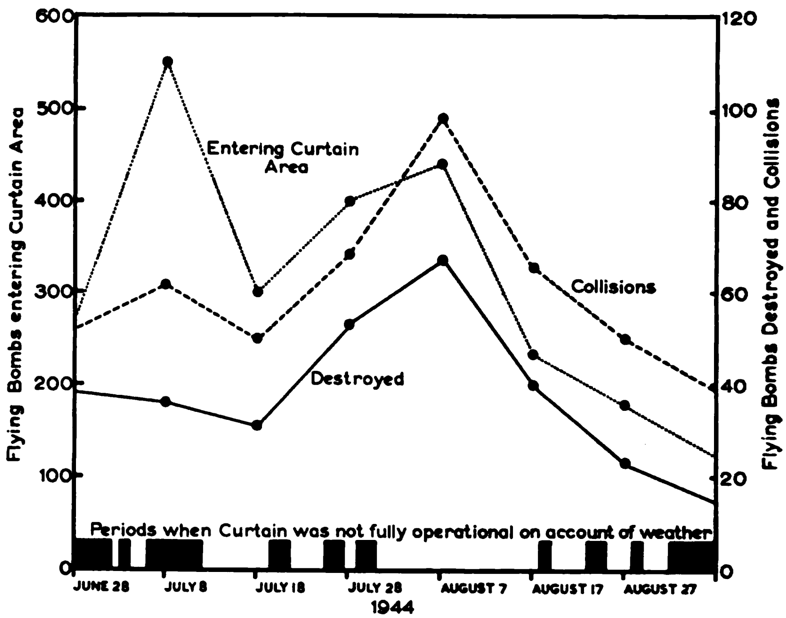
that the W.A.A.F. operators were more accident prone in this respect.

Possibly the greatest factor in the low sickness rate was the splitting up of the Command into many small units on which it was possible to foster a high morale and team spirit and promote good feeling between officers and other ranks; in consequence, the type of person reporting sick for little or no reason was rarely seen in Balloon Command.

APPENDIX



Graph showing collisions and flying bombs destroyed in relation to numbers entering Curtain Area, 1944.

CHAPTER 6

ARMY CO-OPERATION COMMAND

ARMY Co-operation Command was formed on December 1, 1940, and was disbanded on June 1, 1943, when its elements were divided between the new Tactical Air Force and the Air Defence of Great Britain. This account outlines the history of the Command and briefly indicates the circumstances surrounding its formation. The history of the campaign in France is the subject of another narrative, and events which occurred there are only mentioned here in so far as they make this account more easily understood.

The account includes narratives of the training and development of the airborne forces which, in so far as these were controlled by the Royal Air Force, were a responsibility of Army Co-operation Command and a section on the medical aspect of the training of paratroops.

General Narrative

THERE were no Army Co-operation squadrons in existence, as such, during the First World War. However, the early Corps Squadrons became highly efficient organisations by the end of the war, assisting the ground forces in the rôles of:

a. Tactical reconnaissance. *b.* Artillery co-operation.
c. Contact patrol with infantry.

Reductions in all services after the war lessened the requirements for Army Co-operation which, however, remained in being on a limited scale and was later expanded when No. 22 Group of Fighter Command took over responsibility, not only in maintaining Army co-operation squadrons, but also in forming the squadrons which would provide the air arm of any field force sent overseas—the main area for Army Co-operation between the wars. In August and September 1939 the Air Component, destined for France, was formed from the personnel and equipment of the Group, and the force was moved to France during September and October. It consisted of squadrons of Blenheims and Lysanders and the necessary fighter protection, which was provided by other groups of Fighter Command. At home the Group was replenished by fresh intake and its work of training and of supplying the Air Component with personnel was continued. Headquarters of the Component were established at Harceuil, about five miles from Arras, and the squadrons began to settle into the airfields and stations, the development of which had already begun. The force slowly increased in size

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during the winter, and in January 1940 it was merged with the Advanced Air Striking Force to form the British Air Forces in France. The Component then consisted of four Army co-operation squadrons (Lysanders), four bomber reconnaissance squadrons (Blenheims) and four fighter squadrons (Hurricanes). The operational control of the force was vested in the General Officer Commanding-in-Chief, British Expeditionary Force.

The force was not large but there was some difficulty in providing all the needed facilities, for although the twelve airfields available by January 1940 were sufficient at that time, and the quality of personnel and materials was excellent, plans for further development were not far advanced. This was partly due to lack of war experience but was also in some measure due to the peculiar, almost non-combatant, state of affairs which existed and which was not conducive to long-term planning to meet what seemed to be unlikely contingencies.

The weather was bad, both in France and at home, and this, with the factors already mentioned, delayed development. Personnel were trained at the Schools of Army Co-operation in courses of six to eight weeks with an intake of 60 to 80 crews in each course. The bad weather at home delayed and lengthened these courses so that even the small expected number of trained personnel did not materialise. These numbers give an indication of the circumstances at that time, being extremely small in comparison with the numbers in later training programmes, and they reflected to some extent the inertia of the people of this country as a whole, who had been taught that the Germans were fighting a losing battle from the start, and that the longer the war continued the more certain was the eventual downfall of the enemy. The same state of mind, in an attenuated form, was reflected in the life of personnel in France and, despite the preliminary warning of the invasion of Norway, little apprehension was felt, at any rate by the rank and file, until the onslaught by the German forces in May.

The German attack in May developed with such great air strength that the British Air Forces in France were largely swamped. Great exertions were made by the personnel of the Component, both ground and air, during this time, and a large number of sorties against very formidable odds were made. It was during this phase that the good material, both human and mechanical, was so largely in evidence, and the force managed to hold together despite severe casualties in the air and scenes of chaos on the ground. Withdrawal was shortly decided upon as a result of the military situation; it began on May 17, and evacuation followed only two days later. The aircraft were flown home, while the rear headquarters was formed at Hawkinge. Personnel and machines returned to No. 22 Group, where almost immediate use was found for them on account of the extreme danger of the whole

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military position, and they assisted in providing cover for the withdrawal of the B.E.F. The disbandment of the Component as a force was completed by August 1940.

The shock caused by the evacuation of the Expeditionary Forces and the complete defeat of France can hardly be exaggerated, and everyone began to question the size and efficiency of this and that branch of both the Army and the Royal Air Force. There were many valuable lessons to be learnt, not only from the campaign in the Low Countries and France,* but also from that in Norway,* then rapidly drawing to an unsuccessful close. Co-operation between the Army and the Air Force was not the least of the problems, and the realisation came that the enemy had over a period of years evolved a technique which was greatly superior to any yet practised by this country. It also became obvious that the problem was not merely one of size, and that the efforts of the Air Force and the Army, however great, would be wasted unless the forces were capable of acting as one. A further result of this serious and chastened thinking was the realisation that certain definite types of machines would be needed for Army co-operation work, and that it would not do to call upon unsuitable aircraft, such as those of Coastal Command, which had been pressed into service for the destruction of enemy tanks and disorganisation of troops on the march during the Battle of France and the subsequent evacuation.

A decision to separate No. 22 Group from Fighter Command and establish it as an independent Group under Air Ministry was reached in June 1940, and this decision was hastened by two important considerations: one, the importance of freeing Fighter Command from the burden of No. 22 Group, whose whole purpose was Army co-operation, and two, the need for more authoritative action and independence in the creation and development of Army co-operation work.

NO. 22 GROUP

The stations under the control of the newly formed independent Group were as follows:

Andover	Manorbier
Castle Bromwich	Odiham
Cleave	Old Sarum
Christchurch	Redhill
Farnborough	Ringway
Gatwick	Speke
Grangemouth	Watchet
Kidsdale	Weston Zoyland

* *See* Volume III.

The Group continued to function on the same basis as before, so that the stations housed operational squadrons on the one hand and aircraft and personnel for development and training on the other. Some of the operational squadrons were maintained as lodger units at stations in other Commands, and all of them were under the operational control of the Army authorities. Non-operational work was greatly developed during the last half of 1940, and was mainly the concern of the Schools of Army Co-operation, the Anti-Aircraft Co-operation Units, the Special Duty Flights and the School of Photography. Anti-aircraft co-operation had originally been carried out in part by civilian pilots flying civil aircraft, but the work was taken over in February 1940 by Service personnel and aircraft, for which purpose a wing had been formed to provide day and night flying for Army anti-aircraft and searchlight schools in training areas and certain operational areas. This was No. 110 Anti-Aircraft Co-operation Wing and it consisted of five units, whose individual headquarters acted as maintenance bases. The aircraft were operated in small detachments from suitable airfields at any stations which happened to be in the neighbourhood of the Army unit for which co-operation was provided, and these stations supplied accommodation and administrative facilities. Several stations in Wales were established during the autumn of 1940 to accommodate some of these units, as well as the target towing flights, Queen Bee* flights, and other separately formed anti-aircraft co-operation units, which had been at work for some time throughout the country.

The Group became slowly larger, despite the pressing urgency of the other commitments of the Royal Air Force, due to the increasing realisation of the importance of Army co-operation work. The increase in size and unwieldiness and the very wide geographical distribution of stations, as ideas were gradually put into effect, began to show that a Group was not a large enough entity to administer the whole of the activities of Army co-operation. On December 1, 1940, therefore, a command to be known as Army Co-operation Command was formed to carry out all Army co-operation work and to take over the commitments and functions of No. 22 Group, which was then disbanded.

ORGANISATION AND POLICY OF THE COMMAND

The Command consisted of Command Headquarters and two Groups, No. 70 and No. 71. The former, which took over training and development, had Headquarters at Farnborough, where Command Headquarters were also temporarily situated until the move to Bracknell, while No. 71 Group undertook the operational work with Headquarters at Sunningdale. This organisation fulfilled the demands

* Pilotless, radio-controlled, target aircraft.

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implicit in the purposes of the Command, which were re-defined at the time as follows:

(*a*) To control all Army co-operation work;

(*b*) To co-ordinate the training of pilots and crew for the formation of new squadrons ;

(*c*) To maintain a reserve of pilots and crew, and to be responsible for training new squadrons up to war efficiency, arranging for their movement to a theatre of war as might be necessary. The actual transport of Air Force units overseas was an Army responsibility.

The directive to the A.O.C. in C. gave precise instructions. The commander of the operational group was to act in the capacity of an air officer commanding an air component, and he was to carry out his work under the operational control of General Headquarters, Home Forces, while an appropriate proportion of the air branch of the staff of this group was to be located at General Headquarters. The two groups together were to comprise all Royal Air Force units specifically engaged in Army co-operation duties in Britain, and were to be under the Air Officer Commanding-in-Chief, whose responsibility towards the Commander-in-Chief, Home Forces, was to consist solely in ensuring the efficiency of the air forces in the operational group. Any air forces provided by other Commands to act in support of Home Forces were not to be the responsibility of the A.O.C. in C., Army Co-operation Command, but he was to direct the policy and training development to be followed by the Officer Commanding, No. 75 Wing, whose squadrons were under the control of the General Officer Commanding-in-Chief in Northern Ireland.

Many serious difficulties then lay ahead, one of the chief of which was the lack of precedent for modern Army co-operation work. Valuable lessons had been learned, but many of them had a negative value, in that certain tactics were clearly unsound, and the experiences of defeat had given but little indication as to how new tactics should be developed and applied. Many ideas were put forward by both Army and Royal Air Force authorities, but there was at first a lack of practical knowledge of the uses and limitations of air power on the one hand, and of the needs of the land forces on the other. Bombing in support of the Army was envisaged in two forms : first, direct support in which the isolation of the battlefield could be attempted by air interference at the periphery and further back on the lines of enemy supply, and second, close support which implied the intervention of air forces in the battle area itself. The latter was applied by the German Air Force with great success in France, but the Army authorities considered that there was a danger in the tendency to expect similar results under all conditions, particularly against

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vigorous and adequate air defence. Similarly questioned was the value of the dive bomber when the attack was made in the face of strong and well organised fighter and ground defences. The question of bomber support was also a problem, and it was not clear whether such support should be the responsibility of Bomber Command or of bomber aircraft within Army Co-operation Command; one of the chief factors in this difficulty was the general shortage of aircrews and aircraft.

The commitments of the Command were a grave source of anxiety to the authorities during the first half of 1941. It was felt that certain non-operational commitments such as glider training, anti-aircraft co-operation and some air sea rescue work* were absorbing resources to the detriment of the primary operational aim. In addition, a substantial number of aircraft (Lysanders) and their crews were transferred to Fighter Command early in 1941, to supplement fighter defences for the expected German invasion of Great Britain by making continual reconnaissance flights.

The expected invasion did materialise, but in neither the place nor manner that had been foreseen. It was in Crete instead of Britain, and air rather than land forces were chiefly employed. Organised resistance to the invasion was over in May 1941, and repercussions began quickly. At home the authorities were widely blamed for the lack of aircraft and airfields which might have assisted the Army, and many began to wonder how this country would have fared had a similar but more powerful attack been made here. These criticisms were largely uninformed, the fact being that there were not enough aircraft and men available to provide adequate strengths both at home and overseas. However, some justifiable disquiet was felt. It is possible that these events coupled with Operation 'Battleaxe' in the Western Desert may have had some influence in determining a change in Army co-operation policy which was shortly to take place. In fact it was felt that the liaison between the Army and the Air Force under existing arrangements was not as effective as it might be, and on July 25, 1941, the proposal was approved in principle that No. 71 Group should be disbanded, and that in its place a number of wings should be formed. It was decided that one wing should be attached to each Army Command at home, of which there were six, and that the wings should be under the operational control of the General Officer Commanding, Army Command. The commander of each wing was to act as Royal Air Force adviser to the General Officer Commanding, Army Command; for all other purposes the wings were to be under the administrative control of Army Co-operation Command. Each wing H.Q. was to consist of approximately seven officers and thirty airmen, accommodated at Army Command

* *See* Volume I, Chapter 11.

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PLATE XXXVIII: Station Defence. Casualty on Stretcher. Attendant in full Anti-gas Clothing

PLATE XXXIX: Removing a Casualty from an Aircraft using a Neil-Robertson Stretcher

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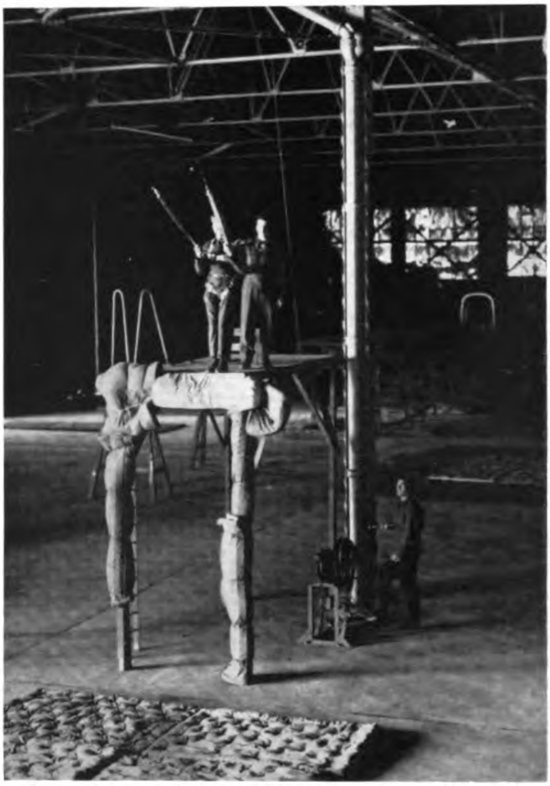

PLATE XL: Synthetic Training Apparatus

PLATE XLI: A Good Landing Position and the result of a Bad One

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Headquarters itself, as well as a number of operational squadrons at airfields, whose situation was dictated by Army requirements and available materials. This arrangement not only gave the fullest opportunity for close contact between the officers of the Army and the Royal Air Force, but gave a more intimate operational control of his squadrons to the Army commander.

MEDICAL ORGANISATION

NO. 22 GROUP

The medical administration of No. 22 Group before the outbreak of war was controlled from Fighter Command, and there were no group medical personnel. The policy of posting a senior medical officer to each group headquarters was not put into effect until after the outbreak of war, and in the instance of No. 22 Group the senior medical officer of wing commander rank was posted on November 1, 1939. This officer had previously been at Headquarters, Fighter Command, and had supervised the medical administration of the Group from that Headquarters.

Some of the junior medical officers on the strength of the Air Component in France were taken from No. 22 Group, particularly those whose squadrons moved to France as a whole unit. The senior medical officers, i.e. the Principal Medical Officer and Deputy Principal Medical Officer, had not previously been associated with No. 22 Group. During the autumn and winter of 1939 other medical officers were posted into No. 22 Group, while a small number left to go to the Component in France. Many of the junior medical officers of the Air Component returned to No. 22 Group after the evacuation from France, and the Group was well staffed with medical personnel during the period of its independence from June to December 1940.

Position Immediately after Dunkirk.—The influx to No. 22 Group stations after the evacuation caused a temporarily chaotic situation. Much material had been destroyed or left behind in France. There were a few stations at which squadrons were housed which did not possess a sick quarters, and in these cases the squadrons were naturally dependent upon their Z.1 scale* of mobilisation equipment. Each station thus presented individual problems and the Medical Stores Depot at Hartlebury was hard at work in regularising the situation as quickly as possible. It was recognised that each Army co-operation squadron had to possess separate field Z.1 equipment, because the squadrons were fully mobile, and so it was arranged that all remnant equipment should be returned to Hartlebury and that new Z.1 scales should be issued. At the same time the conditions at various stations were considered, and stores were

* *See* Volume I, Chapter 8.

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issued according to individual needs and the existing provision of medical accommodation. The confused situation was dealt with adequately and promptly, and almost all demands had been satisfied by the end of the summer of 1940.

Administration was meanwhile being carried on under similarly difficult conditions. One of the worst features of the problem was the lack of information at Group Headquarters as to the location, strength and state of the Army co-operation squadrons which had returned with the B.E.F., and the medical branch was not the only one concerned. Officers of the various branches were accordingly detailed to visit stations, to obtain information and to make local recommendations. The representative of the medical branch who was chosen had been on the staff of the Air Component in France, and thus had a good working knowledge of the squadrons. He was sent first to the Headquarters of No. 22 Group at Farnborough, to consult the Senior Medical Officer, and began inspections of Army co-operation squadrons in the middle of June 1940. Conditions differed considerably from station to station and the medical officer soon became aware of the reason for the lack of information at Group Headquarters. The rapid change, first, from the Air Component to No. 22 Group in Fighter Command, and then from the latter to the independent No. 22 Group, directly under Air Ministry, had proved too much for the administrative experience of some of the medical officers, who did not know to whom they should send medical returns and requests for equipment, or from whom they could obtain assistance in case of difficulty.

The squadrons had lost much field equipment and were particularly deficient in transport vehicles; this had resulted not only in loss of mobility, but also in a diminishing of the 'field' attitude, consequent upon the enforced close association with parent stations. Unfortunately, nearly all the facilities at these stations were overtaxed, and there was in particular a lack of accommodation, which meant that the squadrons did not enjoy all the amenities of a complete station, while at the same time station personnel were also overcrowded.

The situation on such stations where accommodation was mixed or insufficient, demanded both skilful improvisation and ready initiative. All sections of the station were affected as a rule, and there was much competition in seizing opportunities for improvement. The medical officer was consulted continually by all kinds of people about accommodation, drains, grease traps, metalling of roads, provision of men for sanitary duties, disposal of refuse by a civilian contractor, and a host of other matters of daily life. Medical officers who had had previous Service experience were naturally at a great advantage in these circumstances, but the importance of initiative overshadowed even previous experience.

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The Group meanwhile became larger and new stations were being opened and rapidly becoming operational, but there was not a comparable increase in building and equipment. The problems at the various stations were mainly those of finding accommodation, securing adequate messing facilities, and making the hygiene arrangements efficient enough to prevent hindrance of the operational effort.

Some Stations of No. 22 Group. The conditions during the summer and autumn of 1940 are best illustrated by description of a typical Army co-operation station. In June, Royal Air Force Station, Redhill accommodated the Headquarters of No. 50 Wing, No. 16 Army Co-operation Squadron and part of an Army Searchlight Unit: the strengths were 13 officers and 98 airmen, 37 officers and 370 airmen, and 6 officers and 275 men, respectively. All ranks of both Services were accommodated under canvas. Messing was carried out for Royal Air Force personnel in two marquees and food was prepared using an Aldershot oven. Ablution benches, supplied by a main water pipe, were situated in a barn in the neighbourhood of the tents; bathing was carried out in the decontamination centre which had facilities for a plentiful supply of hot water. Latrines were arranged at convenient sites and were fitted with buckets and wooden seats. The disposal of faeces was into pits after which the material was treated with lime and Izal. Soak pit urinals were being built at that time, but only as a temporary measure, as the ground was not entirely suitable. Refuse was collected by a contractor pending the building of incinerators, and other sanitary work was carried out by the sanitary squad.

Technical buildings were of permanent or semi-permanent construction and some had water closets, as had the sick quarters. The latter was of wooden construction and partly protected against enemy air attack; the accommodation consisted of a combined crash and treatment room, a dispensary, two offices (one for the medical officer and the other for clerks), a kitchen and two wards. One ward was single-bedded, used either for an officer or an isolation case, and the other accommodated five beds comfortably while two or three extra patients could be housed if necessary. There were no A or B Category stores (Category A stores were not expendable, e.g. instruments. Category B were expendable over a period, e.g. rubber catheters. Category C were expendable, e.g. drugs and dressings), but there were some expendable stores and many items were on demand; in the meantime the squadron Z.1 equipment was being used. There were two fully equipped ambulances on the establishment of Headquarters, but No. 16 Squadron had no ambulance. Headquarters medical staff consisted of a medical officer, a corporal, a leading aircraftman, and an aircraftman first class. Patients who required hospital treatment were sent to the County Hospital, Redhill, three miles away, or to Princess Mary's R.A.F. Hospital, Halton, or,

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for venereal diseases, to the Royal Army Medical Corps Hospital at Woolwich. There was a new decontamination centre next to the sick quarters and this had a first-aid room, but the building was not protected and there was no sick annexe. The medical share in the station defence scheme was based upon five first-aid posts served by thirty-six stretcher-bearers, mostly personnel of No. 16 Squadron (Plates XXXVIII and XXXIX).

Station medical defence was more than an academic problem owing to the situation of the station; although no bombs had fallen in the immediate vicinity, despite several attacks on the neighbourhood, sick quarters was protected in so far as the windows had been treated with anti-blast preparations or 'scrim'. There were also facilities for the treatment of wounded gas casualties, consisting of sick annexe equipment and an anti-gas box, but there was no accommodation centre for either wounded or unwounded although several proposals were under consideration at that time; one suggestion was that an 18 × 12 ft. garage in the garden of the sick quarters should be converted, decontamination tents being used in the meantime. Several non-commissioned officers and about sixty men had been trained in first aid, and it was the rule for two parties, each of twelve men, to stand by on the receipt of a red warning. Evacuation of casualties in the event of attack or invasion presented a considerable problem. The nearest hospitals were between three and eight miles away, and though these might be within reach of the limited station transport, it was thought that hospitals further afield could not be reached without outside help from the medical officer of health and civilian authorities, who were unable at this time to offer much assistance in view of their own heavy commitments.

The permanent stations, such as Andover, Old Sarum, and Farnborough, presented a very different picture. Accommodation had been planned upon a more generous scale, and other facilities were also available on a peace-time basis. Many such stations had in the course of time acquired extra buildings of one sort or another, notably blocks of married quarters which could be used as barrack blocks. In addition, almost all ancillary buildings were available, and the standard of comfort which was offered was naturally far superior to that which could be expected at stations where there was much new and hurried construction or where tents and temporary buildings had to be used. There was some overcrowding and disorganisation at these permanent stations, but in no instance did the difficulties approach those at more recently constructed camps.

The chief medical concern in the autumn of 1940, after the most pressing difficulties had been solved, was the provision of adequate semi-permanent accommodation throughout the Group before the onset of winter. In general, the problem was solved by the construction

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of wooden buildings of various kinds and the requisitioning of neighbouring buildings, so that all personnel were in some kind of semi-permanent accommodation by the time the cold winter weather, with the attendant problems of blackout and ventilation, began.

MEDICAL PERSONNEL

The Senior Medical Officer of No. 22 Group was in medical charge of the Group throughout the summer and autumn of 1940, and on the formation of the Command on December 1, he continued in this position pending the arrival of the Principal Medical Officer, who had been posted to the Command and took up his duties in March 1941. There were complaints from time to time during 1940 of a shortage of medical personnel, both officers and airmen. These shortages were more apparent than real, and their cause was to be found in the disorganisation following the arrival home of the Air Component. The real shortage of medical man-power did not begin until the spring of 1941.

There were 27 medical officers in No. 22 Group in July 1940 when the strength of the Group was approximately 9,500, including 300 members of the W.A.A.F. Central control was exercised by the Senior Medical Officer of wing commander rank, assisted by two squadron leaders, one of whom remained at Headquarters for the most part, while the other was employed on the visits which have already been described. The number of medical officers rose to 37 at the time of the formation of the Command, when the total strength was approximately 14,000, of whom 360 were W.A.A.F. personnel. The formation of the Command increased the Headquarters establishment by one squadron leader, because a senior medical officer of squadron leader rank was required for each of the new Groups, Nos. 70 and 71, in addition to the squadron leader to assist the Command Principal Medical Officer. This was considered wasteful as the Headquarters of the Command and both of the Groups were within a radius of ten miles, and medical administration and unit medical attention for Command Headquarters personnel could, therefore, conveniently be carried out from one Headquarters. (At that time Headquarters, No. 70 Group, did not require a unit medical officer on account of its proximity to Royal Air Force Station, South Farnborough. On the other hand the strength at Command Headquarters and No. 71 Group Headquarters of personnel living out or in billets was over 460, and a medical officer was considered essential.) It was thought preferable that the proposed new organisation should deal with all medical administration for the Command and for both of the Groups; not only would a squadron leader be thereby freed for other duties, but an economy in station visits would be effected, in that a visiting Command Medical Officer might inspect any station whether in No. 70 or No. 71 Group.

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A proposal to this effect was not at first accepted, but it was put forward again by the Principal Medical Officer, after his arrival in March, and it was finally accepted in July, when Air Ministry approval to abolish the posts of Senior Medical Officer at Nos. 70 and 71 Groups was obtained. A simultaneous request that there should be an establishment for a warrant officer at Command Headquarters was not then agreed to, but the concession was gained at a later date in the year.

It was unfortunate that the change of organisation coincided with a rapid expansion in the strength of the Command and with a further scattering of the stations under the Command's control. These two factors began to cause some difficulty by the middle of the year, chiefly on account of the necessity for frequent visits to new and growing stations. The Command had undertaken all the central medical work of both Groups, and at the same time had to spare for long periods at a time the services of the same squadron leader who had undertaken the visits of the previous year. The situation was not greatly altered by the disbandment of No. 71 Group in the middle of the year, when the separate wings were formed, because within a short time the chain of permanent Army Co-operation Command operational stations had been formed, and these were naturally a medical responsibility of the Command. A further point was that the distance between Command Headquarters and the stations, scattered as they were over England, Scotland and Wales, was so great as to consume much of the time of the visiting medical officer in travelling. There were other Commands, for example, Coastal Command, where the distances involved were as great, but the medical man-power available was on a much larger scale.

Requests for increases in medical establishments at stations had begun to be referred to No. 22 Group Headquarters as early as the summer of 1940, but, as already stated, medical officers did not at that time realise how fortunate they were, despite some disorganisation. There were, of course, some stations at which the influx of personnel did render an increase in establishment necessary. For example, at Farnborough in June 1940, there was one medical officer, a corporal and three orderlies, which was one orderly short of establishment. The medical commitments were: the station personnel of over 1,000, 90 Women's Auxiliary Air Force, 30 to 40 married families, 137 Anti-Aircraft Battery Flight, 715 Instruction Company, and the extra personnel of No. 22 Group awaiting re-organisation; in addition the medical officer had to stand by on receipt of a yellow air-raid warning. The request was then made that another medical officer should be posted to the station and that the station medical establishment should be increased to one sergeant, one corporal and four orderlies. Requests from other stations continued to come in throughout the autumn and winter, and on February 3, 1941,

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authorities at Command Headquarters were instructed to prepare proposals for new establishments, in view of the forthcoming visit of the Establishments Committee. The shortage had become pronounced by December 1940, in view of the increasing size of No. 22 Group, and in February, when the strength of the Command had reached 16,000, the time was fully ripe for an increase.

The general shortage of medical airmen was beginning to be apparent by the spring of 1941, and thus the expectations of the medical authorities at Army Co-operation Command that they might enjoy establishments on a level with those of the other commands in 1940, were not realised, or, if by some fortunate chance a station was able to secure an increase in establishment, it was often impossible to fill the additional posts. The position with regard to the medical airmen continued to deteriorate in 1941 and 1942, and in January 1943, when the Command consisted of Nos. 70 and 72 Group and seven Wings, the establishments against strengths of medical airmen were as follows:

	Total establishment	Total strength
No. 70 Group . .	213	103
No. 72 Group . .	110	90
Wings . . .	261	174
Totals	584	367

The most rapid expansion, as far as medical officers were concerned, was during the first six months of 1941, and in July there were 56. The Wings attached to Army Headquarters had no medical officers on their strengths, and arrangements were made with the respective Deputy Directors of Medical Services of each of the Army Commands for medical attendance upon, and treatment of, the personnel of Wing Headquarters, while at the same time instructions regarding the necessary medical records and returns were issued.

In January and July 1942 the numbers of medical officers in the Command were respectively 59 and 60, and there were no substantial increases when No. 72 Group was transferred to Army Co-operation Command in October 1942. By this time there was a great pressure of medical work at Command Headquarters, and this added to the difficulty of visiting the stations of the still growing Command and made it necessary to reconsider the policy of abolishing senior medical officers of Groups. As a result, these posts were re-established and a senior medical officer of No. 72 Group was appointed on October 10, 1942. A similar appointment at Headquarters No. 70 Group was delayed until December 10, 1942. Attention was drawn at the same time to the shortage of medical officers throughout the Command, but the general

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shortage in the Royal Air Force as a whole made it impossible to increase the strength substantially as had been done in early 1941. The total number of medical officers in the Command at its disbandment was approximately 70.

ENEMY ATTACKS ON ARMY CO-OPERATION UNITS

Some indication has already been given of the attention paid to defence schemes and medical arrangements made in 1940. In fact the stations of No. 22 Group at that time, and of Army Co-operation Command at a later date, were not frequently attacked, although one or two of them appeared to be singled out specially at various times. Royal Air Force Station, Farnborough was first attacked on August 16, 1940, when it was presumed that the chief target was the Royal Aircraft Establishment. Eight Junkers 88 took part in the attack and twelve high explosive and two incendiary bombs were dropped. The only casualties were in the Royal Aircraft Establishment, where two civilians were killed and two others were seriously injured. This was the only deliberate attack upon the station and surrounding Royal Air Force buildings, but warnings, both yellow and red, were of very frequent occurrence. Andover was also an objective during that summer and the dental officer there gave the following report on the several attacks which occurred:

'This station was among the first to experience an air attack immediately preceding the Battle of Britain. It was in the afternoon of July 30, 1940, following an air-raid warning. The patient in the dental chair was sent to shelter and we proceeded to let down and fix the gas proof curtain attached to the window. All electrical appliances were switched off and the spirit lamp put out. Shelter was then taken.'

Apparently the excitement of the moment was very great and at least some personnel watched the beginning of the raid, as is shown by the next paragraph.

'A flight of three Junkers 88 was seen approaching from the west, and we immediately took cover. A stick of five 500-lb. bombs was dropped in a line parallel with sick quarters, about 30 yds. to the north. Some buildings were hit and two officers and one sergeant, who had remained in the buildings, were killed. One officer was badly cut in the arm with flying glass.

'It is of interest to note that one of the bombs fell within 5 yds. of a shelter trench, but no one was injured.

'On return to the dental centre, it was found that all the glass had been blown out of the window. This window was 6 ft. × 6 ft. and was glazed with plate glass. The surgery was in an appalling mess, being covered with dust and plaster as well as broken glass. The time was now around 1630 hours. Efforts were immediately made to clear up some of

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the mess and make the room fit for use next morning. This was accomplished and next day all appointments were seen. . . .

'During several other attacks on this station, bombs were dropped very close to sick quarters. In one, a bomb was dropped immediately opposite the surgery window and about 6 yards away. The building was badly shaken and walls and ceilings cracked, but very little other damage was done. This raid was at night and the writer of this report was away on a maxillo-facial injury course.'

Attacks made on Old Sarum during the same period were of less intensity and, indeed, at most of the stations concerned the most serious effects of the proximity of enemy aircraft were the fatigue and discomfort caused.

Various isolated attacks were made on certain stations during the first few months of 1941 and Andover in particular was attacked several times. Damage was very slight and casualties negligible. The attacks ceased in the summer and both Royal Air Force and Women's Auxiliary Air Force personnel returned to sleeping sites near the airfield, which they themselves preferred because of the improved comforts and amenities.

STATION SICK QUARTERS

The possession of a sick quarters built in peace-time was another of the advantages enjoyed by personnel serving at stations on the permanent list. These buildings were divided into large and airy wards and offices, and lacked no facilities. Stations which were in the course of construction and other stations in 1940 which were accommodated largely in requisitioned premises, were provided with a sick quarters either in a new building of Royal Air Force construction or in a requisitioned house. The policy of dispersal affected the site of sick quarters and late in 1940 two stations, Andover and Gatwick, had dispersed sick quarters in requisitioned premises; meanwhile progress was being made in finding similar accommodation on other stations in the Command. Every effort was made to find it within one or two miles of airfields, and this end was generally achieved; exceptionally, dispersed sick quarters were situated three or four miles away. This dispersal was admirable, not only because it provided greater safety during enemy attacks, but also because the sick could be cared for on a specially chosen quiet site, away from the normal noise of an airfield. There were some disadvantages of which two were important. First, the distance between sick quarters and the airfield increased the use of mechanical transport and the time taken to bring patients into sick quarters; second, a medical inspection room on the station or near the airfield became a practical necessity. These were, of course, already provided on those stations which had a permanent sick quarters, and to which dispersed sick

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quarters were added; the permanent sick quarters was simply turned into a medical inspection room; but construction at new stations was sometimes delayed by the shortage of labour and materials. The words 'medical inspection room' did not really describe the building which was required, particularly on an operational station. It was desirable that a building with sufficient accommodation for sick parades and for the resuscitation of the injured should be constructed. Much could be and was done in a very small space, but at least three rooms were needed to form a satisfactory medical inspection block.

By the end of 1942 many stations had been provided with dispersed sick quarters and a medical inspection room or block on the airfield. All these dispersed sick quarters were in requisitioned premises, most of which had been private houses. They required considerable modification and great ingenuity was shown by medical officers and their staffs in bringing about a conversion of a private house into a well-equipped sick quarters.

THE WOMEN'S AUXILIARY AIR FORCE

The strength of the Women's Auxiliary Air Force in No. 22 Group in June 1940 was only 262. Numbers rose slowly through succeeding months, until there were 367 when Army Co-operation Command was formed on December 1. The increase continued progressively throughout 1941, and there were 1,057 at the end of the year. Two large increases occurred in January and March 1942 and there was a third increase in the months of October and November; at the end of the year the strength had reached 5,000. Administration was carried out at first from No. 22 Group only, but on the formation of the Command, administrative officers were posted to each of the groups, and a staff officer was retained at Command. Administration of airwomen at the Wing Headquarters and at the stations under the control of those Wings, was centralised at Command Headquarters, after the disbandment of No. 71 Group.

All the ordinary trades for airwomen were represented at Army Co-operation Command stations. Many at Ringway, Netheravon and Hurn were employed in the trade of parachute packer: this trade was later included in the trade of Safety Equipment Assistant. Large numbers of airwomen were employed in the trades of Cook and Driver (Mechanical Transport), as they were in other Commands.

All Women's Auxiliary Air Force personnel received necessary medical attention from Royal Air Force medical officers. Women nursing orderlies were posted to any station or unit where airwomen were employed, to provide nursing and treatment. A certain number of women medical officers had come into the Air Force since 1940, and these provided medical attention for airwomen at stations where the

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W.A.A.F. population was large; nevertheless, most of the units to which airwomen were posted had no immediate access to a woman medical officer. This was the position throughout the Air Force, and in 1941, it became a matter of policy to post one woman medical officer to each Command Headquarters, where she would be able to supervise the health and hygiene of all the airwomen of the Command, and to advise the Royal Air Force Command medical authorities on matters pertaining to airwomen. Headquarters Army Co-operation Command shared the services of a woman medical officer from May 1942 with Headquarters Maintenance Command, to whose strength she was posted. The medical establishment at Army Co-operation Command was changed in September 1942 to include a woman medical officer in the rank of squadron leader, but it was not possible to post a full-time woman medical officer until January 21, 1943.

Another advance was made when members of Princess Mary's R.A.F. Nursing Service were posted to Royal Air Force stations in the capacity of Welfare Sisters. These welfare sisters (as distinct from nursing sisters who had been posted to station sick quarters for nursing duties and who had been employed since 1940) had a variety of duties, one of which was to assist in the routine inspections of airwomen, and at the same time to act as intermediaries between airwomen and the medical officer. Lectures on the characteristics of venereal diseases and on sex physiology and hygiene were included in this duty. It was justifiably considered that there were many personal problems which women would prefer to discuss with a member of their own sex who was in a position to arrange matters in a tactful way. One welfare sister was posted to Royal Air Force Station, Andover in June 1942. Two others came into the Command in October 1942 when No. 72 Group was transferred to Army Co-operation Command; these were at Royal Air Force Station, Filey. Apart from these three nursing sisters, much help was obtained from the visits of others who were posted to stations in other Commands.

F.F.I. INSPECTIONS

The 'free from infection' inspections were an important feature of the medical routine. These inspections provided an opportunity for the detection of disease and also for the airwomen themselves to ask questions. In the early days these inspections were not altogether satisfactory, because no clear directions were available for their organisation and procedure, and there was insufficient liaison between the medical branch and the women administrative officers. It was, therefore, fortunate that numbers were small in the early days of the war and that the incidence of sickness was low. Even so, problems arose from time to time; a young Royal Air Force medical officer might,

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for instance, find himself confronted with a difficult situation, in which in civil life he would have had the assistance of an experienced nurse and perhaps some kind of social worker. In 1941 fuller directions were issued regarding the 'free from infection' inspections, and in early 1942 it was decided that the woman administrative officer should be present while a woman nursing orderly carried out an inspection, and that this was to be repeated at regular intervals. Detailed instructions were also issued for the recognition and treatment of pediculosis capitis and various skin complaints.

INCIDENCE OF SICKNESS AMONG W.A.A.F. PERSONNEL

The incidence of sickness among airwomen was not particularly remarkable, but there were matters connected with the organisation of sick parades and medical administration generally, which were of importance. The diseases themselves, which were either peculiar to women or more prevalent among them, presented few problems; of these problems the main were the difficulty of diagnosing venereal disease, and the diffidence felt by some young medical officers, when the question of examination of an airwoman for a gynaecological complaint was raised. Venereal disease was very seldom diagnosed in sick quarters for obvious reasons, and it was inevitable that the medical officer should transfer a patient whom he suspected might be suffering from one of these diseases,* for investigation under a non-committal diagnosis. Medical officers who had no special experience of diseases peculiar to women, often considered that they had little justification for carrying out gynaecological examinations themselves, particularly of older women. There were, too, occasional difficulties in providing a suitable chaperon. It was in dealing with such cases that the presence of a welfare sister was of very great value. Many young girls new to the Service developed temporary amenorrhoea or menorrhagia.

It had always been recognised that airwomen were more prone to report sick than airmen, and that a greater percentage of beds would be required for them. Most of the complaints, however, were of a trivial nature, and it was clear that many girls required reassurance and sympathy rather than treatment. In late 1941 there was a tendency for more numerous and definite psychological complaints to be made. Many of the women involved were misfits in the Service, who were unable to stand up for themselves after removal from the protected environment of home life. The change was thought to be due to the conscription of women into the Services. It is shown elsewhere how difficult it was to deal with men suffering from similar complaints; it was found to be even more difficult to deal with women. The medical

* *See* Volume I, Chapter 5, R.A.F. General Hospital, Evesham.

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officer who possessed the right temperament was able to do much, but medical officers with sympathies and interests directed towards physical disease were not very successful with these cases. The discipline which could be so successfully imposed upon certain men, was largely ineffective, and the majority of these cases eventually came to an invaliding board. This problem of discipline showed itself in other ways, particularly in those cases of airwomen who became sick while on leave or at home. The proper course was for a visit to be arranged by the nearest Royal Air Force medical officer, who would then report to the medical officer of the station to which the airwoman belonged; failing this, a certificate from a civilian medical practitioner was accepted. The position could often be made very unsatisfactory by an airwoman who had no desire to return to duty and cases of this kind were a continual source of annoyance to medical officers. At one station, where the medical officer had discovered that most of these cases were ultimately found to have a psychological basis, it was arranged after discussion that the senior woman administrative officer should interview personally each girl returning from leave, and, in addition, the demeanour of those about to proceed on leave should be observed. It had been noticed at this particular station that psychological breakdowns occurred more frequently after a return from leave than at any other time.

HEALTH OF THE COMMAND

SICK INCIDENCE

Health during the whole of the period under review was good and the incidence of disease was low. The periods in France, during evacuation and in this country before permanent camps had been constructed, did not cause the increase in upper respiratory disease which might have been expected. Statistics for parts of these periods were in some cases lost and in others incomplete, but there was no evidence to show that the conditions under which men were then living had any deleterious effect upon their health.

VACCINATION AND INOCULATION

Men who were called up in August 1939 were vaccinated and inoculated against the enteric group and tetanus on mobilisation, and, although undoubtedly a few escaped vaccination and inoculation as a result of the abnormal conditions prevailing at that time, the great majority were protected. A further inoculation against the enteric group was usually given before proceeding overseas, unless the date of the original inoculation was very recent. However, by the spring of the following year the standard of protection was certainly not 100 per cent. and at the end of 1940, when the state of protection of No. 22 Group as a whole was examined, the percentage of protected men had

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fallen considerably. The figures for certain stations disclosed unsatisfactory conditions; some of the worst were Andover, Cardiff and Farnborough, as well as the Royal Aircraft Establishment at Farnborough, and a Polish squadron at Renfrew.

Station or squadron	Percentage vaccinated	Percentage inoculated T.A.B.	Percentage inoculated tetanus toxoid
Andover	62·8	44·2	22·5
Cardiff	85·3	23·2	23·2
Farnborough . . .	51·6	35·9	25·8
Royal Aircraft Establishment, Farnborough . . .	13·6	0	4·5
No. 309 Squadron, Renfrew	95·9	21·6	13·3

The chief reason given for failure to vaccinate and inoculate during the summer of 1940 was that documents had been lost. However, this difficulty had been removed by the end of 1940, by which time all personnel were due to have annual inoculations, and there was no valid reason why the inoculation state should not be above 80 per cent.*

The percentage who had been vaccinated was usually greater unit by unit than the percentage inoculated; the explanation was that new entrants were almost invariably vaccinated and that it was unnecessary to vaccinate them again for a number of years, unless there was the possibility of contact with smallpox. Inoculations on the other hand were carried out six monthly or yearly, and unless medical officers held frequent inoculation parades and reviews there was nothing to serve as a reminder.

Protection against the enteric group and tetanus was better in 1941, in that there were fewer stations at which only small numbers of personnel had been protected, although the percentages for the Command as a whole were not much higher than in 1940. The vaccination state was quite satisfactory and only a few primary vaccinations remained to be done at squadrons and stations. The inoculation state for the Command as a whole was 85 per cent. for the enteric group and 77 per cent. for tetanus. This was not thought entirely satisfactory and the Command medical authorities issued many reminders to medical officers, who were also instructed to make every effort to overcome objections in those who had conscientious or other scruples.

The figures for the year 1942 showed a slight decline in the percentage protected against the enteric group and a slight improvement in the protection against tetanus.

* The desirable 100 per cent. is more theoretically than practically possible as postings, leave, sickness, etc., render a total protection very difficult to attain on any but the smallest units.

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EPIDEMICS

There were no epidemics affecting No. 22 Group during 1940; a small outbreak of rubella in the early months of the year, which was common to the whole country, did not raise the sick incidence materially. The total number of cases was approximately 200, occurring chiefly at Andover, Old Sarum, Odiham and Farnborough. The outbreak subsided rapidly in April.

There were three minor epidemics during 1941. The first occurred in March, when there were five cases of paratyphoid B among station and squadron personnel at Inverness. The outbreak was at first confined to the civilian population, but a case in the squadron occurred on March 15, and the station was not declared free of infection until April 7.

Between July and September, a few outbreaks of gastro-enteritis occurred at Manorbier, and 220 airmen were affected. The medical officer, at that time of the Royal Army Medical Corps, thought the circumstances serious enough to warrant a bacteriological investigation. Specimens of faeces of the four most severe cases were selected for this purpose, and a coliform organism was isolated and found to be allied to the dysentery group, but it could not be identified.

The illness in the main took the form of diarrhoea to the extent of two to eight stools within three hours, accompanied and followed by abdominal discomfort; only six men presented symptoms for periods longer than three to four days, and apart from these there were a few who passed small quantities of blood in their stools.

The cause of the outbreak was never definitely established.

Another smaller outbreak of gastro-enteritis occurred at Farnborough on September 17 and 18, when 39 airmen complained of colic, vomiting and diarrhoea. The great majority of these patients had recovered within twenty-four hours and there were no further cases.

There were more cases of catarrhal jaundice in the Command than might have been expected; the total for the year was 25, and the majority of the cases occurred in two small outbreaks, one among Polish personnel at Royal Air Force Station, Dunino, and the other at Gatwick. There were 7 cases at Dunino, the first diagnosed on May 31 and the last on August 21. There appeared to be no fixed incubation period, and cases followed at intervals varying from nineteen to twenty-seven days. All the cases were admitted to a Polish Army Hospital in Scotland, where findings proved negative and the opinion was that the cases were catarrhal. It was noteworthy that the squadron was under canvas with the tents pitched in a wood and that personnel had been complaining of the cold and damp. The second series of cases consisted of 9, but these did not occur in epidemic form; instead they were spread out over a period from January to December, and the intervals between cases

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varied between seventeen and twenty-nine days. These cases were also thought to be catarrhal, and were said to coincide with various local increases in the incidence of the disease.

No epidemics occurred during 1942, except for very small and isolated outbreaks of gastro-enteritis at various stations throughout the Command; the first six months of 1943 were similarly free from epidemics.

Skin Diseases

The commonest and most important skin diseases throughout the whole period were scabies, tinea and impetigo. The method of notification of these diseases made the compilation of exact statistics difficult, but in 1942 separate returns from units to Command were requested, so that full information was available from that time onwards. Normally details of each case were not recorded in the sick book at the unit concerned, and a return of the case was made to Command only when the patient was admitted to sick quarters for more than forty-eight hours. Very few cases of tinea required in-patient treatment and similarly many persons suffering from impetigo could be treated as out-patients.

Scabies

The total figures were collected in 1942 for Royal Air Force and Women's Auxiliary Air Force separately; expressed as incidence per 1,000 per annum they were 49 and 76 respectively.

Interest had become centred on the problem of scabies as a result of the increase in the number of cases, and various other returns were asked for by Air Ministry from the beginning of 1942. It was then decided that statistics should be obtained from a check carried out twice a year over a four weekly period. The figures which were returned for Army Co-operation Command were as follows:

Four weekly period	*Ratio per 1,000 per annum*	
	R.A.F.	*W.A.A.F.*
January 1942	45·9	111·6
July 1942	45·5	41·6
January 1943	77·15	108·29

These figures were misleading when considered alone and not in relation to the information supplied from other Commands at home. In fact, the Royal Air Force rate in the Command remained approximately the same as it had been in 1942. No certain conclusions could be drawn from the Army Co-operation Command figures for the Women's Auxiliary Air Force, but it was shown that the rate was high during

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1942, as had already been shown by the separate full figures for that year. Full figures for both Royal Air Force and Women's Auxiliary Air Force were also available for March, April and May of 1943, when the rates per 1,000 were as follows:

Month	*R.A.F.*	*W.A.A.F.*
March	28	52
April	37·4	28·3
May	28	37·8

These figures confirmed what statistics for the other Commands had already shown, namely that the incidence of the disease among airwomen was declining.

Tinea

Tinea infections were widespread, and although there was little statistical evidence, it was again thought that there was a great increase of the incidence in 1941. No estimate of the number of cases was made in 1940 or in 1941, although it was thought to be considerably more prevalent than scabies. It was said to be uncommon among officers and relatively rare among women. The recorded incidence for 1942 was 87 per 1,000 among Royal Air Force and only 7·2 per 1,000 among Women's Auxiliary Air Force personnel. These figures only included obvious cases and took no account of the very high percentage of persons with a slight degree of infection of the feet. The fungus on the floors of bath-houses was often spread by the use of communal articles of clothing, particularly of football boots or games shorts; ordinary cleanliness tended to diminish infection in the groins, but infection of the skin between the toes was not so easily prevented or, once present, eradicated.

Impetigo

The incidence of impetigo in 1942 was 39·6 per 1,000 for Royal Air Force personnel and 14·4 per 1,000 for W.A.A.F. A high incidence of the disease at individual stations usually coincided with a high incidence of both scabies and tinea; there were some stations where there were no cases of impetigo during the year. The tendency of the disease to occur in small outbreaks was particularly well demonstrated among airwomen. Thus three-quarters of the total number of cases occurred at six stations out of the twenty-four to which airwomen were posted.

Naso-Pharyngeal and Respiratory Infections

Naso-pharyngitis, influenza, bronchitis and tonsillitis together constituted the diseases returned to Command under the above heading.

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The incidence for the whole Command during 1942 was 148 per 1,000 per annum; the incidence of naso-pharyngitis alone was 56 per 1,000 per annum. Both influenzal and naso-pharyngeal infections occurred largely in outbreaks, and, owing to the loss of man-hours caused by them, the attention of medical officers was particularly drawn to all possible means of prevention.

Neuroses

The various nervous disorders became more common and more important at the end of 1940, and during 1941. The incidence in Army Co-operation Command differed in no important particular from that in all the Commands at home, and was generally attributed to the same causes:

(*a*) Fear of bombing and the strain consequent upon it, such as loss of sleep and the difficulties of ordinary living arrangements;

(*b*) The difficulties of older men in adapting themselves to Service life in competition with others who were younger;

(*c*) Fear of the consequences of bombing upon relatives and homes.

Venereal Disease

The incidence of venereal disease was in no way remarkable. The rates per 1,000 were as follows:

1940 No. 22 Group	1941 Army Co-operation Command	1942 Army Co-operation Command	
		R.A.F.	W.A.A.F.
9·5	5·87	7·17	3·84

The figures for 1940 are approximate, because there was some administrative difficulty in collecting returns, and some misunderstanding on the part of medical officers regarding the correct way to establish the diagnosis. The position was that the suspicion of venereal disease did not justify its immediate diagnosis and, therefore, until infection had been confirmed, it was only possible to return the case under such a general term as urethritis. This was then recorded pending confirmation, while the patient was passed for investigation and treatment to one of the numerous centres, which might be under Royal Air Force, Army or civilian control. There was thus room for errors in the returns made from Group Headquarters in 1940, and later from

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Command Headquarters in 1941. Other statistics were collected centrally at Record Office, and these represented the original statistics with all the necessary subsequent corrections. In these latter statistics the cases were returned as either primary or other cases of venereal disease. On the other hand, the statistics compiled at Command showed the precise nature of the infection. There were, inevitably, discrepancies between these two sets of figures and the rates quoted for 1940 and 1941 are based on the figures from the central returns. In 1942, the figures agreed in all respects, while both sets of figures indicated that there had been no cases of venereal disease among airwomen in the Command for the years 1940 and 1941.

THE MEDICAL CARE OF FLYING PERSONNEL

Problems of purely medical importance were not numerous in Army co-operation work. Both training and operational flights were carried out at low altitude* so that oxygen and specialised flying clothing were not of special importance, while the incidence of such conditions as otitic and sinus barotrauma was low, although a few medical officers reported on these conditions from time to time. The medical officer at Andover in 1941 found that pupils at the Operational Training Unit possessed only scanty information on the subject of oxygen and barotrauma. The Dominion pilots were better informed, although few of them realised the importance of reporting sick when suffering from a cold in the head. A Canadian medical officer of an Army Co-operation squadron described a small number of cases of rhinitis with subsequent sinus pain, as a result of changing altitudes within comparatively narrow limits. Cases were naturally much more common in personnel of No. 140 Squadron (see footnote below), but there they were more easily treated, possibly because the pilots had a better understanding of the complaint. All medical officers who had experience of the conditions were agreed that it was important to give squadron commanders the fullest possible facts, so that they might send any of their personnel suffering from a cold to the medical officer before allowing them to fly. Pilots did not like to report sick on their own responsibility with something which they thought trivial.

The medical care of flying personnel and the work of flying personnel medical officers under all conditions have been fully dealt with in other chapters of this volume, especially in Chapter 1, Bomber Command, and so need not be repeated here.

* Flying carried out by No. 140 Squadron was exceptional in that it included both very high and very low reconnaissance flights.

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Parachute Training

June 1940 *to July* 1942.

GENERAL ACCOUNT

THE Central Landing School was formed in July 1940, at Ringway near Manchester, to train all airborne forces. It was organised in three sections, a glider section, a parachute section and a technical development section. The airfield selected was originally the civil airport for the City of Manchester, and a suitable area for dropping paratroops was found at Tatton Park, 8 miles distant.

The German invasion of the Low Countries in 1940 had shown the important part which could be played by airborne troops, and it was decided at a conference at the Admiralty that 5,000 paratroops should be trained as soon as possible. The squadron leader selected as Commanding Officer of the Parachute Training School (P.T.S.) estimated that training could be completed within three months provided that the necessary facilities were made available.

The first men to be trained were 500 volunteers, who had undergone a thorough ground training course in Scotland and were all of the Army grade A1. These men were first class material and had in every instance volunteered from serving battalions; their training was completed early in 1941. The next batch of volunteers was drawn from Infantry Training Centres (I.T.Cs.) and holding battalions of the Guards; the former had been told that they were wanted for 'special service duties' but did not discover what these were to be until they arrived in Scotland, with the result that out of 200 men, only 48 volunteered for parachute training. Some of these personnel had had only two months' service in all and their physical condition and mental outlook were in many instances most unsuitable. Those who had volunteered from the Guards, however, wanted without exception to undergo parachute training. During this period the discipline and morale of the original trainees had deteriorated badly, and many of the men were lost through sickness or because they were considered unfit for their special duties. On June 28, 1941 there were only 360 men on the strength of the battalion and the numbers were still falling despite the replacement rate of 40 a month.

In May 1941 the Prime Minister visited Ringway and the Parachute Training School, to inspect progress. The position, even at that time, was far from satisfactory, and this visit brought the state of affairs to the notice of the proper authorities, so that policy decisions were taken which resulted in the large scale training which began in November 1941, when the aircraft establishment was brought up to the following strength:

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Whitley Mark V.	4 + 1
Whitley Mark II.	4 + 2
Anson	1 + 1

Training on the new scales was on a regimental basis; the men were trained at a rate of 300 a fortnight and the first brigade was fully trained by the end of February 1942.

METHOD OF TRAINING

Preliminary Training. The training of paratroops began with what was called synthetic training (Plate XL), and took place in Scotland, at Ringway and later at Hardwick*; the aim was to reproduce as nearly as possible, in suitable stages, the conditions which the parachutist would meet later when making his actual drops. This training consisted of various exercises to promote agility and improve physical condition and to teach the correct attitude for dropping and the gymnastics of landing. The period devoted to this training was originally seven to ten days, but this was later extended to 14 days. When this was completed the trainee made two jumps from the captive balloon and five from an aircraft. The seventh drop completed the preliminary training.

The captive balloon had a gondola attached to it, rectangular in shape, with a circular dropping aperture in the centre. Four men sat on the floor around the aperture surrounded by canvas walls which were at first deficient in two places so that two of the men had a sheer drop on one side and the aperture on the other. This was most unpleasant, as the sensation of height was very powerful and jumps from the balloon were not popular for this reason. The aircraft employed was the Whitley which had a dropping aperture and normally accommodated 10 parachutists, who were so placed that each man might drop with comparative ease. The balloon drops were usually carried out at 600 ft. and those from the aircraft at 500 ft. Special clothing, designed for warmth and ease of movement and including protective helmets and boots, was worn for all drops. The parachute, the 28 foot Irving, was attached to the jumper's back.

METHOD OF JUMPING

Two methods of parachute jumping were utilised: (*a*) A free drop, in which the jumper pulled the parachute release himself after he had fallen clear of the aircraft. This was the method used when it was necessary for aircrew to abandon an aircraft or when one or two persons (e.g. special agents) were being dropped. (*b*) Mass dropping, when the

* Hardwick opened in November 1941, every intake thereafter passing through that unit before going on to Ringway.

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jumpers did not release their own parachutes but the release was automatic and in no way controlled by the jumper. This was the method used for the dropping of paratroops. A hook fastened to the statiline or strop of the parachute bag was attached to a wire running the length of the aircraft which allowed each man to move down the fuselage of the aircraft ready to jump; on jumping the bag was pulled off the parachute which then developed, the statiline and bag remaining attached to the aircraft.

An explanation of some of the commoner terms associated with parachuting is given below:

Aperture . .	The space in the fuselage through which the parachutist jumps.
Statiline . .	The line or strop attached to the aircraft and the parachute bag.
Parachute bag .	The canvas bag in which the folded parachute is placed.
Rigging or lines .	The silk cords attached to the periphery of the parachute and to the harness.
Web lifts . .	The two pieces of webbing that run vertically to the parachutist's body and receive the attachment of the rigging. (They correspond to the ropes of a swing.)
Harness . .	A system of webbing straps by which the parachute is fastened to the parachutist.
Development .	The formation of the characteristic parachute canopy from the folded parachute.
Stick . .	The name given to the group of personnel dropping from an aircraft.
Container . .	The container was used to carry equipment, arms or medical supplies and was either pushed out of the aircraft or dropped automatically. It was usually dropped in the middle of the stick of jumpers so that it would on landing be handy to the majority of the stick.

The Drop—Individual. The drop from the captive balloon was relatively simple although certainly unpleasant. It later became the routine that the parachutist should himself be responsible for the attachment of the hook to which the line was attached, which would open his parachute. The parachute usually opened almost immediately.

The drop from the aircraft was modified by the effects of the slip stream which, by striking the legs, at first exerted a couple of forces, pushing the upper part of the trunk in the direction of the nose of the aircraft. This effect was scarcely noticeable when the parachutist

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dropped from the forward part of the aperture, but was much more marked when dropping from aft the aperture, as it then combined with a man's natural tendency to look down and was liable to cause somersaulting.

The parachutist still possessed a forward speed in the same direction as the aircraft which he had just left, and consequently when his parachute opened he was inclined at an angle to the vertical. The oscillation caused by this angle and observed shortly after the full development of the canopy died down quite quickly and, as a rule, there followed a period of steady descent until the height was reached at which ground gustiness occurred (*see* Figs. 6-8). This usually initiated the second oscillation which might be continued to the ground.

Certain types of incorrect exit from the aircraft and consequent mal-development of the canopy were observed which could give rise to dangerous conditions. For example, a forward somersault might result in the legs or arms becoming entangled in the rigging lines, so shortening the latter that full development of the canopy was prevented.

A common phenomenon, the cause of which was for a long time not properly understood, was twisted rigging lines. This consisted of a twisting of the parachutist's body relative to the unopened parachute, so that as the canopy developed the lines begin to untwist rapidly. When this occurred on exit the parachutist had to grasp the web lifts in order to prevent his momentum twisting the rigging lines in the opposite direction. This was not always successful and occasionally rotation continued until the ground was reached. The fault was seldom found to occur in drops from the balloon, while in drops from the aircraft it was four times as common when jumping from forward of the aperture than when jumping from aft.

A rarer form of mal-development, known as 'thrown lines', in which one or more lines were thrown over the canopy, very occasionally caused complete inversion of the parachute. The rate of descent was increased but there was little or no oscillation, and it was calculated that one thrown line increased the speed of descent by one and a half times and two thrown lines doubled the speed. Another fault occasionally associated with thrown lines was 'rolled periphery', also associated with complete inversion of the canopy.

The Drop—By Pairs or in Sticks. The problem of the drop was complicated by several factors when the dropping was done in sticks (in the early days a 'stick' comprised 10 men). The parachutist might strike the statiline or strop of the man dropped immediately before him; collisions might occur between men and containers or the parachutes of the containers; the container parachute might blow back through the rigging lines of the man who had just dropped, or the man might pass through the rigging lines of the container's parachute. The effect in any

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of these cases was that the two parachutes were locked together after the development of the canopies and the parachutist was usually compelled to land in this fashion.

The Descent. A good exit from the aircraft promoted the success of the descent, although in many bad exits the last part of the descent was still successful. The oscillation which began at the level of ground gustiness could be controlled to some extent by appropriate pulling on the web lifts, while the weather factor might increase or decrease the speed of descent, but any such effect which caused a decrease in speed of descent was less obvious nearer the ground. During the descent the parachutist should be preparing himself for landing, and he was taught to gauge his line of drift from movement of trees and from the direction which he himself was taking. During training smoke was manufactured on the dropping ground to assist the pilot of the aircraft; at the same time this informed the parachutist about wind direction. He was further taught to turn himself into his line of drift by grasping the opposite web lifts and making the appropriate movements. He was instructed to keep his feet and legs pressed firmly together, and to make no attempt to retain his feet, but, whenever possible, to land by falling forward (Plate XLI).

The Landing. The six types of landings were classified after a large number had been observed at the Central Landing School. They were as follows:

(i) Falling forwards. This included all landings carried out in the approved manner, which was as follows: taking some strain by the feet, pressed close together; then falling on to knees, upper part of thigh and finally the shoulders, turning the trunk and pelvis in so doing, in an endeavour to take the main strain on either the left or right trochanter of the thigh.

(ii) Sitting or on back. This included those instances where an almost vertical descent resulted in the man sitting down after touching the ground, as well as those instances where oscillation or a failure to turn into the line of drift threw the man on to his back.

(iii) Standing. Where a man retained his feet after impact with the ground, or where practically the whole shock was taken by his legs, so that the man very nearly retained his feet.

(iv) Falling sideways. This commonly occurred when the man was facing squarely into his line of drift, but had a sideways oscillation. It also included those cases where a man was facing at right angles to his drift.

(v) Sliding forward in sitting position. This type of landing was so characteristic that it has been separated from the class 'sitting or on back'. Slippery or frosty ground was an important factor in its cause

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and it usually occurred on a forward swing or when there was considerable drift. The legs were held very much forward and the feet began to slide after touching the ground. The slide continued after the man's buttocks had also touched the ground.

(vi) On knees. This class included only those where the man finished on his knees.

R.A.F. STATIONS, NETHERAVON AND HURN

The preliminary paratroop training was completed at R.A.F. Station, Ringway, after which the paratroops went on to R.A.F. Stations, Netheravon or Hurn, where advanced training was carried out. This corresponded in many respects to the operational training of flying personnel. The Whitley aircraft used were fitted up in the same way as those at Ringway, but in addition American machines were in use, the latter having a capacity of 20 paratroops instead of the 10 carried in the Whitley. The dropping was from a side door in these machines, not through a floor aperture.

The men were expected to know the technique of jumping and landing and their training was mainly devoted to improving their efficiency as soldiers in their special branch. Dropping was therefore carried out under conditions which were not as favourable as those at Ringway, in that it was necessary to teach the men to adapt themselves to landing on unknown ground in order to develop their initiative and co-operative action.

The number of drops carried out was varied to suit individual requirements, the men remaining meanwhile in the neighbourhood of the stations.

Paratroop training was first carried out at Netheravon in March 1942 and at Hurn later in that year. In the period from June 1940 when paratroop training began until July 1942 there were two actual operations—the first over Italy in February 1941 and consisting of 36 men dropped from Whitley aircraft; the second, on a larger scale, when paratroops were dropped in Northern France during the Bruneval raid in February 1942.

MEDICAL COMMENTARY

CHRONOLOGICAL ACCOUNT

Medical responsibility for paratroops was at first in the hands of the Army and an Army Medical Officer was posted to the first battalion. A Royal Air Force Medical Officer was posted to Ringway in January 1941. He then undertook medical responsibility for the Army parachutists, and treated and disposed of any cases of injury. He was always present when jumping was in progress. His work was carried out under difficult conditions as there was no accommodation, other than the ambulance

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for immediate treatment. After visits by experienced medical officers from the Institute of Aviation Medicine, Farnborough, it was suggested that a medical officer, skilled in parachute jumping, should be posted to Ringway and accordingly in May 1941 a suitable medical officer was established to devote himself almost entirely to paratroop medical problems.

The original batch of 500 had almost without exception consisted of fit and tough men. They did not therefore present any great problem in connexion with their fitness for parachute training. As previously mentioned, however, the next intake of trainees was from Infantry Training Centres and Guards Battalions which meant that the men were either new recruits or, in the case of the Guards Battalions. unfit for first line duties by reason of sickness or accident. As might be expected, the morale of the Guards was good, but that of the men from the Infantry Training Centres was far from satisfactory. The men were selected by the Army Authorities and their first medical examination for fitness was carried out by their Unit Army Medical Officer. The early trainees were examined by another medical officer at a school of training (Commando) near Fort William. After January 1941 there was a third routine examination by the Royal Air Force Medical Officer at Ringway. The Army medical officers did not know the physical requirements of a parachutist, and indeed few people in this country had any very clear ideas about the medical aspects of parachute descents. As a result, some of the men who arrived at Ringway for training were found to have such defects as rupture, flat feet, chronic ear disease, or defective vision. These men were of course useless for training and after some time, when the numbers of trained parachutists had dropped considerably, it was suggested to the War Office that the Royal Air Force standard for Air Gunners, namely A3B, should be adopted as the standard for parachute trainees. This recommendation was accepted, but unfortunately the examining Army medical officers did not possess the necessary equipment for this specialised examination, with the result that unfit men were still arriving at Ringway for training as late as July 1941.

A War Office conference was held on July 10, 1941 under the direction of the Army Director of Hygiene and it was agreed that there had been disregard of the previous medical standards and that men passed as fit were in fact unfit. It was eventually decided that the standard for Warrant Officers, N.C.Os. and men should remain Army category A1*,

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* Army Council Instructions, 1940, paragraph 373, defines Army category A1 as follows:

'A man shall be able to see to shoot or drive, and can undergo severe strain without defects of locomotion and with only minor remediable disabilities.

'It is the degree of disability and the probable effect on function which is of importance in classification, not the fact that a slight disability exists.'

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with the addition of the following qualifications:

(*a*) the candidate to be between 22 and 32 years of age, of average height and of a maximum weight of 196 lb. stripped;

(*b*) his visual acuity to be 6/12 in each eye without glasses and colour vision standard 'Defective safe' or higher;

(*c*) the Eustachian tubes to be patent and the candidate able to hear a forced whisper at 10 ft., with his back to the examiner, using both ears;

(*d*) the candidate to have at least 8 sound or repairable teeth including 2 molars in the upper jaw in good functional opposition to the corresponding teeth of the lower jaw; dentures not to be worn during descents;

(*e*) old fractures of the lower limbs or spine were to disqualify;

(*f*) the candidate must possess an alert mind—in doubtful cases intelligence tests to be used.

These new standards were decidedly more satisfactory although it was found that there were physical disabilities in some of the candidates who were passed fit, and that these physical disabilities, although of little consequence normally, did constitute a definite handicap during descent and landing. Medical officers who had never seen a parachute descent had little idea of the strains and risks implicit in the procedure. One such medical officer gave the confident opinion that the chief danger was the shock to the body when the parachute opened; in fact this risk was negligible. One officer was passed fit for training as a parachutist who had a shoulder paralysis, which prevented him from lifting one arm more than 90° from the body; he had been passed fit for flying duties by an R.A.F. medical board, but it will be realised that during a parachute descent it may be necessary to turn the body into the line of drift before landing and that this entails reaching up with hands crossed above the head, grasping the opposite web lifts and pulling vigorously. The officer was unable to do this and had to be rejected. The standards which were finally laid down were in fact founded upon the impressions of those who had watched a large number of descents.

The R.A.F. standard of A3B was thought by the R.A.F. medical officer at Ringway in June 1941 to be too high in many instances and he suggested that, as more information about paratroops had become available and the attitude towards their training had improved, the modified A1 (Army) standard would prove satisfactory. This standard did in fact justify itself during the training of the 1st Brigade later in the year. The change made the examinations much more simple for the Army Medical Officers, as it dispensed with the special apparatus for the examination up to standard A3B and they were able to examine a candidate with reference to terms with which they were thoroughly conversant.

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CAUSATION OF INJURIES

A visiting medical officer emphasised the strenuous nature of the course at Ringway and pointed out that it involved the stress and strain of descent, as well as the fatigue of soldiering afterwards. He found that the general impression among instructors and observers was that a man of short, stocky physique was least liable to injury and he suggested that a chart should be kept on which the following details were recorded.

(*a*) Nature of injury.
(*b*) Age, weight and height of parachutist.
(*c*) Wind and weather at time of jump.
(*d*) Number of jumps made and number of hours training.
(*e*) Instructor's report.
(*f*) Progress.

By January 1942 enough experience had been accumulated for a report to be issued. This was compiled by two medical officers, both of whom were experienced parachutists and well qualified to discuss the problems both medical and technical on all phases of parachute training. The report was based upon approximately 11,000 parachute descents from aircraft during the training of the second and third parachute battalions in November, December, and January 1941–2.

Injuries could be caused in the following four ways:

(*a*) On leaving the aircraft the face might strike the aperture, the following man's boot, or the previous man's strop. Striking the face was an injury peculiar to men jumping from aft the aperture and it was thought to be caused by the natural tendency to look down, added to the effect of the slip stream striking the legs, which tended to cause a forward somersault. The chin, nose or forehead might be struck in this way but the injuries were usually slight. Fractures were unusual in drops from the aircraft, but they were relatively common in drops from the balloon, until the gondola was no longer rigidly fastened to the balloon, but slung from it by means of strops, so that its position was not continually changing as air struck the balloon.

(*b*) The legs, or in some cases the arms, might become entangled in the rigging lines. This was always due to a bad exit, usually to somersaulting, and all observed cases occurred when men jumped from aft the aperture. Eleven such cases were observed out of two thousand drops. The landing consequent upon such an exit was usually bad—i.e. if the legs were entangled in the rigging lines, the landing was of necessity on the buttocks, but no injuries from this have been

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recorded. One fatal case occurred when a man's canopy failed to develop after a somersault exit.

(*c*) Injuries in descent might be caused by a man colliding with a container or, more rarely, with another man. It was also possible for a man to sustain injury by the container falling on top of him. One of the chief causes of entanglement between the man and the container was the human element—i.e. when the button was pressed to drop the container, the latter dropped automatically and immediately, but when a man's number was called there was often some delay between that time and his leaving the aircraft. For this reason the man who jumped before the container left the aircraft, might find himself in close proximity to it immediately after exit; or in some cases the man following the container might strike the statiline of the latter.

(*d*) By far the greatest proportion of injuries occurred on landing and these are dealt with in greater detail later in this narrative. Night drops from the balloon were associated with a greater incidence of injury, particularly when the light was very bad, for the parachutist could not then make adequate preparations for landing as he did not know the nature of the ground below him or its proximity.

INJURIES DURING SYNTHETIC TRAINING

There were very few cases of injury during synthetic training and in the period under review only sixteen cases of injury occurred during ground training at Ringway. Of these, eight were caused during practice dropping through the aperture, six of them occurring while dropping in sticks of ten. Dropping in sticks was the most dangerous form of parachute training.

At Hardwick, where the men were under Army control and therefore an Army responsibility, the total injuries during training (synthetic) averaged about 7 per cent., of which 1 per cent. did not go on to Ringway on account of the injuries received.

Synthetic Training at Hardwick. The same endeavours to produce efficient trainees for training and to co-ordinate the training in general were made at Hardwick. Personnel should have been absolutely fit on arrival, after examination by their Regimental Medical Officer, but in order to confirm this, they were seen again by the medical officer at the training centre. Night vision was always tested and an ophthalmic examination carried out, if details of a previous one were not already recorded. A failure on the Archer lamp disqualified the candidate. Intelligence tests were invariably held, the standard required being SG3, that is, just

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below average; doubtful cases were seen by a psychiatrist. It was observed that men of higher intelligence were not always suitable and that ordinary, unimaginative men were the best material. Each candidate underwent a swing test which consisted of going on the swing for twenty minutes; if he was sick or felt very uncomfortable, he was given another test the following day and a further test the day afterwards which lasted for forty minutes. A man was not necessarily ruled out by failure on the swing test or poor night vision.

INJURIES DURING DROPPING

The injuries caused during dropping show that the commonest were those to the lower limbs, followed by injuries to trunk, shoulder, head (concussion), upper limbs and face. The total number of injuries in dropping during the period under review, namely November 1, 1941 to January 31, 1942, was 223, out of 11,190 jumps, that is very nearly 2 per cent. Injuries to the lower limbs numbered 141 and of these knee injuries were the most common and caused usually by indirect violence, as for example, sprains to the internal lateral ligament—a common injury—and the various internal derangements of the knee. Fractures were fairly common; there were 18 of the tibia and 19 of the fibula, in some cases the two injuries being co-existent. Sprains were frequent but many of them caused very little disability. Injuries to the trunk were not as a rule serious. Bruising was very common and was related to the frequency of landings in the sitting position; but again such injuries did not normally cause lengthy disability. Five descents, one of which was a balloon night drop, resulted in crush fractures of the vertebrae. It is interesting to note that each of these men had done more than four drops and in the case of the balloon descent it was the man's ninth drop. Three of the cases were fractures of the first lumbar, the others of the 11th and 12th dorsal vertebrae and of the 4th dorsal vertebra respectively, the last injury being caused by sharp flexion of the head on the chest, whereas the others had landed heavily on their buttocks. It has been noted that trunk injuries of every type occurred almost without exception during dropping in high wind speeds. Injuries to the shoulder and upper extremities numbered 21, of which 18 were injuries to the left shoulder. A point of importance was concerned with injuries to the acromioclavicular joint in that such injury prevented a man from turning round in his harness, on a future drop, until the disability had been entirely removed. Injuries to the clavicle itself were surprisingly rare, there being only one case of fracture. Injuries to the area below the shoulder were frequently caused by trauma on exit through entanglement in the rigging lines or striking the hand or forearm on the aperture.

Concussion. Concussion was relatively common (19 cases out of the total of 223) and was frequently caused by landing on the back. The

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Physical Training Department at Ringway have described how a man's head might whip back after a faulty landing on the back, but the appearance of the accident suggested that the body touched the ground first on the buttocks, then on the shoulders and finally the head; at the same time it must be remembered that concussion could be caused by indirect violence to the head, i.e. by a jar transmitted up the vertebral column. In this connection it is interesting to record that there was a common mild injury associated with landings on the back, namely bi-lateral sprain of the sterno-cleido mastoids, thought to be due to a powerful involuntary contraction of these muscles to prevent a blow on the back of the head.

Medical Facilities. Medical equipment was provided more or less in the light of experience. It will be remembered that the Royal Air Force Medical Officer at Ringway had no accommodation other than the ambulance for the immediate treatment of casualties and this state of affairs continued for some time after the arrival of the second medical officer, although since May 1941 there had been a paratroop sick quarters staffed by 2 masseurs and 2 nursing orderlies. In November 1941, a hut was built which gave a good view of the whole dropping ground and which had facilities for necessary preliminary treatment. Casualties were collected by two Morris ambulances and there was also the use of an Albion ambulance from Ringway S.S.Q. in emergency. The hut was used as an office as well as a first-aid room where stitching and splinting and other such measures could be carried out. The equipment held was not elaborate and included only essential material, i.e. :

(*a*) A field fracture pannier.
(*b*) Various splints and necessary materials for stitching.
(*c*) A nitrous oxide anaesthetic machine which proved most useful while splinting fractures.

Disposal of Injured Personnel. Each patient was of course carefully examined, but many were ambulant cases, as for example, those suffering from mild sprains or small cuts; more serious cases were taken to Station Sick Quarters, Ringway, while those which could not be dealt with there were sent to the R.A.M.C. Hospital, Davyhulme, and thus passed out of the hands of the Royal Air Force and became an Army responsibility.

DISCUSSION OF INJURIES

The synthetic training at Hardwick was very strenuous and, as already stated, the average injury rate was as high as 7 per cent., in comparison with only 16 cases of injury during ground training at Ringway between November 1941 and January 1942 when approximately 1,500 men were trained. The low rate at Ringway was possibly accounted for by the 'weeding out' at Hardwick of injury-prone men. The medical

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officer who visited Ringway at intervals during the first part of 1941 reached the conclusion that injuries occurred in the following types of individual:

(i) those in the higher age groups;
(ii) the long legged;
(iii) the stupid;
(iv) the over confident.

Fig. 1 below records the incidence of injury against the age of the parachutist; this graph shows a peak at the age of 22, then falls quite rapidly until the age of 26 is reached, after which it again rises steeply in a straight line. The first peak has been interpreted as due to over-confidence, which in a sense is a type of stupidity. The material from which the graph was made was taken from drops at Ringway, and if the interpretation be correct shows that many over-confident parachutists passed through Hardwick without having incapacitated themselves. The strictness of the regime at Hardwick and its value as preliminary ground training are shown indirectly by the accident rate and the good material which arrived at Ringway as a result.

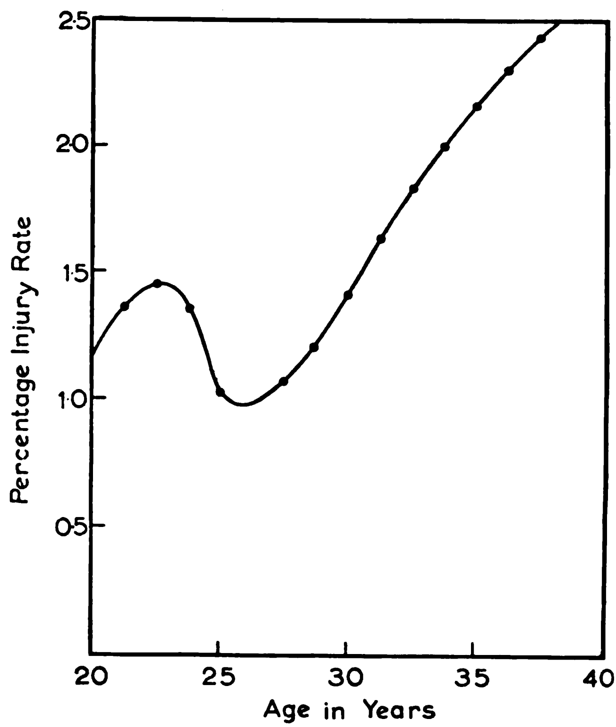

Fig. 1. Graph showing Injury Rate against Age.

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Three simple graphs have been prepared from the Ringway material which show the injury rate against height and weight, and leg injuries against ankle flexibility (*see* Figs. 2, 3 and 4); these show that the danger point with regard to weight is at 12 stone and that thereafter the injury rate climbs quite steeply as the weight increases. The graph of injury rate against height shows a danger point at 5 ft. 11 in., after which the graph rises very steeply. The leg injury rate shows a graph of the same shape, a steep rise occurring where the ankle flexibility is less than 31 degrees.

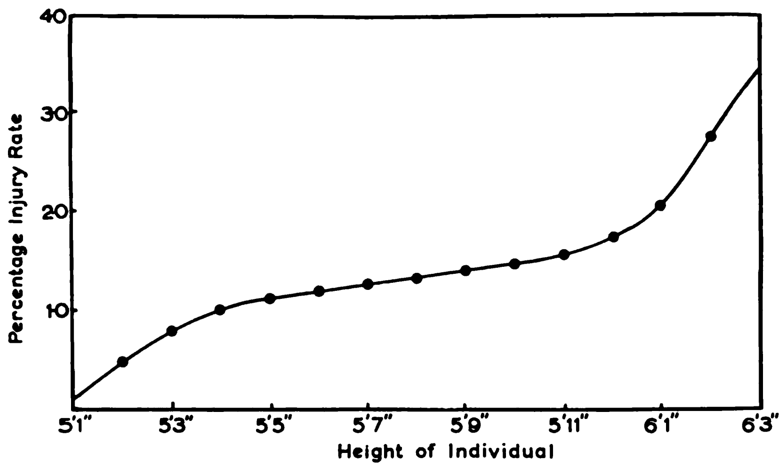

FIG. 2. Graph showing Injury Rate against Height of Man.

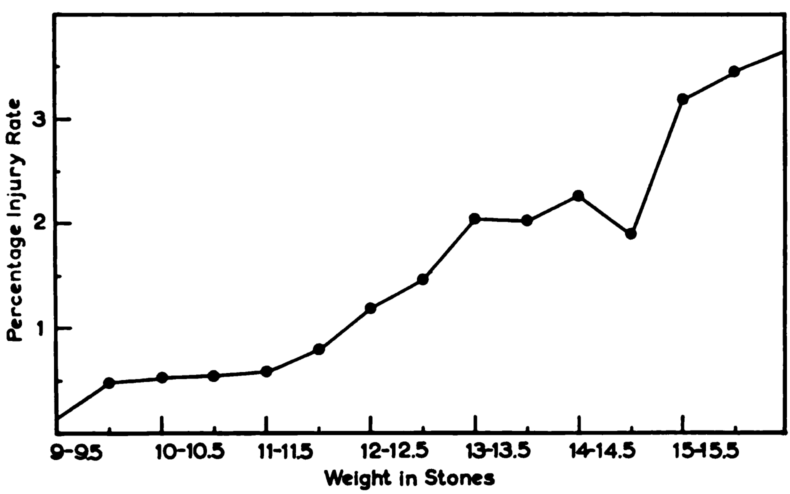

FIG. 3. Graph showing Injury Rate against Weight of Man.

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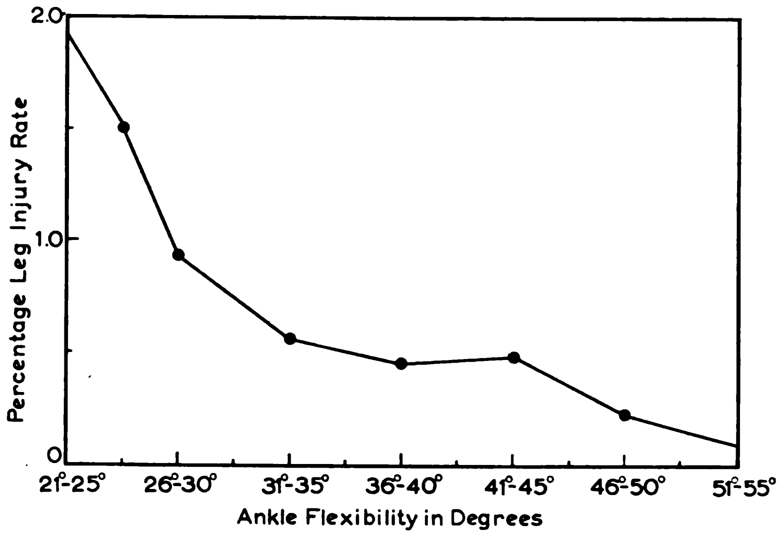

FIG. 4. Graph showing the Rate of Leg Injuries against Ankle Flexibility.

A point of great importance was the length of time for which injured men were disabled. Injuries were classified as major or minor and during training there must have been a temptation to feel relief at the low incidence of serious injury; from the operational point of view however, all injury, except of the most trivial character, had to be regarded as serious, in so far as it rendered the soldier unfit to carry out his duties. Any casualties among paratroops were more serious than casualties, for example, among infantry, because owing to the relatively small number of parachutists usually employed, they represented a greater proportion of the total strength. Large numbers of cases of injury, such as bruises, sprains, minor tears of muscular structures and mild concussion, caused disability of two to three days; some of these men would probably retain most of their value after an operational drop but the cases of concussion in particular might become an embarrassment rather than a help. It has been estimated that some cases of mild injury including severe shake-up from heavy landings would be fit for action within five to ten minutes.

Fractures of the leg above the ankle have been incriminated as having caused the greatest number of days of disability, but in general any fracture caused a long period of disability and concussion also required a fairly lengthy recovery period.

All operational drops were made from aircraft and it was therefore in a sense fortunate that the balloon jumps were found to be considerably more conducive to injuries than aircraft jumps in the same wind speed. The injury rate for balloon jumps—taken from 3,860 balloon descents—was 1·27 per cent. or ·38 per cent. for serious cases; for aircraft, the corresponding figures were 1·46 per cent. and ·73 per cent.; this relative safety of balloon dropping was due simply to the low wind speed in which the balloon was normally flown. For operational purposes, though no doubt every effort would be made to secure advantageous weather conditions, the latter must to some extent always remain unknown factors (*see* meteorological notes for further discussion of wind speed and other weather factors).

Any landing which was in the forward direction with the feet together was taken to approximate to the landing as taught. Bad landings were reckoned to be those in which gross mistakes were made, such as landing with the feet wide apart or falling on to one outstretched hand. One hundred and eighty-seven bad landings were recorded and showed a total of 7 injuries, which gave an injury rate of 3·75 per cent., a figure substantially above the over-all injury rate of nearly 2·0 per cent. It was interesting to note that, for wind speeds up to 14 miles per hour, experienced men made bad landings more often than inexperienced men, while the reverse was true for higher wind speeds. In general, as might have been expected, the proportion of bad landings was found to diminish as experience increased.

The Royal Air Force Consultant in Orthopaedic Surgery visited Ringway in March 1942, to investigate fractures of the spine due to parachute descents. One of the reasons for this visit was that there had been reports of paratroops under training sustaining fractures of the spine, unrecognised until weeks or months later*. It was pointed out that the two mechanisms of spinal fracture in parachutists were:

(*a*) Forcible flexion of the spine;

(*b*) Vertical compression of the spine.

A more strict interpretation of the correct method of landing was then adopted and on this basis it was estimated that only 20 per cent. of landings were made in the correct manner; it was further stated that the man remained standing in 9 per cent. of landings and that nearly 60 per cent. of landings were made in the sitting position or on the back. The parachute harness was criticised as the probable cause of the frequency of landings in the sitting position as the strapping was supported by webs across the front of the shoulders tilting the man back into a sitting position. By analogy with the injuries of civil life, in which a heavy fall on the feet or buttocks is the commonest cause of simple compression fracture of the spine, it was expected that parachute landings in the standing or sitting position would be the chief cause of such fractures. The incidence of spinal fracture, namely 5 out of 11,000 descents, was

* It should be emphasised that paratroop trainees invariably made little fuss over their injuries, and this did not assist in the detection or diagnosis of latent spinal injury.

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lower than expected, but it was suggested that this figure might not be accurate for the following reasons:

(*a*) Simple compression fractures of the spine were difficult to recognise on clinical examination and might escape detection by X-ray unless lateral radiographs of first class quality were taken.

(*b*) There were 26 cases of bruised back (buttocks, sacrum and lumbar regions) out of the 11,000 drops, and these superficial injuries might have concealed the more serious internal condition.

(*c*) The paratroops left the school after their last jump and usually proceeded on leave almost at once. Since they were 'tough' they may have failed to report pain in the back until much later on when the pain persisted.

(*d*) A spinal fracture was in one case first recognised only after six months and in two other cases there were delays of 2 and 5 weeks respectively. Although the series was small it gave, if accurate, an incidence of 1 overlooked spinal fracture in 320 drops.

The Consultant therefore recommended that since the actual incidence of fracture was not known, every effort should be made to detect suspected cases and to arrange for full radiographic examination in instances of apparently mild injury to the back, this vigilance to be maintained after the troops had returned to their units. In addition the medical officer at Ringway should be informed of any cases which arose at a later date, in order that proper records could be maintained. A modified parachute harness and rubber landing pads were recommended from the equipment point of view.

The Consultant drew attention to a sentence in the 1942 Injury Report which read:

'Crushed fractures of vertebrae—this injury renders a man permanently unfit for parachuting and may cause a permanent disability in the form of chronic backache.'

The Consultant was unable to agree with this except in the case of comminuted fractures due to hyperflexion, and he considered that adequate treatment gave such fractures an excellent prognosis.

Fatal Accidents. Post mortem examinations were not carried out on those cases of fatal accident which occurred from time to time, and the valuable information which they might have furnished, not only with regard to injuries caused in parachute dropping, but also about injuries from many other causes, was not obtained. It was of course perfectly obvious that the men had died from gross physical damage and therefore there was no difficulty in certifying the cause of death; but a certificate which read 'Death from multiple injuries' covered all factors such as

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the site and nature of any fractures, the behaviour of the heart and great vessels under conditions of severe strain, the state of the nervous system, etc., detailed knowledge of which would have been of great value to those concerned with the various problems of parachute descent.

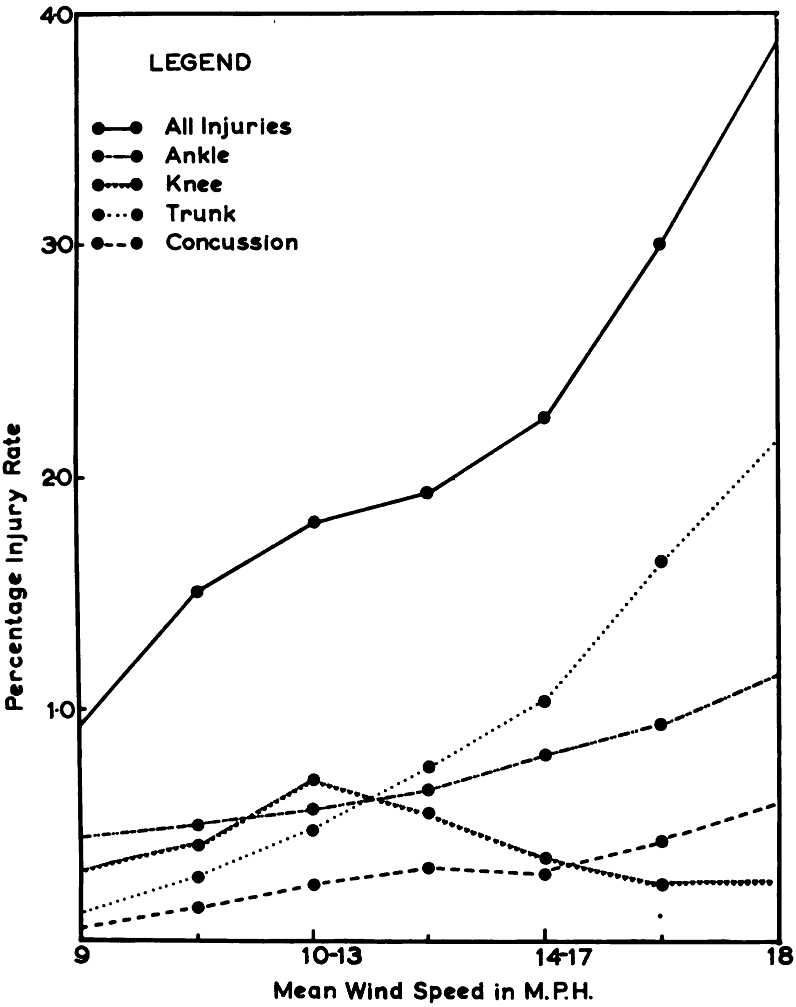

FIG. 5. Graph showing Injury Rates against Wind Speed (Velometer) for different types of Injury.

OTHER FACTORS OF IMPORTANCE

METEOROLOGY

Much research was carried out on the ideal conditions for parachute descent and on the conditions which were likely to cause accident or

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injury. Omitting such obvious dangers as fog, the factors to be taken into consideration were found to be:

(*a*) Wind speed;
(*b*) Gustiness;
(*c*) State of the ground.

A graph has been prepared (Fig. 5) which plots the percentage injury rate against the wind speed in miles per hour, and this shows injuries to various parts of the body as well as the total injuries. With one exception injuries of all types show a fairly steep rise as the wind speed increases, the graph for trunk injuries climbing steadily at an increasing angle. The exception is the curve for injuries to the knee, which shows a peak at wind speeds of 10 to 13 miles per hour; the curve then falls to near its previous level.

The problem of gustiness and its relation to the incidence of injury was a complicated one, but it is generally true to say that both serious injuries and total injuries rose fairly sharply when the maximum speed of the gust exceeded 20 miles per hour (Fig. 6). The same applies if the percentage of injuries is plotted against the speed of the hour's maximum gust (dynes). Up and down currents also affected the landing by decreasing or increasing the speed of descent. Fig. 7 shows the behaviour of the parachute on the edge of up and down gusts respectively. It will be noticed that the parachute is drawn in to the up gust and pushed away from the down gust. Fig. 8 shows the increased probability of landing in down currents. The unbroken line shows

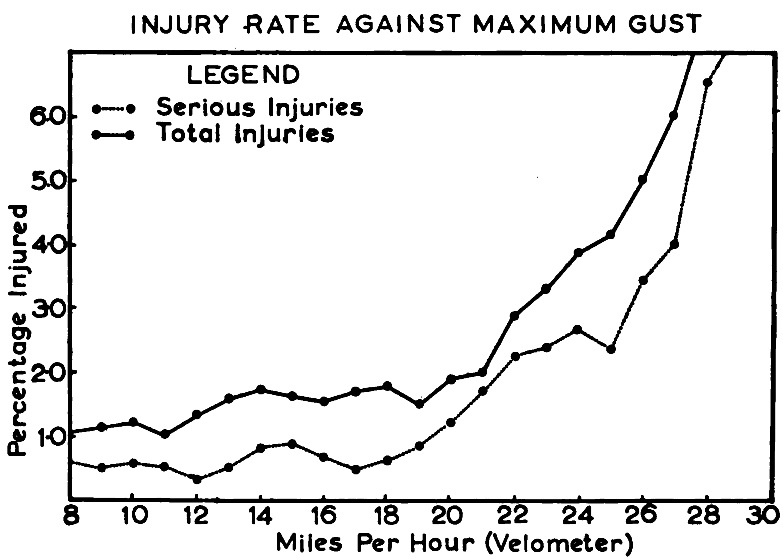

FIG. 6. Graph showing Injury Rate against Maximum Gust (Velometer).

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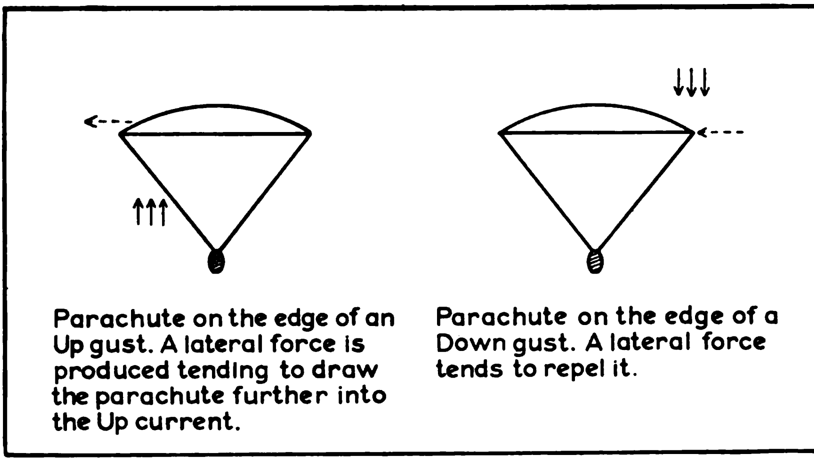

FIG. 7. Diagrams showing effects of Air Currents on Parachutes.

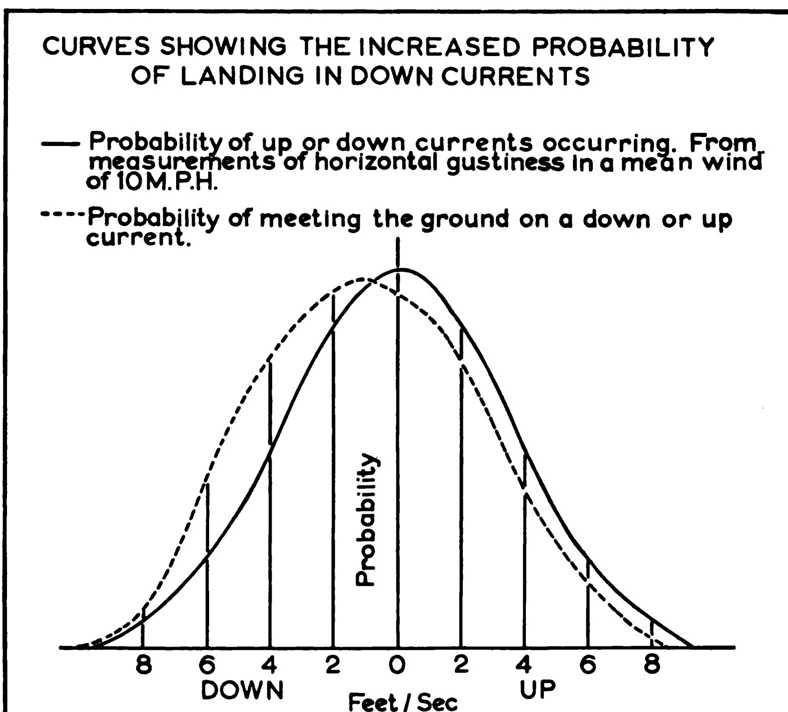

FIG. 8. Curves showing the increased probability of landing in Down Currents.

the probability of up or down currents occurring and the broken line the probability of meeting the ground on a down or up current. The broken line curve shows a shift to the left.

The state of hardness of the ground in this country was found as a rule to be relatively easily assessed. Ground which was frozen hard was naturally more likely to cause injury on landing.

The conclusions reached from the 11,000 drops at Ringway may be summarised as follows:

(*a*) It was undesirable to drop trainees in wind speeds of more than 15 miles per hour, as measured 10 ft. above the ground—readings taken at levels higher than this did not give reliable information about conditions on landing. The velocity at which the ground was struck in a wind speed of 15 miles per hour—excluding oscillation and vertical currents—was the resultant of the wind speed and vertical rate of descent i.e. approximately 16 ft. per second. It should be remembered, however, that a free fall was more likely to cause injury than an oblique impact at the same speed, as in the latter case energy was absorbed in a greater distance and over a larger area.

(*b*) The information obtained on the relation between gustiness and injury was not regarded as entirely satisfactory, but in general it was thought that there would be a sharp rise in injuries where the speed of the maximum gust was above 20–22 miles per hour.

(*c*) Wind speeds and gust speeds should be recorded on the dropping ground, as it was found that the correlation between injuries and wind speeds, measured at the exact moment on the landing ground, was much closer than that which was shown between injuries and the anemometer traces obtained at Ringway. This knowledge may be applied in the following practical form, conditions being divided into three classes:

(i) not expected to become unjustifiably dangerous during period of dropping;

(ii) expected to become dangerous for brief stretches during the period;

(iii) expected to be dangerous for the greater part of the period.

It was thought that a competent person on the dropping ground might decide the degree of danger by careful watch on the velometer, and be able to give warning when he considered that conditions were dangerous.

AIR-SICKNESS IN PARATROOPS

There were no recorded instances of air-sickness in paratroops who were trained at Ringway, except for the case of one man who refused to drop on April 26, 1941, during an exercise. On this day, one man complained of agonising pains in the stomach on entering the aircraft and had to be carried out. The second man then fell through the aperture

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and said that he had injured his back. The third refused to enter, saying that he was afraid of injuring himself. The fourth man—the case in question—copied this example, but was shamed by the instructor into entering the aircraft. He failed to jump because he was later sick in flight. It is justifiable to regard this case as not having been one of true air-sickness, but almost certainly of nervous origin.

On the 'Colossus' operation* in which 36 men were taken over the south of Italy there were three cases of air-sickness during the first leg of the journey, which lasted for 10½ hours. Air-sickness occurred only towards the end of the journey and the men had recovered by the time they arrived at their destination, although one was described as being as 'weak as a kitten'. There was no case of air-sickness during the second and shorter leg of the flight.

The problem of air-sickness was found to be closely linked with the care taken to control the accessory factors which tended to cause vomiting. These are not discussed in detail here (*see* Bomber Command, Chapter 1), but it may be remarked that a suitable diet, warm, comfortable clothing and protection from noises, vibration and unpleasant engine smells were of great importance.

Cases of air-sickness were noted among parachutists undergoing advanced training at Hurn and Netheravon; some of them were thought to be of nervous origin, and it is probably true to say that men who were able to accustom themselves to the relatively short flights involved during their previous training did not afterwards become air-sick. It has been pointed out, however, that the excitement and novelty of the situation might act advantageously and once this had worn off air-sickness might occur in individuals who had never before experienced symptoms.

INTERIOR LIGHTING OF AIRCRAFT, AND DARK ADAPTATION

The training aircraft were originally lighted by one fairly bright light situated in the roof, forward of the aperture, on the port side. The instructor had a standard hand torch by the light of which he made sure that the statiline on the jumper's back was attached to the hook. This arrangement was criticised as being unlikely to inspire confidence, as the jumper's life depended upon the correct attachment.

It was common for men on leaving the aircraft to be slightly dazzled by the light from the instructor's torch as he checked each man on exit; as the descent might take as little as fifteen seconds, rendering any measure of dark adaptation impossible, it was essential that dazzling should be reduced to a minimum and accordingly lights controlled by rheostat were later placed in the fuselage; this provided a sufficient range of illumination but eliminated the danger of dazzling the jumper.

* *See* Method of Training—R.A.F. Stations, Netheravon and Hurn.

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MORALE

It has already been shown that the original selection and the standards chosen for paratroops were unsatisfactory with the exception of the first 500 men. One of the chief reasons for the decrease in numbers of trained paratroops during the last half of 1940 and the first half of 1941 was the deterioration in their morale. The men were satisfactory at first and had good discipline and morale. After training was completed they were sent to the Commando at Knutsford to join No. 11 Special Air Service Battalion; here they were divided into troops of 20 to 40 men each, without regard to regiment, except for one troop which comprised 40 Grenadier Guards. Some of the men left the Commando on account of illness but many were suspended for disciplinary reasons. In twenty-one days in June 1941 nineteen men were returned to their units as unsuitable. Some of the men were difficult to control, as they thought of themselves as heroes or at least a very special kind of soldier.

It was difficult to obtain good officers, as units were loath to release their best material, tending rather to give up those officers who had had difficulty in adapting themselves to the ways of their regiment.

The replacements were insufficient to keep up the full numbers of the original trainees and, as has already been mentioned, physically they were often incapable of standing up to parachuting, although it was not surprising that many personnel from the Infantry Training Centres, having had at the most a few weeks of Army life, were not up to the physical standard required. Many men volunteered for special duties purely to get away from their environment, but they were not prepared to undertake special air service duties.

Selection at Ringway was difficult, owing to the small numbers of volunteers, and for a time training was carried out on the principle that, although the men were bad material, it was better to train them than no one at all. The position did not materially improve until November, 1941, by which time the new standards and attitude towards paratroops began to show beneficial results. The men trained after November were good material although disciplinary troubles arose from time to time. This was apparently due to the buoyancy of spirit and self-congratulation of the men, to whom the temptation to regard themselves 'not as other soldiers' was very great. However, a proper regimental spirit was successfully instilled into them in that they were told that their unit would in future be one with standards and traditions of its own, the creation of which rested upon themselves.

Refusal to Jump. Instances of refusal to jump occurred at all stages of training, from that at Ringway to the advanced training at Netheravon and Hurn. The problem was related to the general question of morale and to individual breakdown. Dropping by parachute was undoubtedly accompanied by considerable nervous strain, especially at first, and

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particularly from the balloon. Originally the canvas walls of the balloon-car at Ringway were deficient in two places, as mentioned earlier in this chapter, and this gave rise to a strong fear of falling which even complete confidence in the parachute did not entirely remove. This fear was abolished immediately the parachutist had left the balloon, and this was equally true of drops from the aircraft, which were, however, not so terrifying in anticipation. Observation showed a marked change in demeanour of the men from the time when they emplaned until the time when they were about to drop, when their faces became serious and tense. A reaction set in after the drop when men would whistle or sing.

It was not easy to decide the reasons for refusals to drop although there were undoubtedly instances of men who had come into the parachute school for the wrong motives; for example, they were 'fed-up' with ordinary Army life, they wished to make a good impression, or they felt a sense of inferiority which they attempted to eradicate by choosing what appeared to them to be a most dangerous occupation. Such men were unlikely to do well and many of them had to give up at an early stage. There were also instances of definite anxiety, one of which merits description. It was that of an officer who found himself unable to make his first drop. On the second and third attempts he showed signs of extreme fear and actually vomited. He began to complain of insomnia and inability to concentrate about ten days after the first attempt and said that he felt he might at any moment break down and burst into tears. He thought that people considered him a coward, and he had been taking benzedrine in large doses to restore his courage. He was of small stature and had previously taken up flying, apparently to compensate for feelings of inferiority, but he had been obliged to give it up owing to claustrophobia in a closed cockpit. It is noteworthy that his symptoms were completely relieved when he had been given a rational explanation.

Refusal to drop was very serious, as it might jeopardise the success of a whole operation. Fear communicated itself readily from one person to another and a lack of confidence on the part of No. 1 might prove disastrous for the other paratroops in the aircraft, while each observer stressed that a confident quick drop by No. 1 had an excellent effect on the other men. At Netheravon there were unfortunate incidents at one time which resulted in the death of three men. Shortly afterwards a senior N.C.O. refused to drop; his example was quickly followed by eight other men.

At Ringway it was generally thought unwise to give men a second chance after they had once refused, although this was not an invariable rule. Some were of the opinion that once a man had refused he would inevitably refuse again. The policy adopted at Ringway was to send a man who refused back to his unit without more ado. On reaching

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Netheravon, however, the men were considered to have had an opportunity to refuse and therefore any refusal there was treated as a serious breach of discipline and was dealt with as such. The view taken at Ringway was that cases of refusal to jump should be investigated by a psychiatrist and that those who refused to jump later at Netheravon should be seen by the medical officer, but only with a view to excluding illness.

There were many discussions as to whether men preferred the aperture to the side-door exit, opinions being fairly evenly divided among observers. The main point stressed on both sides was the view obtained of the countryside below; some maintained that the men wanted to see the country below them and others said that the advantage of the aperture was that the man had to keep his head up and had therefore no view of the ground.

Cases of refusal to jump were reported upon by the medical officers both at Hurn and at Netheravon, where these officers were responsible for the medical care of the paratroops during their work. One man was air-sick and apparently fainted after being about fifteen minutes in the air. Another, a sergeant, had injured his hand earlier and had been trying to complete his thirteenth jump, which however had had to be put off repeatedly. He broke down with acute anxiety and was unable to jump; he said that he had lost self-assurance. Another man, a corporal, stated that he had always been nervous and that, when he had an attack of air-sickness as well, he was unable to jump.

The medical officer at Netheravon reported that the troops became bored with non-operational jumps and he put forward the opinion that this might be a factor in causing refusal to jump during the later stages of training.

ADMINISTRATION

Paratroops became a R.A.F. responsibility during training at Ringway after a R.A.F. medical officer had been posted there. At first, a R.A.F. flight lieutenant (the junior station medical officer) shared the medical duties at Tatton Park with the medical officer of the 1st Battalion which was then at Knutsford, but he had no special equipment there to deal with injuries incurred. Little dropping was done at that time and casualties were not numerous—there were perhaps two or three fractures a month. It was the practice to board each paratroop at Ringway to confirm his fitness for his duties. A daily sick parade was held at the station and sick personnel were treated at Station Sick Quarters, Ringway, being included on the weekly sick returns. Returns were also made to the Army authorities but the men were not admitted to R.A.F. hospitals, those requiring further treatment being sent to the Military Hospital at Davyhulme, which was the nearest

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available orthopaedic centre. The sharing of medical responsibility at the dropping ground obviously made the collection of statistics and information very difficult, and the method of allocation of duties was not conducive to hard work on the subject of paratroops, when, as far as the R.A.F. medical officer was concerned, he had his station duties to carry out. Later, the R.A.F. medical officer had the opportunity of studying injuries as they occurred, and relating them to what he had personally observed. However, serious cases inevitably passed out of his hands and their follow-up became a matter of great difficulty to a medical officer already fully engaged with work at the Central Landing Establishment.

A similar situation existed at Hurn and at Netheravon, where again the R.A.F. medical officers were responsible for Army personnel while on the aerodrome or in the air. This in itself gave rise to difficulties in the precise determination of responsibility. After discussion between the P.M.O., Army Co-operation Command, and the A.D.M.S., Airborne Division, the only practical decision was made that the medical help which in fact was found to be the nearest to any accident or injured persons should be responsible for the immediate treatment and disposal of the case or cases. Unfortunately this did not prove to be quite as satisfactory as might have appeared on the surface, in that such an arrangement entailed a very close liaison between the R.A.F. and the Army, so that the R.A.F., in particular, needed to have prior knowledge of any training plans, especially if exercises were to be held at night. In addition it was clear that a R.A.F. medical officer might in certain circumstances be unable to leave his station on account of other duties; this position however improved greatly in the early part of 1942.

The volume of work at Ringway increased considerably when the training of the 1st Battalion began in November, 1941 and at that time the medical officer suggested that the care of the paratroops should be entirely in the hands of the Army; in fact, however, the R.A.F. medical officer continued the duties which he had already undertaken. It is no exaggeration to say that the duties of the R.A.F. medical officer at the Parachute Training School were from every point of view of an exacting nature.

MEDICAL EQUIPMENT

No scale of medical equipment was laid down for a Parachute Training School, but requirements were slowly discovered in the light of experience. The equipment was actually indented for use either by the P.T.S. Massage Department or at Tatton Park. The medical officer found it necessary to buy some equipment locally, namely, 'Elastoplast' and an infra-red lamp, for use in the Massage Department; but in general the position later became excellent and it was possible to obtain

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all that was required. There was at first difficulty with the ambulances, which had to be borrowed from R.A.F. Station, Ringway, but two (Morris) were eventually allocated to the P.T.S. There was also a Maintenance Unit (M.U.) at Tatton Park which had a Morris ambulance for its own use. It was arranged that this could be borrowed in emergency and in return the medical officer attended to any men from the M.U. who were sick. The use of the station Albion ambulance was sometimes necessary to transport serious cases to hospital.

REQUIREMENTS AND RECOMMENDATIONS

From the experience gained between November 1941 and January 1942, certain recommendations were made, namely:

(*a*) That the assistance of the medical officer of the nearby R.A.F. Station would be required and that it would be necessary to have the use of six beds in station sick quarters at that Station;

(*b*) That there should be facilities for treatment of minor ailments.

There were certain further special requirements:

(*a*) A hospital within easy reach of the dropping ground ready to take 10 to 12 orthopaedic emergencies per week.

(*b*) A medical officer to be on duty at the dropping ground, whenever dropping was in progress.

(*c*) Two medical orderlies; two masseurs; two ambulance drivers.

(*d*) Two ambulances; both to be available when dropping was in progress.

(*e*) Medical officer's room, massage room, both on the R.A.F. Station.

(*f*) Casualty reception room, and first-aid equipment.

A treatment room was provided in the form of a hut late in 1941 and this fully proved its worth. The men were instructed to report there if they received any injury, however slight, in dropping or landing. Many cases required massage as may easily be appreciated from a study of the injuries received. It was estimated that cases requiring massage during training on the envisaged scale would be between 10 and 15 daily. It is of interest to note that the use of turpentine liniment was not advised, as two cases of chemical dermatitis were considered to have been caused by its use.

FURTHER HISTORY

It is not the purpose of this narrative to deal with the now well-known achievements of our paratroops, for these have been covered elsewhere in this series of volumes. An attempt has rather been made to enumerate the initial difficulties which had to be overcome in the early training of parachutists with special reference to the medical branches of the Army

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and the Royal Air Force. It must be emphasised that the early training was largely a matter of trial and error and that it was possible by careful observation of exits, descents and landings and by analysis of casualty figures, for the medical officers concerned to offer suggestions and corrections to the drill, thereby increasing the speed, efficiency and safety of training.

The success and facile development of these training methods, in the later years of the war, were well proven by the large numbers of parachutists who were trained for a diversity of purposes, ranging from special agents of both sexes to native troops of whom the Indians and Ghurkas were outstanding examples.

Mention must also be made of the important question of morale and the help given to trainees by the continual presence of a medical officer, skilled in parachuting, not only in his professional capacity but also as a person who could be approached on personal matters in an entirely unofficial manner.

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CHAPTER 7

MAINTENANCE COMMAND

GENERAL PRE-WAR HISTORY

FROM the formation of the Royal Air Force on April 1, 1918, until the formation of Maintenance Command on April 1, 1938, equipment, aircraft and ammunition storage was undertaken by various units controlled functionally by the Air Ministry and administered by Training Command. These units were organised as follows:

(*a*) Equipment Storage—There were three specialised depots each holding a complete range of equipment. One depot held all accessory airborne equipment, barrack equipment and clothing, another held all aircraft spares, while the third depot held all aero-engines and spares. Reserve M.T. vehicles were stored under the control of one of these Depots in such accommodation as could be found on R.A.F. stations.

(*b*) Aircraft Storage—Reserve aircraft were stored in miscellaneous hangars on various R.A.F. stations and in the airship sheds at Cardington.

(*c*) Ammunition Storage—Orinagilly, there was only one small storage depot at Altrincham, Cheshire, but in 1937 the first up-to-date ammunition unit was opened and caves were used for the storage of ammunition.

In addition to the above there was one repair unit, the Home Aircraft Depot at Henlow, Bedfordshire, which undertook a limited amount of repair work for Royal Air Force units, repairs beyond the capacity of this unit being passed to civilian contractors. The Home Aircraft Depot was controlled functionally and administratively in the same manner as the Storage Units.

During the period of expansion of the Royal Air Force from 1936 to 1938, plans were prepared for the erection of additional Maintenance Units specialised for the work they were to undertake. These Units included:

(*a*) Five Universal Equipment Depots.
(*b*) Twenty Aircraft Storage Units.
(*c*) Ten Ammunition Depots.
(*d*) Three Aircraft Repair Depots.

At this time the Air Ministry also arranged leases for a number of unoccupied factories in order that storage space would be available for the large quantities of equipment for which contracts had been placed.

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FORMATION OF MAINTENANCE COMMAND

It immediately became obvious that this increase in the number of Maintenance Units would render impracticable the system of control at that time in force. It was therefore decided to form a new Command, to be known as Maintenance Command, whose functions would be:

(*a*) To receive, hold and distribute every material requirement of the Royal Air Force except rations and building materials.
(*b*) To maintain records from which future requirements could be calculated.
(*c*) To salvage crashed aircraft and, in parallel with civilian industry, to repair aircraft and equipment as far as the resources of the Command would permit.

The Headquarters of Maintenance Command was formed at Air Ministry in April 1938 and moved to R.A.F. Station, Andover in July 1938. Practically speaking, the new Command could be said to resemble a large business organisation rather than a stereotyped Service machine. Its responsibilities ceased when serviceable equipment was delivered to the operational units, the latter then accepting responsibility for the care of the equipment until it was worn out or damaged, when it was either struck off charge or returned to Maintenance Command for disposal.

ORGANISATION AND ADMINISTRATION

Owing to the complexity and variety of supplies required by a modern air force, specialisation and decentralisation of responsibility were essential. It was therefore decided that within Maintenance Command there should be four specialised Groups:

Group	*Functions of Units*
No. 40	Storage and issue of all barrack and technical equipment except that shown under Nos. 41 and 42 Groups below.
No. 41	Storage and issue of aircraft of all types, including gliders.
No. 42	Storage and issue of bombs, ammunition, pyrotechnics, petrol, oil and oxygen.
No. 43	Salvage of damaged aircraft. Repair in parallel with civilian industry of aircraft and equipment.

Each Group's supply system covered the whole of the United Kingdom while the first three Groups were responsible in addition for supply to overseas Commands. Skeleton Headquarters of Nos. 40, 41 and 42 Groups were detached from the Command within a few months and housed in one building at Andover, Hampshire.

The Munich Crisis in September 1938 hastened the expansion of the Royal Air Force in all respects. In early 1939 the first two Universal Equipment Depots, although not complete, were able to accept their

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first demands from units and as the year progressed the remainder of the new Maintenance Units began to accept demands, although they were not fully functioning until the autumn of 1940.

Nos. 40, 41 and 42 Groups became fully established, self-supporting formations in 1939, when No. 43 Group was also formed. Two of the three proposed Aircraft Repair Depots were ready for occupation in the same year. Finally, when war broke out, Headquarters Maintenance Command moved to Amport near Andover and the four Group Headquarters took over separate buildings in new locations.

OPERATION OF THE COMMAND IN WAR

FUNCTIONS OF COMMAND AND GROUP HEADQUARTERS

The Command Headquarters was as small as possible compatible with the efficient direction and co-ordination of the various Groups. Certain matters such as defence and the control of movements were centralised in Command Headquarters, but apart from this the policy was to lay down broadly the responsibilities of each Group and allow the latter complete freedom in the detailed organisation of their work. The Headquarters of each Group was responsible for the execution of policy as determined by Command Headquarters and also for the day-to-day administration of its units.

Each Group consisted of a number of Maintenance Units, most of which were located in areas thought to be least liable to the risk of air attack.

A new policy applicable, as far as possible, to the Maintenance organisation as a whole, was the substitution of units each holding a wide range of articles for the previous system of each unit specialising in certain articles. The risk that the destruction of one unit would endanger the supply of a particular item was thereby avoided.

NO. 40 GROUP

This was composed of four main types of unit:

(*a*) Universal Equipment Depots—These comprised by far the greatest number of units of No. 40 Group. Each held the whole range, with a few important exceptions, of general equipment required by the Service.

(*b*) Mechanical Transport Storage Units—These Units held between them the entire reserve of mechanical transport (which in May, 1945, totalled 26,500 vehicles).

(*c*) Marine Craft Storage Units—Two such units were formed; in addition to issuing replacement craft for commands at home, these units prepared boats for shipment overseas and were responsible for ferrying them to ports of loading and for supervision of their storage.

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(*d*) Forward Transit Centres and Canal Clearing Depots—These were points at which equipment from depots or contractors or in transit was collected and sent forward by the canal system to the nearest convenient point to destination.

NO. 41 GROUP

This Group was composed of a number of Aircraft Storage Units and Packing Depots:

(*a*) Aircraft Storage Units—These, as their name suggests, were concerned with all aspects of the storage of aircraft. Each consisted of several hangars dispersed on sites adjacent to an aerodrome or a short distance from it, each site being arranged to merge as much as possible with the local surroundings. In order to reduce further the risk of damage by air attack, the stored reserves of each type of aircraft were dispersed among different Aircraft Storage Units.

(*b*) Packing Depots—These units were responsible for the packing for overseas dispatch of such aircraft as could not be flown all the way to their destinations. These aircraft would be flown, sometimes by Service crews but more often by the Air Transport Auxiliary (a civilian organisation operating under the Ministry of Aircraft Production), from the Aircraft Storage Units to the Packing Depots where they could be dismantled, cased and shipped.

During the period of the War in Europe, approximately 125,000 aircraft were issued by No. 41 Group, this total including aircraft issued to the Royal Navy, for it was not until the end of 1945 that the Admiralty established its own aircraft storage units.

NO. 42 GROUP

Units of No. 42 Group operated on the same principle of 'universal' holding as that which applied in No. 41 Group and a Master Provision Organisation* was established similar to that in No. 40 Group. Ammunition Depots, Air Ammunition Parks and Fuel Depots were the main types of unit in No. 42 Group:

(*a*) Ammunition Depots—Main ammunition supplies were stored at units where underground storage space was available, chiefly in old quarries. In order, however, to provide against a possible rail breakdown between the depots and the consumer units, most of

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* The Master Provision Organisation maintained records which made it possible (i) to ascertain, at any time, the exact stocks held and their whereabouts; (ii) to inform Air Ministry provisioning branches of probable future requirements.

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which were in the eastern half of the country, a number of forward air ammunition parks were formed in close proximity to operational units.

(*b*) Air Ammunition Parks—Each of these held at least sufficient stocks to cover one week's maximum demand by the operational units which it served. Air Ammunition Parks also undertook the issue of oxygen, one of the responsibilities of No. 42 Group. This service was operated by the British Oxygen Company on an agency basis, oxygen being produced at a number of plants built by the Company and delivered by the latter to the ammunition depots. All stocks were delivered by rail from the ammunition depots to the parks and collected from there by the operational units, using their own vehicles.

(*c*) Fuel Depots—No. 42 Group was also responsible for checking and keeping records of the quantities of petrol and oil delivered into storage by the Petroleum Board. These stocks were kept in Fuel Depots. The maintenance of large stocks of packed lubricating oils and of aviation fuel in tins (cased in readiness for mobile operations or as an emergency reserve), for issue in the event of bulk installations at airfields being put out of action, involved the formation of special storage depots; it was from these that fuel and oil were drawn for Operation 'Overlord.'

The soundness of No. 42 Group's organisation was demonstrated after the explosion at Fauld, Staffordshire, in 1944 in which a large number of 4,000-lb. bombs were destroyed, for it was possible to transfer the issue load to other depots immediately and in spite of the heavy loss there was no faltering in supply. The peak year for the Group was 1944 when 3,100,000 dead weight tons of explosives were handled.

NO. 43 GROUP

The two main functions of this Group were repair and salvage. The repair work was supplementary to that undertaken by the Civilian Repair Organisation (C.R.O.) and was carried out in large Service-manned Aircraft Repair Depots; the latter, in relation to the C.R.O., might be regarded as 'fringe-firms' in that their available repair capacity was at the disposal of that organisation. Another function of the depots was that of supplementing the technical resources of Aircraft Storage Units (under No. 41 Group) in their task of keeping stored aircraft modified to date.

It was important that any aircraft that had crashed should be removed as soon as possible, not only because of the adverse effect on public morale which would be produced by the sight of a large number of crashed aircraft, but also because of the value of the material concerned. Quick and efficient salvage was therefore essential. It was mainly carried

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out by Salvage Centres. In addition, a number of large civilian motor transport firms were instructed in the dismantling and removal of crashed aircraft. Repairable aircraft were either repaired on the spot or returned to the appropriate contractors, while badly damaged aircraft were stripped and the components divided into three categories of serviceable, repairable or scrap material. Serviceable equipment was returned to the Equipment Depots for re-issue; repairable equipment and scrap were fed into the Civilian Repair Organisation.

The repair of the general ranges of equipment, a further function of No. 43 Group, necessitated setting up yet another series of depots through which repairable equipment could be fed into the repair organisation and led to the formation of Repairable Equipment Depots and Repairable Equipment Units, which were to some extent specialised for particular types and ranges of repairable equipment.

Marine Craft repair was carried out extensively at the Marine Craft Repair Units, at which no fewer than 1,574 craft were repaired during the year 1944. The majority of M.T. repairs were undertaken by contractors operating under the Ministry of Supply, but in addition workshops for the repair of vehicles, as for all other types of equipment, were set up at each Service repair depot.

NOS. 53 AND 54 WINGS

During the War it was found necessary to form in Maintenance Command two additional Wings, Nos. 53 and 54. The work of the former, that of packing aircraft for shipment overseas, was closely allied to that of No. 41 Group and consequently many of its packing depots were located alongside aircraft storage units. The duties of these packing depots included:

(*a*) The dismantling of aircraft and removal of loose and delicate equipment, especially radio and radar accessories liable to corrosion.

(*b*) The thorough anti-corrosive treatment of all vulnerable parts of the aircraft.

(*c*) The packing of the aircraft to ensure complete protection in transit.*

As there was no means of knowing precisely when shipping space would be available, there was frequently a back-log of packed aircraft awaiting shipment; to meet this contingency, Packed Aircraft Transit Pools were formed, close to the various ports, where aircraft could be stored pending transit. In all, some 35,000 aircraft were packed for shipment during the War.

* Until the formation of No. 53 Wing, in March 1941, all packing of aircraft had been undertaken by No. 41 Group; from this date No. 53 Wing undertook part of this increasing commitment.

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No. 54 Wing controlled the Mechanical Transport Companies and was itself controlled operationally by the Director of Movements, Air Ministry.

CONCLUSION

It will be seen from the foregoing that Maintenance Command, with decentralisation of responsibility and the construction of numbers of widely scattered and virtually interchangeable maintenance units, was expressly designed to reduce to a minimum the effect of heavy air attack. The broad layout of the Command was that its units, in general, lay towards the west, spread widely to north and south. Tactically, the units were sited to provide an all round supply system to operational and training units within convenient geographical areas. Contact between consumers (operational and training units) and suppliers (maintenance units) was direct, higher formations (the usual channels) being excluded in dealing with routine matters, unless very exceptional circumstances obtained.

MEDICAL ADMINISTRATION

Before the formation of Headquarters, Maintenance Command, in April 1938, medical administration of the then existing Equipment, Aircraft and Ammunition Storage Depots and the Repair Unit, was undertaken by various units in other commands of the Royal Air Force. When Maintenance Command was formed, the medical administration of units controlled by the new Command Headquarters was centralised and became the responsibility of the Principal Medical Officer, Technical Training Command.

The rapid expansion of this new Command made the latter arrangement impracticable and it was decided to transfer the medical administration of all units in Maintenance Command to the Command itself. Consequently, on April 24, 1939, a separate medical establishment was created comprising a Principal Medical Officer, Deputy Principal Medical Officer and medical staff.

As two of the ultimate four Groups of the Command (Nos. 40 and 41 Groups) were then in the process of formation and as no medical officers were established other than at Command Headquarters, the medical administration of units, which would normally have been undertaken by Groups, was the direct responsibility of the Principal Medical Officer, Maintenance Command. The latter arranged for all medical treatment of Royal Air Force personnel in Maintenance Command units to be undertaken either by medical officers of R.A.F. stations in other commands or, failing this, by local civilian medical practitioners on a casual payment basis.

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The medical treatment of civilian employees did not present many difficulties to the Service as such persons were entitled only to first-aid treatment for injuries received or illness occurring while on duty, subsequent care being provided by their own civilian medical attendant.

THE COMMAND PRINCIPAL MEDICAL OFFICER

In addition to ensuring adequate medical care of personnel at units the Principal Medical Officer was at this time directly responsible for making the necessary arrangements in respect of:

(*a*) The hospitalisation of all cases requiring in-patient treatment.
(*b*) Special medical examinations—e.g. fitness for flying; fitness for overseas service; examination of all personnel employed in 'dangerous' trades.
(*c*) Supervision of hygiene and sanitation on units, including the examination of water and food supplies and supervision of new buildings and drainage.
(*d*) Medical inspection of requisitioned buildings and sites.
(*e*) Statistical returns and medical documentation of Service personnel.
(*f*) Liaison with Royal Naval and Army Medical Services and Civilian Health Authorities.

GROUP SENIOR MEDICAL OFFICERS

With the rapid growth of the Command it became apparent that decentralisation of medical administration was essential and it was therefore decided, in 1940, to establish Senior Medical Officers as 'Competent Medical Authorities' at Group Headquarters. These senior medical officers' duties were similar to the responsibilities found in other groups but included a larger commitment in respect of industrial hygiene and sanitation. The dates on which senior medical officers and medical staffs were appointed to the Headquarters of the various Groups were as follows:

No. 40 Group . .	December 3, 1940.
No. 41 Group . .	December 2, 1940.
No. 42 Group . .	January 23, 1941.
No. 43 Group . .	April 29, 1940.

Henceforth, all routine matters were delegated to the senior medical officers while the Principal Medical Officer retained responsibility for matters of policy, liaison with the medical departments of the Navy and Army, the co-ordination of all medical services and medical establishments within the Command and for the distribution and training of all its medical and dental personnel.

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MEDICAL MANNING

During the war, Maintenance Command underwent a considerable and rapid expansion as shown in the table below.

Strength	Dec. 1939	Dec. 1940	Dec. 1941	Dec. 1942	Dec. 1943	Dec. 1944	Dec. 1945
R.A.F. . .	5,782	23,781	37,940	43,744	47,729	56,993	65,289
W.A.A.F. .	Not available	539	3,108	8,794	11,408	13,006	12,378
Dominion	—	Not available	73	193	129	93	—
Civilians:							
Full time .	16,000	34,000	38,175	45,146	45,651	44,591	41,575
Part time .	—	—	—	—	1,332	1,653	1,291
Italian co-operators	—	—	—	—	—	—	2,712
Totals	21,782	58,320	79,296	97,877	106,249	116,336	123,245

In 1942, as a large proportion of personnel in the Command were employed in industrial work, the problems associated with industrial hygiene demanded increased attention and it was found necessary to establish at Command Headquarters a medical officer whose duties were solely to supervise the health and working conditions of the industrial population of the Command.

Owing to the increased number of W.A.A.F. personnel in the Command it was also decided in 1942 to establish Women Medical Officers at Command Headquarters and selected units in the Command. Their duties included the giving of lectures to W.A.A.F. personnel at units in the Command, medical examination of W.A.A.F. personnel and acting in an advisory capacity to unit commanders on problems concerning the W.A.A.F.

PROBLEMS OF WAR-TIME EXPANSION

The rapid war-time expansion of Maintenance Command brought in its train many new medical problems, some of them identical with those being experienced in civil industry but others peculiar to the Royal Air Force. Problems associated with the extensive employment of women, of untrained or unskilled workers and of the disabled and elderly, and those arising from the so-called 'dangerous' trades, were common to both Service and civilian industrial undertakings, but the Service had its own peculiar problems in such matters as the shortage of medical officers and the necessity for taking precautions to deal with possible enemy air attack. (*See also* Medical Research Volume in this Series, Chapter 8, Industrial Health Research.)

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EMPLOYMENT OF WOMEN IN INDUSTRIAL OCCUPATIONS

Consequent upon the employment of airwomen and civilian female workers in industrial occupations, it became an immediate necessity to provide at their place of work, drying rooms, accommodation for clothing, separate lavatory and washing facilities and rest rooms. These extra commitments added to the tasks of the already overburdened Works Service, but thanks to the co-operation of all concerned difficulties were overcome quickly and the necessary amenities were made available. Arrangements had also to be made for the supply of protective clothing for female workers.

Vague illnesses in female workers were often traced to long hours of work, night shift work, inadequate recreational facilities, lack of amenities for privacy and lack of proper sleeping facilities for those employed on night work. All these were problems which had to be faced and for which a solution had to be found.

EMPLOYMENT OF UNTRAINED, DISABLED OR OLDER PERSONNEL

During the war, the employment of untrained or unskilled personnel on skilled or semi-skilled industrial work, however undesirable, was unavoidable, and resulted in an increased industrial accident rate for the Command and a higher incidence of industrial fatigue, the latter manifesting itself in symptoms of a neurotic nature. Continual education in accident prevention was an important factor in counteracting the inexperience of these employees, as also was their constant medical supervision to detect early signs of industrial fatigue; only by this latter means was it possible to weed out individuals who were permanently accident prone and thus reduce to a minimum the percentage of such personnel in industrial occupations.

The employment of the disabled and elderly presented yet another medical problem, for these employees, by reason of their age or disability, were more prone to accident and disease caused or aggravated by adverse environmental conditions than were younger, completely fit individuals, and their presence in the industrial population necessitated the provision of special medical supervision with periodic examinations to ensure that their health did not suffer through such employment.

MEDICAL EXAMINATION OF PERSONNEL EMPLOYED IN DANGEROUS TRADES

The periodic medical examination of all personnel employed in dangerous trades such as luminising and working in lead compounds, chrome, T.N.T. and doping, presented a further problem. In many instances, owing to the acute shortage of Service medical officers, these examinations had to be carried out by already overworked civilian medical practitioners (C.M.Ps.).

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SHORTAGE OF SERVICE MEDICAL OFFICERS

One may take as a typical example of the medical officer manning situation in the Command the position in 1943, as shown below:

(*a*) Number of Units with R.A.F. Medical Officers . .	23
(*b*) Number of Units given medical cover by medical officers enumerated in (*a*)	42
(*c*) Number of Units employing C.M.P. on contract . .	17
(*d*) Number of Units employing C.M.P. on casual payment basis	19
(*e*) Number of Units given medical cover by R.A.M.C. . .	5
(*f*) Number of Units medically catered for by other R.A.F. Commands	40
Total	146

As each R.A.F. Command and the R.A.M.C. had their own varying commitments and as the exigencies of war often led to a breakdown in the Inter-Command or Inter-Service agreements for reciprocal medical care, strict day-to-day supervision of the medical officer manning position was essential, so that alternative arrangements could be made in the event of illness or other non-effectiveness of Service or civilian medical personnel.

UNIT MEDICAL ARRANGEMENTS IN THE EVENT OF AIR ATTACK

A scheme defining the action to be taken in the event of air attack had to be worked out for each individual unit. The scheme covered fully the following details:

(*a*) Duties to be undertaken by individual medical personnel.
(*b*) Alternative accommodation for the temporary reception and detention of casualties should the unit sick quarters or medical treatment room be put out of action.
(*c*) Detailed plans for the evacuation and transport of in-patients and/or casualties to suitable hospitals or other R.A.F. sick quarters in the area.
(*d*) Decontamination and treatment of possible gas casualties.
(*e*) Dispersal of medical stores and equipment throughout the unit.
(*f*) Training of non-medical personnel in first aid and stretcher-bearer duties.

W.A.A.F. SUBSTITUTION*

The policy of substituting W.A.A.F. for R.A.F. personnel wherever possible presented new problems, of which the provision of accommodation was one of the most outstanding. The problem was two-fold—

* *See also* Volume I, Chapter 9—Medical Arrangements for the Women's Auxiliary Air Force.

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firstly, to provide suitable accommodation on units already in operation, and secondly, to ensure segregation and privacy. An example of the situation which arose was that at Henlow, where airwomen were posted in large numbers to an already overcrowded unit, so that a long-disused, condemned Officers' Mess and Quarters, bearing an entirely inadequate scale of sanitary conveniences, had to be rapidly adapted for the reception of W.A.A.F. personnel.

Building programmes were already in arrears but the difficulties encountered in housing W.A.A.F. personnel, only gradually overcome, were alleviated to a great extent by the high morale, excellent spirit, enthusiasm and good-will displayed by the 'pioneer' airwomen. Moreover, as the airwomen became competent to take over duties from airmen, the latter were gradually posted out of the units and the situation was eased. At some stations, vacated married quarters were allocated for the accommodation of airwomen, and bathing and lavatory facilities were adequate for the W.A.A.F. personnel housed in these buildings.

The segregating of airwomen in self-contained W.A.A.F. sites, although desirable, was at first fraught with difficulties. For example, at Stafford, the small site allocated to W.A.A.F. personnel soon became so overcrowded that it was necessary to accommodate airwomen in airmen's huts which became vacant as the airmen were gradually posted out, temporary sack-cloth screens being erected around the huts taken over by the W.A.A.F. to secure privacy; further difficulties arose when the scale of bathing and lavatory accommodation provided for airmen proved inadequate for airwomen, but although this led to a certain amount of inconvenience in the early days, the position was soon rectified by hastening the necessary works services. With the rapidly increasing proportion of W.A.A.F. personnel in the Command, it was not always possible to accommodate them on the units and recourse had then to be made to billeting in the neighbourhood or requisitioning local houses.

The necessity for the provision of recreation rooms, canteens, separate sick quarters accommodation and facilities for sewing and personal laundering, soon became obvious and endeavours were made to provide such accommodation wherever possible.

MEDICAL ORGANISATION

ROYAL AIR FORCE STATION HOSPITAL, HENLOW

In September 1939 the only R.A.F. Station Hospital in the Command was located at R.A.F. Station, Henlow, having been transferred to Maintenance Command from Technical Training Command on September 21, 1939. It consisted of one new building, one old building reconstructed, one converted airmen's barrack block, and one married quarter to accommodate W.A.A.F. personnel. The total number of

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beds available was 150, and the medical staff consisted of 10 R.A.F. medical officers, 15 members of Princess Mary's Royal Air Force Nursing Service, V.A.Ds. and medical airmen and airwomen.

Personnel requiring in-patient treatment were sent to this hospital from Royal Air Force and Army units located within a radius of several miles of Henlow, while Service personnel injured in aircraft or other accidents in the area were admitted direct.

Out-patient facilities were also provided for cases requiring the opinion of the various specialists at the hospital. The hospital was well equipped from a Service point of view, and very well organised. (For further details *see* Volume 1, Chapter 5.)

STATION SICK QUARTERS AND MEDICAL INSPECTION ROOMS

These in the early days presented difficult problems, as the personnel of many of the units were housed in scattered hutments and living in isolated areas in accordance with the existing policy of dispersal. In many instances medical inspection rooms consisting of improvised huts or rooms, or even tents, had to be resorted to as an emergency measure, but by the end of 1941 some ten stations were provided with proper sick quarters which were either built to R.A.F. type design or located in requisitioned houses adapted as necessary.

Gradual but steady progress continued to be made until suitable sick quarters type accommodation was made available, in permanent, semi-permanent, or temporary buildings, at all units where a Service medical officer was established or where a civilian medical practitioner was employed on contract or casual payment basis.

MEDICAL EQUIPMENT

Scales of medical equipment were drawn up by Command Headquarters to meet the needs of the various types of units in the Command. These scales were approved by Air Ministry and issues made accordingly. (*See* Volume I, Chapter 8.) In addition, each unit was issued with Emergency Medical Stores Equipment, while all station sick quarters were equipped to a special scale authorised by Air Ministry.

At units, medical equipment and stores were as far as practicable distributed among various buildings, thus ensuring that in the event of damage by enemy action medical supplies would be readily available at various points on every unit.

E.M.S. ARRANGEMENTS

Arrangements with the E.M.S. were made under the direction of Air Ministry acting in close co-operation with the Ministry of Health. One or more suitably located hospitals were made available to receive patients or air-raid casualties from each unit in the Command and

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arrangements were made for Blood Transfusion Services to be provided at any unit if and when required.

Many first-aid parties were organised at each unit. At Service-manned units, the parties consisted of personnel specially trained in first aid, whilst at civilian-manned units volunteers holding the St. John's Ambulance Brigade or similar certificate or specially trained to this standard of first aid were employed. Wardens and fire-watchers were not employed on first-aid work owing to the nature and importance of their own duties.

A 'Leader' was appointed to each first-aid party and all parties were placed under the control of the station defence officer. Owing to the dispersal of units to sites and the dispersal of buildings on sites, it was imperative that sufficient parties should be formed to ensure first-aid cover for each building in the event of casualties being sustained. Conveniently situated first-aid equipment was made available for each party.

HYGIENE AND SANITATION

Hygiene and sanitation in Maintenance Command was generally satisfactory at all units during the war years. Occasionally, owing to lack of consultation with the Local Health Authorities, sites were selected in undesirable areas and, if the difficulties thus caused proved to be insurmountable, the site would have to be abandoned. Accordingly in the later years of the war, close liaison between Service and civilian authorities was insisted upon in this matter and prospective sites were invariably inspected by a medical officer well versed in local conservancy before construction work was commenced.

APPOINTMENT OF SANITARY ASSISTANTS

In 1941 Sanitary Assistants were established at Command, Groups and the larger stations. These airmen, all of whom were of sergeant rank or above, had been sanitary inspectors in civil life and were of unquestionable value to the Service, bringing with them as they did specialised knowledge of modern hygiene practice. Sanitary Assistants paid regular visits to all units in the Command and gave much valuable advice to commanding officers on matters of hygiene and sanitation.

WATER SUPPLIES, SEWERAGE AND DISINFECTION

The general principle of having all drinking water bacteriologically examined at intervals was adhered to. Water supplies from wells, rivers and streams liable to be contaminated were either boiled or chemically treated before consumption. Automatic chlorinating plants were installed at many units and regular tests of the chlorine content of the water were carried out.

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Water shortage reported at some units proved on investigation to be largely due to wastage of water through absence of plugs in wash hand basins and baths (replacement plugs were invariably pilfered), or the practice of leaving water taps turned on after use.

Sewerage arrangements followed in general those in other Commands.

Throughout the war years, the normal Service procedure for disinfection was followed satisfactorily, fixed standard type disinfectors being used on the large units, while smaller units were issued with portable disinfectors. When, in the early years of the war, sheets were withdrawn from airmen, blankets had to be disinfected regularly; it was laid down that each airman, on arrival at a unit, was to be issued with clean blankets for his personal use and on his posting from the unit the blankets were to be collected and disinfected before re-issue to another incoming airman.

ACCOMMODATION

Broadly speaking, the accommodation provided at units may be divided into six categories:

(*a*) Pre-war permanent accommodation of approved type design.

(*b*) Temporary accommodation consisting of well-constructed, suitably lined, heated, lighted and adequately ventilated wooden type or Nissen huts.

(*c*) Unsuitable, unlined and poorly ventilated huts constructed from aircraft packing cases.

(*d*) Requisitioned houses.

(*e*) Civilian billets.

(*f*) Tented accommodation. (Used during the summer months to relieve overcrowding on some units.)

The billeting of personnel with or without subsistence was occasionally resorted to in some localities but fortunately this never became necessary on a large scale. Many difficulties were encountered when billeting was attempted in industrial areas; the houses in such districts were of the working class type and in most instances already filled to capacity as a result of the increased civilian labour intake by the local factories or shipbuilding yards. In these circumstances, billeting of extra Service personnel led to instances of airmen being required to sleep two to a bed and it was necessary for Air Ministry to sanction the provision of Service issue beds in such billets.

It was thought at first that the problem of overcrowding on units could be solved by using tiered bunks for doubling sleeping accommodation but investigation soon showed that the less obvious corollaries—i.e. lack of adequate sanitary accommodation, ablution facilities and recreational facilities—could not be so easily overcome. Consequently

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it was decided that before tiered bunks were introduced on any unit, the Principal Medical Officer was to be consulted as to whether sanitary and hygienic amenities on the particular unit could bear the extra load.

INDUSTRIAL HYGIENE

From the very nature of the functions of Maintenance Command, it followed that the medical problems encountered were similar to those of civilian industrial concerns, rather than those normally associated with the Services.

Owing to the rapid expansion in the industrial commitments of the Command, new occupational causes of ill-health arose with every new application of science to industry and continual vigilance was essential to safeguard the health of workers and to identify quickly any specific cause or causes of ill-health in an individual, whether due to working environmental conditions, or to the reactions of the human body to a harmful agent. If the incidence of sickness in units of this Command was not kept within normal limits, the work of operational commands would be seriously hindered by the resultant decrease in industrial output and delay in production and delivery of supplies.

In 1941 it was apparent that industrial hygiene in Maintenance Command was not as advanced as in civilian industry, and investigations were carried out by the medical officers of the Command in consultation with Commanding Officers, Chief Technical Officers and Civilian Administrative Officers. The problems dealt with covered the following subjects:

(*a*) Work and fatigue.
(*b*) Lighting.
(*c*) Heating and ventilation in workshops.
(*d*) Accident and sickness rate.
(*e*) Absenteeism.
(*f*) Medical supervision of employees.
(*g*) Underground workers.
(*h*) Meal facilities.
(*i*) Investigation and analysis of all occupations undertaken in the Command to assess the significance of any possible hazard resulting from such employment.

MAINTENANCE COMMAND INDUSTRIAL MEDICAL MEMORANDA

Very valuable information was obtained from the above investigations and it was decided to issue an Industrial Medical Memorandum to all units in the Command. This memorandum listed the various industrial processes undertaken in the Command with their inherent health risks and specified the precautionary measures which should be taken to safeguard the health of employees.

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The issue of this memorandum met a long-felt need. As any disturbance of health, either occupational or non-occupational, presented common symptoms and signs, it was essential that every medical officer or civilian medical practitioner at units in the Command should be acquainted with the occupational causes of ill-health, the diagnosis and treatment of occupational diseases and appropriate preventive measures. As time went on and new toxic substances were introduced or hazards to health came to be associated with other occupations, further memoranda were issued. (*See* Industrial Medical Problems.)

THE UNIT INDUSTRIAL SANITARY DIARY

In March 1943, it was decided that in addition to the Industrial Medical Memoranda, which gave advice to unit medical officers and civilian medical practitioners responsible for the industrial supervision of units, more definite instructions should be drawn up to give guidance on carrying out Industrial Inspections of Units, as uniformity of procedure was considered to be essential.

This decision resulted in the institution of the Unit Industrial Sanitary Diary, which was to become a corner stone in the organisation of Industrial Hygiene in the Command. In the Diary, the medical officer or civilian medical practitioner entered his comments on the health and/or working conditions of employees as observed during his regular periodic inspection.

To ensure uniformity in the compilation of these diaries, a standard *pro forma* for reports was devised by the Principal Medical Officer.

After each report the diary was passed to the unit commanding officer, whose duty it was to rectify as far as practicable any adverse conditions recorded. In addition, the diary was open to inspection by the Command Industrial Medical Officer and Group Senior Medical Officers.

EXTENSION OF MEDICAL SUPERVISION TO CIVILIANS

In August 1942, on Air Ministry instructions, a comprehensive scheme to extend medical supervision to all civilian-manned units was submitted by Maintenance Command.

Briefly, it was proposed that these units should be visited, as far as possible, by existing Service medical officers of Maintenance Command or other Royal Air Force Commands, who would carry out specific duties on the lines suggested in Ministry of Labour and National Service Form 327, entitled 'Medical Supervision in Factories'. Air Ministry authority was also sought for the employment of a civilian medical practitioner, on a sessional basis, to carry out these duties where a Service medical officer was not available. The scheme was approved by Air Ministry and put into effect by the Command.

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INDUSTRIAL MEDICAL PROBLEMS

Various medical problems associated with the environmental conditions and specific industrial functions of each unit were encountered. These may be considered under the following headings:

Lighting. Poor industrial lighting was an ever-present problem and cause of complaint, and in far too many instances the standard of lighting provided fell below that necessary for the comfort of the workers and the maintenance of maximum output. One of the difficulties encountered in improving the lighting was the total exclusion of all natural light—many of the storage sheds had no windows, and in other buildings compliance with blackout regulations had resulted in all window and skylight glass being coated with blackout paint or boarded over with wood or other opaque material. Removal of the blackout paint and the substitution of suitable blackout curtains or movable shutters was considered, but the expense involved and the shortage of suitable materials and labour rendered this impracticable. The provision of improved lighting, however, was a matter of urgent necessity, and it was therefore decided to give priority to this task in future demands submitted by units for various works services. In addition, the intensity of lighting appropriate to any particular industrial occupation was laid down, the lighting requirements of units being classified according to the type of work carried out—i.e.:

(*a*) Fine Lighting—For close work or work on small objects.

(*b*) Medium Lighting—For ordinary stores and stock control work.

(*c*) Coarse Lighting—For general interior lighting where no detail work was required.

In addition, local spot lights were to be used for fine precision work.

Gradually, as more labour became available, the problem of industrial lighting grew less and by 1944 the position generally was satisfactory.

Heating. The inadequacy of the heating of industrial buildings in some localities led to lowered efficiency, decrease in production, increased absenteeism and general discontent among employees.

Satisfactory heating of the large storage sheds in particular, presented great difficulties. The sheds were usually heated by central heating (hot water) systems or electrically heated hot air radiators, but owing to the size of the sheds and the fact that the doors were continually being opened to allow the passage of goods and transport, the maintenance of a reasonable temperature was well-nigh impossible. In many instances, slow combustion stoves were installed, in addition to the existing system, in a forlorn attempt to improve the heating of these sheds.

Ventilation. It was essential to keep a careful check on all potentially toxic processes and mechanical extractor ventilating fans or systems were installed as considered necessary.

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General Industrial Health Precautions. Certain industrial precautions taken on units had a common value against all forms of risk. Among these may be included:

(*a*) Adequate washing facilities with hot water, towels and soap.*

(*b*) Protective clothing suited, where necessary, to the particular risk.

(*c*) Pre-employment medical examinations.

Precautions peculiar to particular risks are detailed in the succeeding paragraphs.

Industrial Dermatitis. The possibility of industrial dermatitis occurring was an ever present problem. Contact with irritants was unavoidable in many of the processes undertaken and appropriate steps were taken to prevent or minimise the incidence of this disease. Precautionary measures included:

(*a*) Control of environmental factors, such as high temperature, excessive humidity and poor ventilation in workshops, likely to act as predisposing causes in the production of the disease.

(*b*) Insistence on good accommodation and cleanliness in workshops.

(*c*) Substitution of non-irritant substances where practicable.

(*d*) Provision of suitable barrier creams for application to hands and forearms.

(*e*) Periodic medical inspection of all personnel engaged in occupations where dermatitis was likely to occur.

(*f*) First-aid facilities to ensure early treatment of minor cuts and abrasions.

(*g*) Education of employees in the care of the skin.

In addition, industrial dermatitis was made notifiable to the Principal Medical Officer, so that it was possible to keep a check on the incidence of the disease and to investigate at once any sudden increase in the number of cases at a particular unit; such an increase was sometimes found to be due to the introduction of some new substance or compound.†

Effects of Inhalation of Vapours of Organic Industrial Solvents. The extensive use of organic industrial solvents in many of the processes carried out in the Command necessitated constant vigilance, medical supervision and the application of appropriate preventive measures. The solvents included amyl acetate, butyl acetate, butyl alcohol, benzene toluol, xylol acetone, tetrachlorethane, carbon tetrachloride, trichlorethylene, carbon bisulphide, dioxane, spirit, etc. These were used in various ways:

(*a*) As degreasers and fat solvents in all kinds of metal cleaning.

(*b*) As vehicles, solvents, or 'thinners' for paints, lacquers, varnishes.

(*c*) As solvents for nitro-cellulose in dope.

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* A special issue of soap was made to supplement the war-time ration of this commodity.

† *See* Investigations into, and Discovery of, Specific Industrial Hazards.

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(*d*) In paint removers.
(*e*) In anti-corrosive fluid and compounds.
(*f*) As constituents of proprietary compounds.

To assist medical officers and civilian medical practitioners responsible for supervision of the health of industrial employees, Industrial Medical Memoranda, as already described, were issued regularly from Command Headquarters. These Memoranda listed the many organic solvents used in the various industrial processes, gave a summary of their toxic effect on the system and prescribed appropriate preventive measures to minimise dangers to health. The latter included:

(*a*) Attention to the type design of the workshops where these substances were used, to ensure adequate ventilation (if necessary mechanical exhaust ventilation) and suitable temperature.
(*b*) Cleanliness of workshops.
(*c*) Apparatus used. If materials containing solvents were sprayed on to articles, the spraying pressure was to be kept as low as practicable. If articles were dipped into baths containing solvents, specially approved baths with extractor lip ventilation were to be used.
(*d*) The wearing of approved respirators.
(*e*) Periodic medical examinations.
(*f*) Precautions to prevent fire and explosions in the workshop.

Close liaison was maintained between Medical and Technical Branches and before the introduction of any new compounds in workshops the advice of the Industrial Medical Officer was sought as to their possible adverse effect on health.

Toxic Dusts, Fumes and Mists. Dusts, fumes and mists containing toxic substances were encountered in many industrial processes; lead, chromium and cyanides were the principal substances concerned and their uses and inherent dangers are described briefly here:

(*a*) *Lead.* Dusts, fumes or mists containing lead were met with:
(i) In accumulator repair and maintenance.
(ii) In tinning—the tin might contain up to 70 per cent. lead.
(iii) In using or applying paints containing lead.
(iv) In the 'rubbing down' process in preparing old lead-painted surfaces for repainting.
(v) In metallisation of metal surfaces.
(vi) In engine sparking plug salvage—if leaded petrol had been used, the deposit on these old plugs might contain a high percentage of lead.
(vii) In the constant contact with petrol and/or its vapours containing tetra-ethyl lead, lead fumes might be inhaled or lead absorbed through the skin.

In all these processes, lead poisoning could be caused by the inhalation or ingestion of lead-containing dusts or the inhalation of lead fumes or mists. The medical problem, therefore, was to prevent the absorption

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of lead in any form and to that end the following precautionary measures were taken:

(i) Prohibition of food, drink, smoking or use of cosmetics in workrooms.

(ii) Monthly medical examinations (with blood counts if considered necessary).

(iii) Good housing and cleanliness—all workrooms were washed down daily.

(iv) If practicable, mechanical exhaust ventilation at the site of work, to remove dust, mists or fumes containing lead.

(v) Use of approved respirators where necessary.

(*b*) *Chromium.* Chrome compounds were used extensively in:

(i) Chrome plating.

(ii) Anodic oxidation of aluminium alloy parts (electrolytic processes e.g. Stuart and Bengough).

(iii) The anti-corrosive treatment of metals (e.g. application of pigmented lanolin resin).

The mists generated in these processes, if not controlled, conveyed the chromium or chromic acid on to the body, and these substances attacked the skin and mucous membranes giving rise to chrome ulcers.

Appropriate precautions to safeguard the health of personnel working with chromium compounds had to be compiled; briefly, these precautions made provision for:

(i) Efficient mechanical exhaust ventilation at the site of work.

(ii) Bi-weekly examination, by a first-aid attendant, of hands and forearms of all personnel.

(iii) Fortnightly examination of all personnel by the medical officers.

(iv) Facilities for the first-aid treatment of cuts and abrasions and for covering these injuries with waterproof dressings.

(*c*) *Cyanides.* Hydrocyanic acid and its compounds.

The processes in which cyanides were used in Maintenance Command were:

(i) Heat treatment of metals.

(ii) Electro-plating.

Hydrocyanic acid and cyanides, being fulminating poisons which may be absorbed by inhaling or ingestion and, in the case of the acid, by skin absorption, also presented a problem which demanded the imposition of suitable rigid precautionary measures to safeguard health and prevent serious accidents. The precautions advocated were:

(i) Substitution of less toxic substances for hydrocyanic acid and its compounds, if at all practicable technically.

(ii) All cyanides to be stored away from acids in order to avoid the formation of hydrocyanic acid gas.

(iii) Local mechanical exhaust ventilation of all baths containing cyanide solutions.

(iv) Efficient and adequate general ventilation of workrooms where any process involving the use of cyanides was undertaken.

(v) No manual handling of cyanides by workers.

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(vi) All effluents (e.g. floor washings) containing cyanides to be neutralised before entry into main drain, by passing them through a mixture of coke, lime and ferrous sulphate.

(vii) Special antidotes to be made available for immediate use wherever there was a risk of cyanide poisoning. (Antidote recommended was ferrous sulphate 158 g. in 1 litre of water; anhydrous sodium carbonate 60 g. in 1 litre of water. Equal parts of these solutions were to be mixed, and ¼ pint of mixture administered to the patient.)

(viii) In the case of the heat treatment of metals with molten cyanides, the dross from the crust which formed was to be neutralised with ferrous sulphate before disposal by burying in an approved site.

Radio-active Materials. Luminous compound was used in the Command to paint the dials of aircraft and other instruments. The methods of storing the compound and instruments treated with it, and the precautions necessary to safeguard the health of personnel dispensing or using it or cleaning the workrooms where luminising work was carried out, were medical problems which required careful consideration. Inspection of units using and storing luminous compounds revealed that insufficient precautions were being taken, and as a result of the investigations made it was decided that the luminous compound should be stored in mechanically ventilated lead-lined storage boxes; at the same time, instructions were issued that special care should be taken by those in medical charge of units using the compounds, to ensure that the requirements of the Factories (Health and Safety Provisions) Orders, 1942 and amendment 1943 (S.R. and O. No. 703 of 1942 and No. 1053 of 1943) were rigidly adhered to. Medical examination and the taking of periodic blood counts of all personnel employed in luminising were carried out either by R.A.F. medical officers specially appointed or by the local examining surgeon appointed for the purpose under the Factories Act, 1937. In 1943, with a view to centralising the records of these examinations, application was made by Command Headquarters for exemption under article 5 of the Factories (Luminising) Health and Safety Provisions Order 1942 in respect of all R.A.F. units; thus authorisation for all necessary medical examinations and blood examinations came under the direct control of the Royal Air Force. No cases of ill-health due to the use of luminising compounds were recorded for Maintenance Command during the war years.

Storage of Chemical Weapons. The hazards involved in this work were by far the most serious to which personnel in the Command were exposed; furthermore, the frequent postings of Service personnel engaged on duties connected with the storage of chemical weapons resulted in the continual employment of inexperienced workers and contributed largely to the high incidence of chemical burns. A conference

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convened at Maintenance Command in June 1942 to consider ways and means of reducing the casualty rate made the following recommendations:

(*a*) That decontamination facilities for employees be provided at all storage sites.
(*b*) That suitable clothing, rubber boots, aprons, gloves, proofed trousers, eye-shields and respirators be supplied and used.
(*c*) That a Service medical officer or civilian medical practitioner under contract be established for each unit holding gas weapons.
(*d*) That regular courses of instruction in the handling and decanting of gas weapons and in first-aid treatment of casualties be instituted. (All N.C.Os. in charge of gas handling, and medical orderlies on the strength of holding units, to be required to take this course.)
(*e*) That personnel employed at chemical weapon storage units should be 'screened' from posting.

These recommendations were agreed and put into effect, with the result that the casualty rate fell appreciably.

It was further decided that personnel employed in handling chemical weapons should be medically examined before undertaking such employment. Those suffering from any of the following conditions were to be excluded:

(*a*) Diseases or hypersensitivity of skin.
(*b*) Inflammatory eye conditions.
(*c*) Chronic respiratory diseases.
(*d*) Cardio-vascular diseases.
(*e*) Anxiety states.
(*f*) Orthopaedic disabilities of such a nature as to render the individual accident prone.
(Excellent though these rulings may have been, the employment of many Grade III personnel was unavoidable owing to the manning position during certain periods of the war and these provided a continuous trickle of casualties.)

As a further step to control and reduce the number of casualties, all units were required to forward to Command Headquarters a monthly return of all gas burns, however trivial; units showing a high incidence were then inspected by experienced officers and the latter gave advice on appropriate precautionary measures.

When it is remembered that the early type 65 lb. tin-case mustard gas containers were relatively fragile and that 'leakers' were extremely frequent, the number of casualties (approximately 100 per year) in the early war years cannot be considered unduly high, and bears testimony to the effectiveness of measures already taken to safeguard the health of these industrial workers. In the later years, experience gained, training of personnel, stricter supervision, improved types of containers

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and methods of decanting, better preventive measures and improved technique in immediate first-aid treatment reduced the incidence of casualties.

Bombs—Handling and Storage. Accidents due to handling of high explosive and incendiary bombs and small arms ammunition boxes were relatively frequent and injuries sustained were of such a nature (e.g. fractures of feet, ankles, legs and hands) as to involve the loss of a considerable number of man-hours. The accidents reported by various units appeared in certain instances to be disproportionate in number to the tonnage handled and were often due to lack of adequate supervision, inexperience and low mental capacity of workers and lack of mechanical handlers. As a result of an investigation in 1942 into the causes of these accidents, it was recommended that detachable steel foot protectors should be issued to workers employed in handling bombs and boxes; this, together with the education of workers in the correct methods of handling, soon led to an appreciable decrease in the incidence of injuries from such causes.

Custody of Poisonous Substances. Strict and continual supervision of the safe custody of poisonous substances used industrially was an ever present problem. Unfortunately, in some cases, attention was drawn to the necessity for issuing appropriate instructions only by the occurrence of fatal accidents. In 1943, for example, there were three fatal cases of poisoning due to the drinking of ethylene glycol, the individuals concerned apparently having been under the impression that this liquid was a harmless alcohol; the exact quantity of the substance consumed in each case was not recorded, but symptoms similar to those of alcoholic poisoning proved fatal in all three cases. The facts of these poisonings were reported to Air Ministry as the existing Air Ministry Orders (A.M.Os. A.621/1940 and A. 758/1940) dealing with ethylene glycol did not mention the danger of drinking the substance. To prevent similar fatalities, a Command Routine Order was issued requiring the attention of all personnel (Service and civilian) to be drawn at quarterly intervals to the danger of consuming even the smallest quantity of ethylene glycol, and instructions were given that all containers of this liquid were henceforth to be marked 'POISON'.

Eye Injuries. Several industrial occupations undertaken in the Command carried with them eye hazards which had to be guarded against. Thus, to prevent foreign bodies entering the eyes in operations such as grinding, buffing, chipping or hammering metals or stone, suitable protective eye-shields or wire gauze goggles were provided; to combat the effects on the unprotected eye of the short ultra-violet rays emitted during welding, goggles conforming to British Standard Specification 679 were issued to all welders and welders' mates, and to counteract chemical burns of the eyes due to acids or alkalis, suitable

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neutralising eye lotions were always available where such hazards existed (e.g. battery charging, electro-plating and breakdown of sodium-filled aero-engine valves). Constant education in the care of the eyes was necessary for personnel employed in occupations where such injuries could occur.

INVESTIGATIONS INTO, AND DISCOVERY OF, SPECIFIC INDUSTRIAL HAZARDS

Use of Leaded Petrols. Much concern was felt from time to time with regard to the possible hazards to the health of personnel using leaded petrols in industrial processes. As a result of investigations at R.A.F. Station, Henlow, the fear of the possible occurrence of lead poisoning proved to be only too well founded. Personnel employed in constant contact with leaded petrols were henceforth regarded as being exposed to a definite lead absorption risk.

A survey was made of all processes in the Command in which this hazard could possibly occur and appropriate precautionary measures were drawn up and issued to units.

Use of 'Finuglaze'. In 1942 a proprietary compound known as 'Finuglaze' was brought into use for final finishing of 'Jablo' propeller blades. Attacks of nausea and giddiness were reported among personnel using this substance and investigations revealed that the substance contained a high percentage of amyl acetate and possibly some benzene. Appropriate precautionary measures, similar to those in force for personnel employed on 'doping', were immediately instituted and no further complaints were received.

Filling Practice Bombs with Titanium Tetrachloride. Following the occurrence of an eye injury which was sustained during the filling of practice bombs with titanium tetrachloride, it was decided to standardise the design of the bomb-filling sheds and filling apparatus, and to lay down a uniform procedure for the immediate first-aid treatment of personnel sustaining splashes of the liquid in the eyes.

Dyeing of Balloon Cords. In 1944, complaints were received that personnel using oil orange E and coal tar naphtha, in the dyeing of balloon cords, suffered from sore throat, loss of appetite, headache and in some cases transient rashes of forearms, thighs and legs.

Investigations revealed that these symptoms only developed when the work was done indoors and it was decided that the following precautionary measures should be taken by all personnel employed in cord dyeing:

(*a*) Work to be carried out in the open air on a dry day, personnel to work from upwind.

(*b*) The coil of cord to be manipulated by tongs or hooks and every endeavour to be made to avoid direct contact with the dye.

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(*c*) Protective clothing to include rubber gloves, aprons and boots.

(*d*) Approved barrier cream to be applied before commencing work.

Use of Dulac 86. This protective varnish was used to protect radar and radio equipment against tropical damp and fungi. Investigations showed that it contained pentachlor-phenol (a chlorinated hydrocarbon) and was therefore potentially toxic, so that adherence to the appropriate precautionary measures when using Dulac 86 was essential to safeguard health. Accordingly, the following instructions were issued by Command:

(*a*) Spraying of the substance to be done in booths with exhaust ventilation.

(*b*) Sprayers to wear approved respirators.

(*c*) Protective clothing to be worn on head, neck and hands.

Bostik Compounds. As a result of investigations, it was ascertained that certain Bostik compounds used in the Command contained toxic solvents. These compounds included:

Compound	Toxic constituent
'13' glazing	16 per cent. petrol + toluol
'C' adhesive	petrol
Adhesive 699	53 per cent. chlorinated hydrocarbon
Lacquer No. 103	61 per cent. ethyl acetate + toluol
Lacquer No. 104	53 per cent. ethyl and butyl acetate and toluol
Cleaner No. 1	100 per cent. monochlor benzol

To prevent symptoms due to inhalation of these toxic constituents, appropriate instructions regarding preventive measures were drawn up and issued to units; in certain instances precautions included the provision of mechanical exhaust ventilation and the wearing of respirators in workshops where the compounds concerned were in use.

Investigations of Specific Substances alleged to cause Industrial Dermatitis. From time to time newly introduced substances were stated to cause an industrial dermatitis in persons using or handling them. In such cases, investigations were carried out to ascertain whether the substances were in fact irritants. Some of the substances investigated were:

Pigmented Lanolin Resin (*D.T.D.* 663). This substance was used as an anti-corrosive. In 1942, four cases of industrial dermatitis alleged to be due to its use were reported, but the dermatologist to whom the cases were referred considered the condition in each was due to secondary infection of abrasions and not to any constituent of the compound. In 1943, however, complaints were received that a further 29 cases of dermatitis had occurred in personnel using this substance and further investigations showed it to contain:

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Lanolin	40 parts by weight
Resin	30 " " "
Zinc Chromate	50 " " "
Kaolin	60 " " "
Proof Spirit	56 " " "
Xylol	8 " " "

It was therefore apparent that there was definite risk of pigmented lanolin resin causing chrome dermatitis. Appropriate instructions regarding precautionary measures were issued immediately and no further complaints were received.

Contact with Fordigraph Carbon. In 1943 fourteen cases of dermatitis were alleged to have been caused by contact with Fordigraph Carbon. Investigations proved that of the total number reported, only four mild cases could possibly have arisen from contact with this substance and even in these cases there was no conclusive evidence that the dermatitis had actually been caused by its use.

Fibreglass. This substance was a glass wool used in the Command for preservation and packing of various types of equipment. Investigation of dermatitis occurring in personnel using fibreglass showed it to be an extremely irritating substance, and it was decided to abandon its use.

Casein Glue. Complaints that this substance caused excoriation of the finger tips of personnel using it were fully substantiated on investigation. Appropriate measures to prevent the glue from coming in contact with the skin of workers soon had the desired effect and no further cases of dermatitis from this cause were notified.

RESEARCH

INDUSTRIAL DERMATITIS

Experiments with substances to assess their efficacy in preventing industrial dermatitis were continually being carried out in the Command. These tests included:

(*a*) *Tests with 'C.E.' Cream, 'C.E.' Powder and 'C.E.' Skin Food.*

Cream was composed of:

Acid stearic	2 lb.
Liquid paraffin	1½ lb.
Glycerine	½ lb.
Tragacanth	2 drachms
Spiritus vinum methylatum	1 oz.
Kaolin	1½ lb.
Acid boric	2 oz.
Liquid hamamelidis	10 oz.
Colouring agent	q.s.

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Perfume	q.s.
Aqua distillata	150 oz.

Powder was composed of:

Amylum	4 parts
Zinc oxide	1 part
Kaolin	1 part
Zinc stearate	1 part
Talc	1 part

Skin Food was composed of:

Lanolin	1 part
Olium arachis	3 parts

Before beginning work, the hands were washed with hot water and soap and dried; C.E. cream was then applied to hands and forearms and massaged in, and after a few minutes C.E. powder was lightly dusted over the hands and forearms with cotton wool. When coming off duty the hands were again washed thoroughly in hot water and soap, dried, and a little of the skin food well rubbed into them. The results obtained were encouraging and this method was advocated for protecting the skin of those working with pigmented lanolin resin.

(*b*) *Skin Food as Protection against Dermatitis due to Oils, Greases and Solvents.*

The skin food mentioned in the last paragraph was also tested to assess its efficiency in preventing the occurrence of dermatitis due to oils, greases and solvents. Hands and forearms were washed in hot water and soap and dried, before commencing and after ceasing work; after drying, a little of the skin food was well massaged into hands and forearms. It was noted that in personnel using the skin food as directed, the skin of the hands was much softer and the incidence of dermatitis nil. One universal criticism of this substance was that it rendered the hands too greasy for certain industrial processes.

(*c*) *Sulphonated Castor Oil as a preventive against Industrial Dermatitis and as a Cleansing Agent in lieu of Soap.*

Sixty personnel were selected for this trial. After ' cease work ' the selected personnel wetted their hands with water, then massaged into them a little sulphonated castor oil; the hands were then washed again in hot water. As a result of this test, however, it was decided that sulphonated castor oil was inferior to soap as a cleansing agent and had little beneficial effect on the skin.

(*d*) *Rozalex Preparations* (*Barrier Creams*).

These barrier creams were tested against various dermatitis producing agents with invariably good results. It was this type of

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barrier cream which was used almost universally in the Command to prevent industrial dermatitis.

PHOSGENE GAS (C.G.)

In 1941 minor cases of poisoning occurred among Aeronautical Inspection Department personnel who were engaged in the inspection of light case containers filled with C.G. The holding of such weapons was made necessary by the uncertainty of German intentions regarding the use of chemical weapons.

These personnel relied on their sense of smell for the detection of small leaks in the containers. Experiments were carried out to devise a safer method of detecting leaking containers and it was found that dry p-dimethylamine benzaldehyde-diphenylamine paper changed to a yellow colour when exposed to C.G. Unfortunately, this reaction was not sufficiently conclusive, as similar effects were given by hydrochloric acid and chlorine, but it was found that these latter substances could be removed by first passing the air or vapour to be tested over pumice granules impregnated with sodium thiosulphate and sodium iodide solution.

A suitable apparatus for applying the test was contained in the Gas Identification Officer's Outfit. This apparatus contained a pump for drawing the air or vapour to be sampled through the test papers which were placed in a glass tube; adaptor tubes, containing the impregnated granules to remove hydrochloric acid and chlorine, were also available.

This test worked well in the vicinity of leaks from containers, but like most chemical methods of detection it had its limitations, especially when a small leak had to be discovered in a large stock of stored containers.

LUMINOUS COMPOUNDS

In 1944, a survey of units storing instruments which had been treated with luminous compound showed that in some instances as many as 1,000,000 such items were stored in one shed; investigation was therefore made into the possibly danger to health created by radiations emitted from articles so treated.

Preliminary tests were carried out at one unit with photographic plates wrapped in black protective paper. These plates were placed in various positions in the sheds and after one month's exposure they were all developed under similar conditions. Upon comparison with 'control' plates all the plates used in the sheds were found to have been fogged, to varying extents, by radiations emitted from the luminised instruments. From this test it was apparent that possibly dangerous radiations could be received by employees working in the sheds.

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It was next decided to assess the actual radiation received by individuals working in these sheds, and, accordingly, specially prepared films were obtained from the National Physical Laboratory and issued to selected personnel to wear on their persons whilst working in the storage sheds. The films (badges) were carried in the breast or waistcoat pocket whilst at work for a period of one week, and then forwarded to the National Physical Laboratory where an assessment was made of the radiations received by each individual during the week in question.

The results of this experiment showed that of 24 employees tested, one individual had received a total exposure dose of between 0·1 and 0·2 Röntgen and the remaining 23 had received less than 0·1 Röntgen. The exposure of all personnel was well within the maximum permissible exposure dose recommended by the British X-ray and Radium Protection Committee.

MEDICO-LEGAL ASPECTS

CIVILIAN

It was essential for the proper functioning of the preventive side of industrial medicine that early notification be made of cases of accident (including those due to gases and fumes) or illness. Under Section 66 of the Factories Act, 1937, certain diseases contracted in any factory or workshop had to be notified, by the medical practitioner who made the diagnosis, to H.M. Chief Inspector of Factories (Ministry of Labour and National Service). The occupier of the factory or workshop, or in the case of a R.A.F. unit the officer commanding, was also required to make a similar notification.

Accidents and diseases liable to occur at Maintenance Command units and notifiable under the Factories Act, 1937, included the following:

- (*a*) Poisoning from lead, phosphorus, arsenic, mercury, carbon bisulphide, aniline and manganese.
- (*b*) Chronic benzene poisoning.
- (*c*) Compressed air sickness.
- (*d*) Toxic jaundice.
- (*e*) Toxic anæmia.
- (*f*) Anthrax.
- (*g*) Epitheliomatous ulceration.
- (*h*) Chrome ulceration.

In addition, the following conditions were subject to compensation under the Workmen's Compensation Act:

- (*a*) Poisoning by lead, mercury, phosphorus, arsenic, benzene and its homologues, nitro or amino-derivatives of benzene or 'dope' and its homologues.
- (*b*) Poisoning by nitrous fumes.
- (*c*) Poisoning produced by dust or liquids.

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(*d*) Ulceration of the skin produced by dust or liquids.
(*e*) Ulceration of the mucous membranes of the nose or mouth produced by dust.
(*f*) Epitheliomatous cancer or ulceration due to tar, pitch, bitumen, mineral oil or paraffin.
(*g*) Ulceration of the cornea due to tar, pitch, bitumen, mineral oil, or paraffin.
(*h*) Chrome ulceration.
(*i*) Inflammation of the synovial lining of the wrist joint and tendon sheaths.
(*j*) Inflammation, ulceration or malignant disease of the skin, subcutaneous tissues or bones, and anaemia of an aplastic type, due to X-rays, radium or other radio-active substances.

SERVICE PERSONNEL

The above regulations applied only to accident or disease occurring among civilian personnel but similar provisions existed in respect of members of the Royal Air Force in that personnel were required:

(*a*) To report (on Form 551) any accident occurring on duty.
(*b*) To report sick before remaining off duty.

Should any individual be admitted to hospital for the treatment of a disease or accident due to work performed, the facts appeared in the medical record Form 48 and its enclosures, while notification of such accident or illness, if these came within the terms of the Factories Act, 1937, or the Workmen's Compensation Act, was made through the usual channels to the Director of Hygiene, Air Ministry.

From both the legal aspect and the point of view of the employee, Service or civilian, therefore, adequate machinery existed for the notification of disease or accident and no further provision was necessary to safeguard the interests of either the personnel concerned or the Air Ministry.

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CHAPTER 8

FLYING TRAINING COMMAND

GENERAL PRE-WAR HISTORY OF FLYING TRAINING 1918–1936

UNITED KINGDOM

PILOT *Requirements*, 1919. The First World War patterned the needs of pilot training, which were the requirements of short-range flight in the single- or two-seater aircraft. These essentials may be set down as:

(*a*) complete mastery of the aircraft in all evolutions of flight so that it could be exploited, fully and competently, in combat;

(*b*) the ability to shoot;

(*c*) the ability to find one's way to the target, even at night, in bad weather, over a fairly short distance.

The pilot had to fly with competence all types of aircraft but in addition he could specialise in certain technical duties.

Experience had shown that, before a pilot could undertake operational flying, he needed to be thoroughly instructed in the art of aviation, for inadequate training meant heavy casualties, calling for hasty replacements by yet more hastily trained men. The Gosport system of flying instruction was evolved to provide a sound training and this was perpetuated after the First World War and improved by the Central Flying School until it provided a model of flying instruction in basic aviation and a standard in the art of pure flying which gained international repute.

Ten Years Rule. In 1919, the Cabinet first laid down the so-called 'Ten Years Rule'—an assumption that there would be no major war for ten years— and this was reviewed periodically up to 1932. In consequence, although flying training in these years was improved and maintained at a high standard, little provision was made for adequately trained reserves to man the War Training Organisation.

Reserve Flying Training. In January 1923 five civilian-operated Flying Schools were opened to provide an efficient regular nucleus of reserve pilots. This scheme operated until 1933, when the Treasury sanctioned an increase in the size of the Reserve from 700 to 1,500 pilots.

Position in 1932. In March 1932, events in Western Europe and Japan forced the abolition of the Ten Years Rule and it is from that time that the development of flying training for the Second World War may be dated.

At this time the aircraft was essentially a one-man machine and if a combatant passenger was carried he was a ground tradesman who

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undertook the duties of air gunner in his spare time; any ground duties which he left undone in order to fly were dealt with immediately on his return, even though this probably entailed his working after normal hours of duty. In the multi-engined machines from 1932 onwards, however, a full-time crew was employed.

Flying Training Organisation in 1932. The flying training organisation of the Royal Air Force in 1932 was training pilots at the rate of 300 annually, these personnel being carefully selected from an abundance of volunteers, mainly from civil life. The flying training establishment comprised:

(*a*) the Royal Air Force College, Cranwell;
(*b*) four Service Flying Training Schools, viz.:
  (i) No. 2 at Digby.
  (ii) No. 3 at Grantham.
  (iii) No. 4 at Abu Sueir, Egypt.
  (iv) No. 5 at Sealand; and
(*c*) the Training Base, Royal Air Force, Leuchars.

To the Royal Air Force College were admitted the cadets and university entrants, to the Service Flying Training Schools went the Short Service Commission personnel and airman pilots, while Army and Royal Navy officers attached to the Royal Air Force were trained at Leuchars.

With the exception of the Cranwell entry, who were admitted to the College direct, all entrants from civil life spent their first two weeks at Royal Air Force Station, Uxbridge on a disciplinary course,* before proceeding to the Service Flying Training Schools for some ten months, during which 150 hours' flying were achieved in the two stages of '*ab initio*' and 'advanced' flying training. At the Service Flying Training School the pilot was taught to fly an aircraft and thereafter, if he obtained his 'wings', was sent to a squadron or, if specially selected, for further training at any of the following specialist training units:

The School of Army Co-operation, Old Sarum.
The School of Navy Co-operation, Lee-on-Solent.
Air Pilotage School, Andover.
Flying Boat Training Squadron, Calshot.
Navigation School, Calshot.
Coast Defence Training Unit, Gosport.

Central Flying School. The Central Flying School at Upavon trained certain pilots who were specially selected to become instructors. The School also evaluated and laid down the handling procedures for aircraft in the Service and standardised flying and flying training

* A course designed to teach the general rudiments of Royal Air Force procedure.

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techniques. A Director of Training was appointed at Air Ministry and under him all training activities were centralised and the training effort co-ordinated.

Civil Operated Schools take over all Elementary Flying Training–1934. In October 1934 the Director of Training proposed that all elementary flying training should be undertaken by the civil operated Schools (up to that time engaged solely on Reservist training), thus freeing the Service Flying Training Schools for more advanced training, which had previously been carried out at the operational squadrons.

The formulation of this policy marked the beginning of the transition to a war training organisation and was the first step in producing, in a training command, a person available for immediate operational duty on posting to his squadron.

This new system commenced in August 1935, and by January 1936 some 20 Civil Schools were teaching flying, leaving the military flying training to the Service Flying Training Schools.

First Air Observer School, 1936. The first Air Observer School opened in 1936 became responsible for armament instruction, and a new category of aircrew, the air observer, was introduced to replace the part-time air gunner. Navigation was still the pilot's responsibility.

In 1936 the Chief of the Air Staff had ruled that two-seater fighter aircraft should carry a crew of pilot and observer while general reconnaissance coastal aircraft should carry two pilots, one of whom would act as navigator; heavy bomber aircraft would also carry two pilots in addition to the observer; on medium bombers which could not accommodate two pilots, the observer was required to assist the pilot in navigation.

It was not until 1939 that it became settled policy that the observers should be fully responsible for navigation.

INCEPTION OF ROYAL AIR FORCE COMMANDS IN THE UNITED KINGDOM, 1936

In July 1936 were formed Bomber, Coastal, Fighter and Training Commands, the last mentioned comprising a complexity of units whose component bodies later formed the nuclei of three separate commands, viz.: Technical Training Command, Reserve Command and Maintenance Command.

Formation of Royal Air Force Volunteer Reserve, 1936. A further burden was placed upon Training Command soon after its inception by the formation of the Royal Air Force Volunteer Reserve in August 1936. This project, which resulted from the realisation that new arrangements must be made to deal with the increases in reserves, aimed at an annual recruitment of 800 citizen volunteers with common entry and promotion and commission on merit. The training of the first volunteers began early in June 1937 and by the end of that year the new Reserve showed

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a strength of 845 pilots, of whom 150 had flown solo on the Hart aircraft.

The close of the year 1936 showed the Royal Air Force to have a total personnel strength of 55,000 (the corresponding figure for 1934 being 31,000) and an expanding aircraft industry approaching an annual output of 1,000 aircraft, while the provision of airfields and satellite airfields for training purposes received constant attention. The front line strength was now 87 squadrons compared with 76 squadrons in 1934, and in 1937 Air Staff proposals for a further increase in the front line strength, received Cabinet approval.

The number of aircraft per squadron was increased, the bomber force accepted a further 11 squadrons, 13 more airfields were provided and the necessary personnel were forthcoming.

Civil Schools Teach Navigation. The proposal to supply two pilots for each bomber aircraft increased the strain on training facilities within the Service and in consequence the Civil Schools were asked to teach navigation to their pupil pilots.

The use of two-seater aircraft such as the Wellesley, Blenheim, and Battle, which could not carry a second pilot, emphasised the need for increased navigational training for the observers, who were carried in lieu. This marked another step towards the dichotomy of the duties of pilot and navigator with the assumption by the navigator of navigational responsibility.

As the Hurricane replaced the Hart and the promise of the D.H. Don went unfulfilled, the Oxford aircraft filled the gap in trainer aircraft and prepared the pupil for the heavier aircraft coming into the Service.

Introduction of Link Trainer, 1937. During 1937 the 'Link Trainer'* was introduced into the Service and provided an inestimable aid to instrument flying and blind landing procedures and a peerless means for implementing the transition from flying by the senses to precise flight by instruments.

Direct Entry Observers. The Chief of Air Staff's decision to recruit observers from civil life and train them in navigation, ended the use of ground staff as part-time aircrew and speeded the transition of observer to navigator.

Germany's rape of Austria in March 1938 increased the tempo of Service growth. A scheme to produce 2,400 aircraft by 1940 was accepted by the Cabinet. The aircraft industry began to work double shifts.

The above scheme required an annual intake of 2,000 pilots and 20,000 other aircrew for training supplemented by an addition to the Reserve of

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* The Link Trainer consisted of a cockpit and complete instrument panel mounted on a movable pivot. It was possible to simulate flight conditions very closely and expert instruction could be given, irrespective of weather, without any element of danger and at a comparatively low cost.

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7,000 pilots and 9,250 other aircrew. Eight more Flying Training Schools and 25 new aerodrome centres, to bring the totals to 19 Flying Training Schools and 58 Civil Schools, became necessary.

To create a reserve of civil pilots for both the Regular Air Force and the Volunteer Reserve, the Civil Air Guard came into being in July 1938 and 35,000 people registered; this Civil Air Guard proved to be of great assistance to the Air Transport Auxiliary in the latter's war-time ferrying and communication duties.

To meet all needs the Cabinet later authorised Air Ministry to accept up to 12,000 aircraft by 1940.

No. 26 (Training) Group. In December 1937, No. 26 (Training) Group assumed responsibility for the organisation and administration of all Reserve Forces, one of the first steps being to rename and number the Civil Flying Schools as Nos. 1 to 20 Elementary and Reserve Flying Training Schools. Thereafter, as each expansion scheme was adopted, the strength of the reserves grew proportionately; the projected 25 town centres were expanded to 55 under Scheme L and similarly the number of Elementary and Reserve Flying Training Schools was increased to 58.

Unfortunately, recruiting was often delayed by the length of time required by the Air Ministry and the Office of Works to acquire new town centres—up to the summer of 1938 it was taking an average of nine months to obtain each new centre.

Director of Volunteer Reserve Expansion Appointed, 1938. The many problems peculiar to the Reserve necessitated the appointment of a Director of Volunteer Reserve Expansion, in the Department of the Air Member for Supply and Organisation, in September 1938. Nominally, No. 26 Group in Training Command carried out the necessary administration, but this was in fact largely controlled by Air Ministry, for the Group could not deal with all matters of administration, nor was Training Command adequately staffed for this. About this time the responsibility for organisation and administration of the maintenance units was transferred to a new formation, Maintenance Command, leaving Training Command with the responsibility for flying training (including that of the Volunteer Reserve) and technical training.

Reserve Command Formed, 1939. The A.O.C. in C., Training Command, felt that the number of units controlled by a single group should be reduced, and that the advisability of forming a separate command to administer the Elementary and Reserve Flying Training Schools should be considered; it was finally decided in November 1938 to introduce a new command of four groups to deal with these matters, and on February 1, 1939 Reserve Command was formed with Headquarters at Hendon.

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EMPIRE AIR TRAINING

The Empire Air Training Scheme as it was known in the Second World War, had its origin in the Overseas Training Scheme of the First World War.

Overseas Training Scheme of the First World War. In late 1915 a Flying Training Scheme was inaugurated in Canada and by July 1917 there were 15 training squadrons; after the entry of the U.S.A. into the war in April 1917, ten squadrons of the Canadian Scheme carried out winter training in Texas, while 10 American squadrons carried out summer flying in Canada. By the end of the First World War, the Canadian Scheme comprised four wings, totalling 20 squadrons and several specialist schools, and was sending some 200 trained pilots a month to Britain.

In Australia, the Central Flying School established at Point Cook before 1914 had produced four squadrons by 1916–17; this was in addition to the Australian manned training wing in Britain in 1918.

Pilots were trained in two New Zealand Schools during the First World War, but South Africans desiring to become pilots received their flying training in Egypt or the United Kingdom.

Thus was laid by the end of the First World War the foundation of an Empire Training Scheme which was to provide the precedent for its greater counterpart of the Second World War.

So far as Royal Air Force training overseas between the wars was concerned, No. 4 Flying Training School functioned at Abu Sueir in Egypt from its inception in April 1921 until its transfer to Royal Air Force Station Habbaniya, Iraq, in September 1939.

Empire Air Training Scheme of the Second World War. The establishment of the Empire Air Training Scheme of the Second World War was marked in its early stages by financial difficulties and the growing political consciousness of the Dominions, especially Canada.

In accordance with the policy laid down by the Official Medical Historians Liaison Committee of the Commonwealth at its meeting in Ottawa in 1947, this scheme is only briefly referred to below. Accounts of the work of the scheme will be found in the Medical Histories of the countries concerned, particularly in the Canadian Medical History, as the greater part of the training under this vast organisation was carried out in Canada, where over 150,000 pilots from the Commonwealth countries were trained.

Canada. Before 1936, it had been proposed to the Canadian Government that 15 cadets be trained yearly in Canada, serve five years with the Royal Air Force, and then revert to the Royal Canadian Air Force Reserve. Simultaneously it had been proposed that Canada select 25 officers for training by and for the Royal Air Force.

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In March 1936, the possibility of manufacturing aircraft in Canada had again raised the question of obtaining pilots from the Dominions. In November 1938, negotiations with Canada to train 300 pilots annually for the Royal Air Force had resulted in the Canadian Government undertaking to train 50 pilots a year, the first course of 17 to begin in September 1939.

The question of setting up a Service Flying Training School abroad was also discussed.

Australia. The Australian Government proposed to send 50 officers in 1937 and 25 annually thereafter. Her own re-armament programme came into force in 1938, and after May 1939 Australia no longer sent trained pilots to Britain.

New Zealand. In New Zealand the Government proposed to train 1,000 pilots annually. The Royal New Zealand Air Force was to be increased to five times its existing size and a regular Royal Air Force officer had been loaned to them as Chief of Air Staff.

In 1937 the Royal New Zealand Air Force agreed to train 15 officers a year for the Royal Air Force, while by mid-1939 output had been stepped up to 280 pilots annually.

The creation of aircraft industries in New Zealand and Australia had fortunately given their training organisation the necessary background to fit these countries for participation in the Empire Air Training Scheme.

South Africa. South Africa was at that time unable to participate in the scheme to any appreciable extent.

Kenya. The proposal in May 1939 to establish a school in Kenya was accepted.

France. In September 1939 the French Government agreed to locate Training Schools in France.

RESERVE COMMAND

PRE-WAR HISTORY

The functions of Reserve Command on its formation in February 1939, were threefold:

(*a*) elementary training of short service officers and airman pilots while at Civil Flying Schools;

(*b*) administration and training of the Royal Air Force Volunteer Reserve ; and

(*c*) administration and training of all reservists, including annual training and instructors' camps.

The Command developed out of No. 26 Group, Training Command, which then divided into No. 50 Group in London and No. 51 Group in Leeds, the intention being to add a further two groups at Bristol and

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Edinburgh respectively in order that administration could be carried out as follows:

Western Schools	Bristol Group
London and Home Counties Schools	London Group
Midlands Schools	Leeds Group
Northern Schools	Edinburgh Group

Although the Groups at Bristol and Edinburgh did not materialise, No. 54 Group was formed later at Reading and became responsible for Initial Training Wings.

After the outbreak of war, Headquarters Reserve Command controlled the training and administration of Nos. 50 and 51 Groups and arranged for the attachment of flying instructors, both commissioned and non-commissioned, for examining and liaison duties at the Schools. Elementary Flying Training Schools and Air Navigation Schools comprised the units of the Command and to these were sent those candidates for aircrew duties who had passed the medical board and been accepted and allocated as pilots or observers by an aircrew selection board. The Schools were operated by civil companies under contract to accommodate, mess and train the pupils, under the supervisory control of Reserve Command.

In order to deal expeditiously with the greatly increased numbers of trainees, proposals for preliminary pre-flight training were examined and, in August 1939, Aircrew Reception Depots to accommodate recruits were set up at Volunteer Reserve Town Centres, Universities and Holiday Camps. On the outbreak of war these became known as Initial Training Wings.

On August 30, Headquarters Reserve Command moved from Tavistock Place, London, to Wantage Hall, Reading.

WAR PERIOD—SEPTEMBER 1939–MAY 1940

The Outbreak of War—September 3, 1939. At the outbreak of war, flying training was the joint responsibility of Reserve and Training Commands. The recruitment of aircrew, their reception into the Service, initial training, selection for aircrew category and preliminary flying training was the task of Reserve Command, the pupil aircrew then being passed to the flying training groups of Training Command for further training, before disposal to the operational commands, or other flying duties.

Reserve Command in War. The move of Reserve Command from London to Reading began on August 30, and was completed on September 4; at the same time (September 2, 1939) No. 50 (T) Group moved from Tavistock Place, London, to Royd Park, Bristol, so that the declaration of war found Reserve Command in the midst of removal

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and re-organisation. As soon as possible, 27 Schools were closed and those remaining (i.e. 19 Elementary Flying Training Schools, 4 Air Observer Schools and 4 Initial Training Wings) were brought more closely under the control of Reserve Command Headquarters.

The day before war was declared three Schools for training wireless operators were set up, viz.:

No. 1 Supplementary Wireless Training School, Hamble.
No. 2 Supplementary Wireless Training School, Prestwick.
No. 3 Supplementary Wireless Training School, White Waltham.

These Schools were administered by Reserve Command, which was also responsible for technical training at the first two, Air Ministry retaining the responsibility for technical training at No. 3 School.

On September 3, 1939, three more Initial Training Wings were established, and the following day a new Group, No. 54, with Headquarters at Reading, came into being to administer the Initial Training Wings.

Certain functional changes occurred with the outbreak of hostilities. All attested men had been mobilised, and all recruits were absorbed into the Volunteer Reserve, although the Town Centres remained in being until the last of the reservists had been dealt with; all aircraft and personnel were concentrated in nineteen schools, the remainder being closed.

By the end of the year, it became apparent that certain changes were desirable in the status of the instructors at the Civil Schools, and on January 1, 1940, all flying instructors were mobilised.

MEDICAL ORGANISATION OF RESERVE COMMAND

General. When Reserve Command was formed on February 1, 1939, and took over the functions of No. 26 Group, Training Command, it assumed control of Nos. 1 to 46 Elementary and Reserve Flying Training Schools and the affiliated Town Centres of the Royal Air Force Volunteer Reserve.

As already stated, from that date until the outbreak of war, the civil firms owning the Schools were responsible for their operation, i.e. the training, accommodation, messing and medical arrangements for the pupil pilots and other aircrew in their initial stages under the general supervisory control of Reserve Command. The Command Headquarters controlled the inspecting medical staff officers and the Travelling Medical Boards which toured the country holding boards on aircrew of the Volunteer Reserve. Furthermore, the Command Headquarters administered the medical stores for the whole of the Command.

The Training Schools provided civilian nursing staff and engaged local civilian medical practitioners to undertake the routine medical work on a contract basis. These practitioners were instructed in the

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special medical tests necessary for aircrew examinations and later, under Air Ministry authority, they were permitted to carry out such tests, although this arrangement constituted a departure from normal Service procedure.

When war was declared medical officers of the Reserve of Air Force Officers, the Royal Air Force Volunteer Reserve and the Royal Air Force were posted to the Training Schools, while certain formations also received Service nursing staff.

Medical Manning of Reserve Command. The medical establishment of Reserve Command Headquarters was as follows:

Officers 1 Group Captain (Principal Medical Officer)
1 Wing Commander (Deputy Principal Medical Officer)
3 Squadron Leaders
9 Flight Lieutenants
Total 14 Officers

Other Ranks 3 Sergeants
6 Corporals
12 Aircraftmen
Total 21 Other Ranks

This scale included provision for two Travelling Medical Boards, each comprising one squadron leader, two flight lieutenants and two corporals.

In No. 54 Group medical posts were established for 1 squadron leader, 1 sergeant and 1 aircraftman.

Nos. 50 and 51 Groups originally had no medical establishment as the Command Headquarters catered for their medical needs, but in the last month of the Command's existence both Groups were upgraded to full administrative and executive status with a medical establishment commensurate with their new duties.

The medical staffing of typical units in the Command is given below:

Formation	Date established	Medical personnel
No. 1 Elementary Flying Training School, Hatfield	November 6, 1939	1 Flying Officer
No. 3 Air Observer Navigation School, Carlisle . . .	January 1, 1940	1 Flying Officer 1 Corporal 2 Aircraftmen
No. 1 Initial Training Wing, Cambridge	February 1, 1940	1 Flight Lieutenant 1 Flying Officer 1 Sergeant 1 Corporal 3 Aircraftmen

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Medical Administration. The medical administration within the Command conformed to normal Service practice in these matters with two exceptions: the maintenance of Royal Air Force Form 48 (Medical History Envelope containing all medical enclosures) at the Training Schools and the prophylactic inoculation of personnel.

With regard to the former, before the outbreak of war and up to the end of 1939, the responsible authority at each Training School was the Chief Instructor, who, being a civilian, was not empowered to hold Forms 48; accordingly, these were held at the Reserve Command Pool, all necessary entries being made at Headquarters. With the posting of Service medical officers to the Flying Schools it was possible to revert to the normal procedure for the retention of Forms 48.

Inoculations with T.A.B. vaccine and tetanus toxoid, vaccinations, blood grouping, etc. and a full medical examination were carried out at the Receiving Wing of the Initial Training Wings, so that the interference with fitness for flying usually attendant on inoculation was eliminated from the Flying School stage, as also was the need to devote time to medical matters.

When personnel were posted from Initial Training Wing to Flying Training School, a nominal roll with particulars of their vaccination/inoculation states and medical category for flying was despatched for the information of the medical officer of the new unit; any further prophylaxis or treatment could then be completed as necessary and all details forwarded to Command Headquarters for inclusion in the individual's documents.

In this way the medical fitness and prophylactic states of personnel in the Command could be checked at Headquarters, and any possible omission such as might result from early posting of an individual from the Initial Training Wing before his second inoculations, could be remedied.

Lectures on Medicine and Hygiene. All aircrew cadets were instructed in aspects of medicine and hygiene which had a bearing on Service life and responsibilities; in particular the relationship between health and fitness for flying was stressed with special reference to moderation in the consumption of alcohol and tobacco. Hygiene, especially of the Tropics and sub-Tropics, was covered in broad outline, the syllabus including teaching concerning diseases carried by food and water, cleanliness of cookhouses, conservancy both on the station and under field conditions and all allied matters.

In further lectures the physiology of flight was explained in simple terms with special reference to the problems likely to be encountered, such as lowered pressure, dinghy technique (Plate XLII), oxygen and temperature. In the final lecture a brief résumé was given of first-aid procedures and techniques, applicable to aircrew, and the physical,

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psychological and social implications of venereal diseases were emphasised.

The Travelling Medical Board. In order to carry out adequate medical examination of the large numbers of reservists and other candidates for aircrew and ground duties who came forward with the expansion, it was decided that medical boards would have to tour the country, and accordingly Travelling Medical Boards were established as a formation in Reserve Command. These boards were held at the various Volunteer Reserve Town Centres or Civil Flying Schools to which personnel were summoned for interview regarding their suitability for aircrew duties.* The Interviewing Board usually consisted of the Volunteer Reserve Town Commandant—normally a retired Royal Air Force officer with the rank of wing commander, but sometimes an ex-Royal Navy or ex-Army officer—the manager of the Civil Flying Club, which incorporated an Elementary and Reserve Flying Training School, and an Examining Officer, who was a flight lieutenant from Headquarters Reserve Command, detailed to assist in supervising the school training, and to examine pupils from time to time.

Improvisation, owing to unsuitable accommodation, was often necessary and at one place the candidates undergoing the Snellen's Eye Test were examined sitting on the seat of a lavatory whose dimensions, added to that of the corridor on to which it opened, gave the necessary distance. Blanket screens could, if necessary, be improvised to shut out the light from windows during eye examinations.

Members of the Boards travelled extensively. One weekly itinerary was from Hendon to Coventry by road, thence to Northampton and Leicester, returning to Headquarters on Friday night for the Saturday morning conference. Another itinerary was by train from London to Perth on Sunday night, thence to Glasgow Town Centre, thereafter to Manchester and Southend, and returning to London at the end of the week. Initially twenty boards were carried out each day, but as the expansion proceeded this number was increased to thirty.

Candidates with a history of travel, sea or air sickness were checked at the civil airport by the medical officer, who stood by while the candidate was flown and examined him on landing when the actual effects of flight could be observed and motion sickness assessed.

GENERAL CONSIDERATIONS

Accommodation. As was the experience in all Commands during the war-time expansion of the Royal Air Force, difficulties in finding suitable stations and of accommodation and other facilities were many, resulting

* It is of interest to note that the Volunteer Reserve candidates were only examined for fitness for flying so that when the Reserve expanded to include such as Meteorological Officers, the rejects had to be re-boarded.

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in a diversity of medical problems. Inevitably, delays occurred over the provision of suitable living quarters and there was some overcrowding pending the completion or conversion of buildings.

An examination of Reserve Command units reveals great variety in the accommodation provided. The Initial Training Wings were housed in university colleges, hotels, modern blocks of flats or billets in requisitioned houses, while the accommodation which had formerly been provided by the Civil Flying Companies at Elementary Flying Training Schools consisted mainly of brick barrack blocks and office buildings; one Elementary Flying Training School was housed in concrete buildings and 'B' type hutting was found on two of the Elementary Flying Training Schools and the four Air Observer Navigation Schools.

Sick Quarters. The provision of a suitable type of sick quarters was not overlooked and stations lacking adequate facilities in this respect were provided with a standard type of hutted sick quarters.

Drying Rooms and Early Treatment Rooms. Among other essentials which received special attention may be noted the provision of drying rooms attached to ablution huts and of facilities on stations for early prophylactic treatment for venereal diseases; this latter requirement was usually met by appropriate modifications to a latrine compartment, which was provided with a separate entrance and suitable accessories, such improvisation best serving the twin deities of hygiene and economy.

Water Supply and Sanitation. Water supplies and sanitary services were obtained, whenever possible, by tapping the resources of the public authorities and, once installed, rarely gave trouble.

At Sywell, the existing water supply from a spring of doubtful purity was replaced by tapping the urban supply from Northampton; at No. 10 Elementary Flying Training School, Yatesbury, animal pollution of the water supply was investigated in October 1939 when it was found that the catchment area was polluted by a sewage drain some 15 ft. from the spring source, and possibly from cottages and pasture land in the neighbourhood; at Derby, where water from a shallow well was occasionally used, boiling of all drinking water was the rule.

FLYING TRAINING COMMAND

MAY–DECEMBER 1940

On May 27, 1940, Reserve Command ceased to exist, and Nos. 50, 51 and 54 Groups amalgamated with Nos. 21, 23 and 25 Groups of Training Command to form a new Command with Headquarters at Shinfield Park, Reading; thus Flying Training Command, with responsibility for all flying training throughout the Royal Air Force, came into being. On its formation, the Command had an establishment of 3,189 aircraft of 56 different types—that is, three times as many aircraft and

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four times as many types of aircraft as any other Command—while the number of stations (26 taken over from Reserve Command and 49 from Training Command) was double that for any other Command.

Medical Manning. The medical establishment of Headquarters Flying Training Command comprised:

(*a*) *Officers* . .	1 Air Commodore—Principal Medical Officer	
	1 Group Captain—Deputy Principal Medical Officer.	
	1 Squadron Leader	
	1 Flight Lieutenant—Unit Medical Officer or Flying Officer.	
(*b*) *Other Ranks* .	1 Warrant Officer	Nursing Orderlies
	1 Sergeant	Nursing Orderlies
	2 Aircrafthands	Nursing Orderlies
	5 Civilian Clerks*	

New Stations. During 1940 the policy of dispersal, to which reference has been made in earlier chapters, was adopted in many of the recently opened stations. The setting up of these gave rise to many drainage problems similar to those experienced in other Commands and was attended by similar difficulties.

Ventilation and Blackout. Continual difficulty was experienced in providing a satisfactory blackout without completely sacrificing ventilation. The importance of correct ventilation, particularly to allow shelters and other accommodation to be adequately dried out in wet weather, stressed the need for a better form of blackout apparatus than curtaining which, although fulfilling its purpose satisfactorily, prevented the free circulation of fresh air. Fibre shutters incorporating light traps were eventually tried out with favourable results and were adopted as the method of blackout whenever possible.

Medical Research. With regard to specific medical investigations during the year, four teams were engaged in psychological tests for pilot pre-selection and five research teams investigated the night visual capacity of aircrew.

1941

Organisation. The units in Flying Training Command on February 14, 1941, consisted of 84 units, distributed among the six groups, and the Central Examination Board at Twyford. By the end of 1941, seven stations had been transferred to other Commands, while eight had been received in lieu and a further twenty-three new stations opened.

Grading. The opening up of the Empire Air Training Scheme made the careful selection of trainees imperative if both money and vital

* 5 Clerks, General Duties, were later substituted for the civilian clerks.

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shipping space were to be saved by the elimination of unsuitable candidates prior to despatch from the United Kingdom.

Grading consisted of applying the actual test of flight to discern the potential ability of the candidate to fly. Grading Schools were set up on the released Elementary Flying Training School aerodromes and each aircrew candidate was given twelve hours dual flying instruction and initial ground training over a period of three weeks.

Personnel Reception Centres. On return to the United Kingdom, aircrew personnel trained overseas found the weather of a very different type from the climates of America or Africa, in which they had become accustomed to flying. Their difficulties were increased by the prevailing blackout conditions and accentuated in winter.

Further, delays in attachment to the Operational Training Units necessitated a waiting period which, added to travelling time, resulted in a deterioration of morale and of recently acquired flying skills, so that useful employment had to be found for them. In February 1941 the first Personnel Reception Centre with a capacity of 750 was opened for personnel from overseas; by the end of the year it had expanded to house 3,000 personnel with overflow. A second Personnel Reception Centre was formed in March 1942 and expanded to 2,500. It was very difficult to employ usefully the large numbers of aircrew involved and the following paragraph outlines the way in which the problem was solved.

Advanced Flying Units. It was desirable to provide flying facilities for these aircrew from overseas awaiting admission to the Operational Training Units. As the Empire Air Training Scheme became established, nearly all *ab initio* and Service flying training was carried out abroad; consequently, the facilities of the Flying Training Schools in the United Kingdom were available for other needs and accordingly Advanced Flying Units were formed on these aerodromes. These provided refresher training and so bridged the gap between return to the United Kingdom and the commencement of operational flying training. At first, a three weeks' course was planned, but by December 1941, this had been increased to four weeks except for personnel destined for Bomber Command who were given an eight weeks' course. By March 1942, some ten Pilot Advanced Flying Units were in operation.

Aircrew Reception Centres. In order to ensure adequate reinforcements of suitable aircrew candidates against expected losses in a long war, the Deferred Service Scheme, whereby potential aircrew registered and then returned to civil life pending a later call-up, was introduced. The expected aircrew casualties, however, did not materialise and much public criticism was occasioned during 1940 by the consequent long-continued deferment of these keen young aircrew candidates. This criticism was partly allayed by the formation, early in 1941, of an

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Aircrew Reception Centre which held aircrew candidates between the Aviation Candidates Selection Board and Initial Training Wing; the latter was thus relieved of part of the administrative load and enabled to concentrate more on purely aircrew training. The Aircrew Reception Centres also carried out the re-selection of candidates who failed the pilot and navigator courses for other flying or ground duties.

Accommodation. During the year accommodation presented many difficulties. Overcrowding, which was in theory ameliorated by the reduction of floor space to 45 square ft. per man, never became serious but demanded constant supervision by the medical officers. Representations were made to commanding officers directly any overcrowding was reported, and immediate action was taken whenever possible.

Tented Camps. Tented camps had to be used on many occasions during the war, particularly in the initial stages when the difficulty of providing permanent accommodation for the large influx of personnel was most marked. Nevertheless, all possible steps were taken to avoid using tents, or at any rate to minimise their use, in winter. In the matter of field hygiene on tented camps, experience showed the importance of providing suitable kitchens, protected from the weather, and adequate latrines, with proper means of disposal, before the camp was occupied. The medical officers in charge and the local medical officer of health had to pay particular attention to both the siting and the actual construction of latrines, although this often presented great difficulty on sites where the surface drainage was unsatisfactory.

It should be recorded that the use of tents appeared to have no repercussions on the health of personnel occupying them.

Heating. Heating difficulties were reported from many stations in respect of both living and barrack accommodation. Slow combustion stoves were primarily employed but these were found to be generally unsatisfactory, being both dirty and inefficient and also requiring considerable time for maintenance; oil stoves were used in certain buildings to supplement other methods of heating.

Lighting. During the year the lighting of classrooms presented difficulty, especially in requisitioned premises. It was realised how essential was an adequate standard of lighting, properly presented, which would ensure sufficient illumination and protect the eyesight of aircrew candidates, in whom good vision was a vital function. It was submitted that the policy of providing lighting on the antiquated 'wattage system' should be abolished and that a 'foot-candle' basis should be introduced; further, it was recommended that photometers should be provided for senior medical officers and works representatives so that unsatisfactory lighting could be immediately detected. A general survey which was carried out at Nos. 1, 3, 4, 5, 6 and 13 Initial Training Wings, the Aircrew Disposal Wing and Elementary Air Observer

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School revealed that the lighting on a 'foot-candle' basis was far below the required standard.

Various recommendations were made and their implementation resulted in a greatly improved standard of lighting, so that it was considered that all danger of eye strain had been satisfactorily removed. One of the recommendations submitted was that for all premises in the Command used for instructional purposes standards of lighting should be laid down and as a result the Directorate of Works, Air Ministry, issued new regulations concerning lighting at Royal Air Force training units, these standards subsequently being enforced throughout the Service.

Ventilation and Blackout. The provision of adequate ventilation in living and working quarters had been facilitated by the introduction, throughout the Command, of a system of blue lighting for use after dark, making it possible to dispense with blackout screens. Also of value was the inspection carried out daily by the duty officer and at irregular intervals by medical officers to ensure that ventilation during the hours of darkness was adequate.

Catering Officers and Messing. The appointment of catering officers during the year much improved the standard of messing and greatly reduced food wastage. Complaints were made by the staff about the design of the new kitchens, particularly the lack of adequate larder space, preparation rooms and vegetable stores, while in many instances floors sloped the wrong way, resulting in inadequate drainage and increasing the difficulties of maintaining a satisfactory standard of cleanliness. Seldom were separate washing and lavatory facilities provided for male and female staff and this, together with the lack of staff accommodation generally, led to much discontent among the personnel concerned.

There were three outbreaks of food poisoning. At the Aircrew Reception Centre, London, in August, 250 cases of mild diarrhoea occurred; this was thought to be caused by milk which stood in churns in the heat of the sun for several hours before use; when this practice stopped the diarrhoea ceased. At Booker, 50 airmen who ate meat pie suffered from food poisoning; most cases recovered within 24 hours. At Bobbington in the same month, 15 cases of mild food poisoning of unknown aetiology occurred.

Physical Fitness. Physical standards throughout the Command improved as a result of the establishment at commands, groups and units of Physical Fitness Officers; similarly, the provision of long overdue facilities for proper training and for organised games increased the opportunities for physical training, with most encouraging results.

Courses for Medical Officers. Some 90 per cent. of the medical officers in the Service were recruited from civil practice or from hospital soon after qualifying and consequently they had little or no knowledge of

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field sanitation, particularly as practised on the Relief Landing Grounds and in tented camps. It became evident that much benefit would accrue if these medical officers, after completing their entry course at the Medical Training Establishment and Depot, were to proceed to the School of Hygiene, Halton, for a course in elementary hygiene; such courses (which catered for all Commands in the R.A.F.) were organised during the year and their value became immediately apparent. A large number of medical officers also attended the Oxygen and Flying Physiology Course at Farnborough, which was both instructive and popular.

Courses for Airmen and Airwomen. During the year several non-commissioned officers attended the course in administration at the Medical Training Establishment and Depot, where instruction based on A.P. 1269* was given. Other airmen passed through the water trailer course at Halton and the number trained there was augmented by Command courses held at Headquarters Nos. 21 and 23 Groups, where the sanitary assistants attached to these Groups gave instruction to nursing orderlies on the use of the trailer.

Sanitary Assistants. Sanitation on stations and other units was much improved during the year as a result of the appointment of sanitary assistants at Group Headquarters; these personnel, who, as mentioned elsewhere, were sanitary inspectors in civil life, proved of great assistance in dealing with matters of hygiene and sanitation. The proposal that sanitary assistants should be commissioned in the Administrative and Special Duties Branch in view of their special qualifications and civilian status was submitted to the Air Ministry for consideration but the suggestion was not adopted. From a Command point of view the decision, while doubtless based on sound reasons, was unfortunate in that its adoption could have avoided the embarrassing situation that sometimes arose when adverse reports on units had to be made to the officer-in-charge, especially in instances where the latter was very conscious that the complaint emanated from a non-commissioned officer.

X-ray Unit. A mobile X-ray Unit was installed at the Aircrew Reception Centre for mass radiography of prospective aircrew. (*See* Volume 1, Chapter 6.)

1942

Organisation. Over the year 1942, the functions of the Command were exercised through the various groups as follows:

No. 54 Group	—Initial Aircrew Training. All Categories.
No. 50 Group No. 51 Group	—Grading for flying ability. Pilot, Navigator, and Air Bomber categories.
No. 25 Group No. 29 Group	—Training of Navigators, Air Bombers and Wireless Operator Air Gunners.

* Manual for Medical and Dental Officers, R.A.F.

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No. 23 Group —Advanced Flying Training and Glider Flying Training.

No. 21 Group —Advanced Flying Training, apart from a Service Flying Training School at Cranwell, a Polish Elementary Flying Training School at Hucknall and a Polish Service Flying Training School at Newton.

Accommodation. In June a review of the accommodation on all stations in the Command brought to light certain instances of overcrowding and these received immediate attention. Two months later, however, the scales of sleeping accommodation for airmen were reduced, a comparable reduction being made in November in the scales for officers and non-commissioned officers. Thus overcrowding was theoretically abolished, but many commanding officers and medical officers were dubious about the adequacy of the new scales and realised that henceforth even greater vigilance would be necessary in all matters relating to hygiene and sanitation.

Heating. In view of the acute shortage of solid fuel throughout the country, it was necessary to extend the period during which heating was forbidden, the ban coming into force on April 1, and remaining until October 31, although exceptions were made in the case of sick quarters and similar establishments. In some exposed and remotely situated stations this ban led to a certain amount of hardship but Command statistics gave no evidence of the increased sickness rates which might have been expected to result.

Operational Record. On May 21, 1942, the A.O.C. in C. was approached by the A.O.C. in C. of Bomber Command, with a request for assistance in the Bomber Command plan to carry out 1,000 bomber aircraft raids on Germany; instructions were accordingly given to the Air Officer Commanding, No. 25 Group, to prepare as many aircraft and aircrews as possible to take part in these raids, and on May 24, the Group was requested to attach 25 operational type aircraft, with crews, to Bomber Command for ten days with effect from May 25.

The provision of 25 aircraft operationally equipped was not an easy task, but every effort was made to prepare as many as possible and eventually seven Hampdens, four Wellingtons and three Whitley aircraft were supplied, together with crews, which included many of the instructional staff. Unfortunately, excessive oil consumption and other difficulties made the use of the Hampdens impossible, but on the night of May 30, 1942, the Wellington and Whitley aircraft were able to participate in the 1,000 bomber raid on Cologne.

Three days later, the Flying Training Command Wellingtons accompanied the Lancaster and Manchester aircraft of Bomber Command on the second 1,000 bomber raid, on Essen, on the night of June 2 and on

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that occasion several Flying Training Command crews succeeded in finding places on the Bomber Command aircraft for the raid.

Although the Flying Training Command effort was necessarily small, one result which became immediately apparent was a marked raising of the morale of instructors, pupils and ground crews.

1943–44

General Medical Considerations. During this period there were no radical changes in the constitutional functions of the Command.

Accommodation. Examination of the sickness incidence indicated that the authorised scale of floor space had now reached the minimum compatible with the maintenance of a reasonable standard of health.

Heating. Slow combustion stoves again proved dirty, smoking frequently and burning badly, while universal complaints were received from sick quarters of the failure of these stoves to maintain adequate heating of the wards; similarly, it was stated that the standard stoves fitted in Nissen hutting were ineffective in keeping the huts either warm or dry during the winter months. At certain stations fuel shortages led to complaints of insufficient heating while on the northern stations, e.g. Morpeth, the provision of one combustion stove per barrack hut was considered inadequate. The use of oil stoves as supplementary means of heating, however, was considered to be unsatisfactory as well as dangerous.

Apart from their inefficiency, slow combustion stoves created much smoke and fumes, adding to the difficulties of ventilation, which could often only be overcome by leaving the hut doors open; in winter months this was, of course, impossible if any degree of warmth was to be achieved.

There was no conclusive evidence that the coal shortage and lack of heating had any bearing on sickness rates.

Malaria Prevention. In order to prevent the possible spread of malaria at Eastchurch, where the mosquito vector is indigenous, instructions were given that all transient personnel arriving on the station between June 1 and October 15 who had had malaria during the previous twelve months were to sleep under a mosquito net, and that any permanent staff on the station who had had malaria within the previous twelve months were to be posted away as soon as possible.

Air-Raid Shelters. The experience of the Command in the matter of air-raid shelters is worthy of note.

Some anxiety was felt over the condition of shelters on units and it was fortunate that they were so little used, for many of them were damp and in several water collected owing to defective drainage.

During the V.1 attacks on London in the summer of 1944, aircrew cadets and permanent staff of No. 3 Aircrew Reception Centre slept nightly in the reinforced basement of those requisitioned properties

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which were used as barrack blocks. Overcrowding occurred in these, as well as in the station sick quarters shelter at Abbey Lodge, for 11 to 15 sq. ft. was usually the maximum amount of floor space available per person. Such conditions, however, were no worse than those being experienced by large numbers of the civilian population, and in spite of the almost nightly occupation of these shelters no adverse effects on health were recorded.

At that time, only the sick quarters shelter and two other buildings were fitted with mechanical ventilators and in many other shelters the bricking up of windows to reduce the effects of blast meant that there was often no through current of air. In view of this direct threat to health it was recommended that mechanical ventilators should be installed as soon as possible and as a precautionary measure all patients with pulmonary tuberculosis awaiting admission to hospitals or sanatoria, were posted away from London.

In July, 1944, approval was given for the installation of mechanical ventilators and work was commenced, but on September 3 the unit was placed on a care and maintenance basis and further action became unnecessary.

Recreational Facilities. In all formations of the Command, the closest co-operation was maintained between the medical officer and the physical fitness officer and careful attention was given to physical fitness facilities for aircrew.

At Aircrew Reception Centres, accident rates due to physical training and organised games were particularly scrutinised in order to ensure that the type of instruction given would be appropriate to the physical standard of the cadets in the early stages of their training.

Lectures to Personnel on Hygiene and Venereal Disease. The upward trend in the incidence of venereal disease continued to cause anxiety. All Royal Air Force—as well as Dominion and Allied—personnel were shown the instructional film 'Sex Hygiene'; in No. 54 Group, for instance, all aircrew cadets were shown the film on entry, when they also received a short talk from the medical officer, and arrangements were made for it to be seen by non-aircrew personnel in the group; in no circumstances was the film shown more often than once in six months.

Copies of the film were established at the headquarters of all other groups in the Command and the group senior medical officers arranged for its regular showing on all units.

The Command woman medical officer continued her visits to stations and lectures to personnel of the Women's Auxiliary Air Force while Princess Mary's Royal Air Force nursing sisters detailed for Women's Auxiliary Air Force welfare work lectured on the subject of sex hygiene as required.

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Arrangements were made for each airwoman to attend a lecture or see the special film once every six months. In April 1944, the film 'Briefing for Health' became available, and a copy was shown by the woman medical officer on her regular visits. As more copies came to hand, two were allocated to each group headquarters for regular showing throughout the group.

MOUNTAIN RESCUE

One of the major advances in Aviation Medicine during the Second World War was the building up of the Mountain Rescue Organisation which was conceived and developed in Flying Training Command.

With the war-time expansion of the Royal Air Force, not only were there more aircraft being flown, but the air routes used covered an increasing amount of country, so that, over terrain which had been avoided in pre-war air routeing, the noise of aircraft was heard by day and night and the outlying mountainous areas of the British Isles were regularly traversed in communication, training and operational flights.

As the tempo of flying quickened, so did the number of aircraft accidents increase, and, as was to be expected, those mountainous tracts which present great hazard to an aircraft lost, off track, or in distress, claimed their tragic share of victims. For example, in the North Wales area from April 22, 1942, to January 14, 1943, eleven aircraft crashed with 35 fatalities and 12 persons injured.

Need for Mountain Rescue Service. In any crash the chance of survival for the injured is in direct ratio to the speed with which effective rescue measures can be taken and medical aid reach the site.

Before the introduction of the Mountain Rescue Service, the discovery of missing aircraft was primarily an impromptu exercise in search and navigation which took a considerable time to be put into operation. If an aircraft failed to return from night flying, little could be done until daylight made it possible for the available aircraft to search the area and even this could only be done if the weather permitted. There was no ground search organisation apart from that which could be raised locally for each particular incident.

When the scene of the crash was spotted from the air or found by chance, a hastily recruited party would attempt a rescue, making use of whatever facilities were available in the way of men and equipment. As no special methods, training or equipment had been evolved, the rescuers often spent long and dangerous hours locating the crash and manhandling the casualties to the ambulance, which, not being designed for this type of country, had usually to be left at a road point which might be some miles distant from the crash.

Early Development of Mountain Rescue. The succession of mountain crashes in Snowdonia presented new and unexpected problems to the station medical and flying control staffs at Royal Air Force Station,

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Llandwrog. It became obvious that a new organisation specially trained and equipped to deal with aircraft crashed in the mountains was required, if delay in finding and rescuing survivors was to be minimised and the chance of saving life correspondingly enhanced; similarly, only thus could it be hoped to reduce appreciably the number of man-hours spent in dealing with such occurrences. An example from the crashes attended during 1942 will illustrate the nature and urgency of the problem:

An aircraft crashed in a gully on the north-east slopes of Foel Grach at approximately 2045 hours; by about 1400 hours the following day the pilot, despite concussion and lacerations of the face and scalp, managed to find his way down to a farm several miles away. The medical officer at Llandwrog was summoned and reached the farm with two orderlies at 1630 hours, by which time the pilot was irrational, and beyond saying that he had climbed a ridge and had seen two lakes, he was unable to give any information about the direction in which the aircraft lay.

The medical officer and the two orderlies proceeded to search the slopes of Foel Grach far into the night, only abandoning the search at 0200 hours when a heavy snowstorm made the situation hopeless.

Soon after dawn they were out again, assisted by a Royal Air Force party summoned from the station and by a few civilians. The medical officer split the party into two groups, one of which he sent by Foel Grach over the area searched the previous night while he himself led the second group up Foel Fras. The weather had improved and the Foel Grach party soon found the aircraft with one member of the crew still alive; the other two men were dead, having succumbed to the effects of exposure and their injuries. As the medical officer was in the other party, contact had to be made before the injured man could receive proper medical attention. Communication between the parties was so bad that it was another hour and a half before the medical officer reached the scene of the crash and removal of the patient to the ambulance necessitated a further three hours of arduous work carrying a general service stretcher.

From such an experience the following points stood out:

(*a*) The improvised nature of the original search party.

(*b*) The length of time taken to raise a search party of adequate size from the station.

(*c*) The difficulties of search at night or in conditions of poor visibility and bad weather.

(*d*) The danger to life resulting from exposure in the mountains.

(*e*) The absence of adequate means of communication between the search parties.

(*f*) Difficulties in carrying casualties on the general service stretcher over rough ground.

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(*g*) The unsuitability for hill work of the standard ambulance.

(*h*) The need for a special organisation which would overcome these dangers and difficulties.

Formation of First Mountain Rescue Unit. The station medical officer at Llandwrog set out to solve the problem. His plans were examined by the station technical officer and the visiting Flying Personnel Medical Officer from the Principal Medical Officer's staff at Headquarters Flying Training Command. Their joint proposals for the formation of a special Mountain Rescue Unit were placed before the Commanding Officer, Llandwrog, on January 22, 1943, and began to be put into effect during the year. Some of the developments and progress made in the matter are described in the following paragraphs.

Ambulances. In view of the unsuitability of the standard Albion and Morris ambulances for mountain work, trials of the 3 hundredweight Willys truck (the jeep) and the Humber 4 × 4 ambulance were carried out and proved successful.

Communications. Wireless communication between the searching aircraft, the ground party and the base was considered to be essential. A transmitter-receiver set Army Type 19 was accordingly installed in the Humber ambulance and proved able to maintain communication with the aircraft above, as well as with the ground search party, who were equipped with pack sets Army Type 38, up to a distance of six miles. At Llandwrog base a transportable set R.1084–T.1154 kept in touch with the ambulance up to 40 miles radius although reception varied owing to the intervening hills; it was found, however, that poor contact between base and ambulance due to mountain topography could be successfully overcome by using an aircraft overhead as a relaying link between the two. All these tests had been made successfully by June 1943.

General Equipment. A scale of special equipment for the vehicles, drawn from technical, barrack, medical and catering sections, was then drawn up by the station medical officer and technical officer and submitted for approval.

The medical supplies carried were confined mainly to those useful for first-aid and resuscitation measures and this was found to be adequate. Food to maintain the unit for forty-eight hours was usually sufficient and it was rarely necessary to send out additional rations from base. The plentiful supply of hot sweet tea which was carried for the mountain rescue unit personnel proved also to be of great value in the treatment of shock in victims of the crash.

After much experiment, the satisfactory stowage of these items on the vehicles, with the maximum saving of weight and space, was achieved.*

* Food supplies and equipment are dealt with more fully later in this narrative.

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With further experience in all weathers, additional coverage proved desirable and to this end a lean-to tent was designed for attachment to the Humber ambulance (Plate XLIII); this tent provided a shelter for two additional stretcher cases and was sufficiently large to allow the medical officer and his orderlies to attend the patients therein.

Method of Search. When an aircraft was reported missing, its probable position was calculated from such data as were known, viz., the last reported air position, the aircraft's course, speed, direction and endurance, the wind and weather conditions prevailing and the high ground in the vicinity of the route. Failing further definite data and if weather conditions were suitable, an air-to-ground search was carried out over the most likely areas and, if the aircraft was found, the mountain rescue unit was vectored to the spot by wireless communication.

When flying conditions were unfavourable, the mountain rescue unit was dependent on local information from police stations, observer posts, and shepherds or other hill dwellers who had either found the crashed aircraft or reported any relevant suspicious occurrence in their area. All available information was passed to flying control and the mountain rescue unit advance party was despatched; failing any such information, the mountain rescue unit proceeded to ground search the likeliest areas; in either case the assistance of such experienced civilians as stalkers, gamekeepers or shepherds, who were familiar with the local countryside, was usually enlisted, and on arrival in the area, the local police were contacted for the latest hill news.

All members of mountain rescue units were equipped with ordnance maps and the most suitable track leading into the area was selected. When a point was reached where the Humber ambulance could proceed no further, the advance base was set up at the track head, wireless contact with base at Llandwrog was established, the latest information was exchanged and base notified that the search was beginning. If the search of that particular area was unfruitful, the parties either returned to the advance base or met at a pre-selected point where further plans were confirmed and the search renewed. At thirty-minute intervals contact was established with the Humber ambulance, which, being in contact with Llandwrog, co-ordinated information and, if necessary, directed the search.

At Llandwrog, on receipt of news that the search had started, 20 men forming the support party were called forward, drew their equipment and were taken to the forward base by motor-coach, a Willys jeep acting as an auxiliary carrier if the coach was held up by adverse road conditions before reaching track head.

The ideal method appeared to be for a small party, including the medical officer, to remain at the advance base until a signal was received that the crash had been located; the medical officer's party, carrying the

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requisite number of stretchers, blankets, hot water bottles and other medical equipment, then proceeded direct from advance base to the crash; first aid would be given, in the meantime, by the party which had discovered the crash, who would also give assistance in the removal of the injured and dead. The casualties were then transported to the Humber ambulance *en route* to sick quarters or hospital as necessary, the base being notified in order that adequate preparations could be made for their reception.

Although, as stated, this scheme was felt to be ideal, in practice it was usually found that the medical officer was keen to accompany the searching party and this arrangement functioned satisfactorily.

Personnel. All personnel engaged on mountain rescue duties were volunteers, interested in mountain climbing, and specially selected from all trades on the station. No definite figure was laid down for the strength of a mountain rescue unit, but experience had shown that an advance party of 15 and a supporting party of 20 personnel was satisfactory.* (Post-war mountain rescue teams normally consist of 36 members.) All members of the unit were given intensive training and in February 1945, in order that their special knowledge of the particular mountain area served should not be wasted, such personnel were screened by the Air Ministry from posting.

As there was no establishment for mountain rescue personnel as such, all members of the unit carried out their normal station duties when not engaged in rescue training or operations. There is now an establishment for a senior non-commissioned officer, specially trained as a mountaineer, for full-time mountain rescue duties, while a wireless operator, two M.T. drivers and an administrative orderly are also annotated on station strength for mountain rescue duties.

Training. As much of the original conception of the mountain rescue organisation and of the formation of the first mountain rescue unit was the work of a medical officer, it was to be expected that medical officers would figure prominently in the formation of new units. At the end of the war, when some eight mountain rescue units were functioning, at all units except one the maintenance of the unit and general training of the personnel was the responsibility of a medical officer.

As new mountain rescue units came into being, it was found necessary to engage a specialist mountain training officer. Accordingly an experienced Alpine climber, who had been instrumental in training one of the Scottish Divisions for mountain warfare, was seconded from the War Office to the Deputy Directorate of Rescue at Air Ministry. This officer was responsible for visiting the various mountain rescue units

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* Aircraft carried, according to type, 1–8 crew members and sometimes up to 20 passengers.

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PLATE XLII: Practice Instruction in Dinghy Handling

PLATE XLIII: Rescue Tent being erected on the back of the Ambulance. Note Aerial on Ambulance for communication with the Rescue Team

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PLATE XLIV: A Practice Rescue

facing p. 553]

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on their formation and thereafter at regular intervals for the purpose of training the personnel (Plate XLIV).

The amount of mountain rescue training given to each unit varied, the commanding officer of the station arranging, at his discretion, for such time to be devoted to it as was thought necessary and found practicable. Physical and operational fitness was ensured by regular practices held both in daylight and at night, in all weathers. Most units held day practices at least once weekly, and a weekend practice, which could incorporate a night exercise, once monthly, throughout the year.

A typical arrangement, which still obtains in post-war mountain rescue practice, was for briefing to be given in the mountain rescue hut on Tuesday evening for a short trek or climb in the adjacent mountain area the following afternoon, while briefing would be held on Friday evening for the longer weekend exercise. The opportunity was taken at these Tuesday and Friday briefings to hold discussions and give practical demonstrations.

On weekend exercises a party might proceed by transport to the distant part of their mountain area, perhaps 100 to 120 miles away, leaving the station at mid-day Saturday. On arrival in the selected area in the early evening, the two-man tents would be set up and the party spend the night there; an early start would be made on Sunday morning and the area searched up to a distance of some 30 miles, the party returning to its home unit late on the Sunday evening or early on Monday morning.

Rations. In general no requirements arose for food stuffs beyond the normal unit entitlements; there was very close co-operation between the executives of the mountain rescue units and the station catering officers and on stations where mountain rescue units were established, the 'operational' needs of the units were supplied from within existing entitlements by local adjustments (e.g. by provision of 'Haversack Rations'). Nevertheless, there were occasions when such arrangements proved insufficient, and formal authority was given for appropriate additional provisions known as 'reserve' and 'emergency' rations respectively.

Rations for the expected period of the exercise were made up as haversack rations, and only if the exercise was abnormally prolonged or in other exceptional circumstances, were the reserve rations broken into. The emergency rations were provided for the use of personnel engaged on the search when no other rations were available or conditions precluded the use of the reserve or haversack rations provided out of normal station entitlement; in some instances the 'Emergency Ration Type P', which fitted conveniently into the pocket, was carried by each individual. Arrangements whereby the catering officer of the parent station could demand these foodstuffs

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from the normal R.A.S.C. source of supply were authorised by Air Ministry, while the emergency rations were obtained from the appropriate Maintenance Unit. At the end of each exercise the medical officer or other officer in charge of the mountain rescue unit endorsed the appropriate issue voucher as a certificate that certain items had been consumed and the latter were replaced by the issue of fresh rations as necessary.

Equipment other than Mechanical Transport. The scale of equipment for mountain rescue units (Special Scale No. 32) was finally settled in November 1944. Equipment included axes, saws, shears, spades, crowbars, bolt croppers, etc. for breaking into crashed aircraft, while head lamps and torches, accumulators and dry batteries were supplied as lighting aids; route cards, altimeters, map protractors, maps, compasses, binoculars, etc. were all carried. For wireless communications, wireless and 'walkie-talkie' sets to transmit and receive were provided and means of visual and audible signalling, i.e., Very pistol, torch, heliograph and whistle, were also supplied.

In addition to the specially designed sick tent, two-man tents (Army pattern) were used for shelter and the necessary stoves, flasks and cooking equipment were provided. Individual members of the unit were suitably clothed with balaclava helmets, aircrew sweaters, long mittens, seaboot stockings, grooved-heel ankle boots, white duffle coats and drab suits in addition to the war service dress. Personal equipment was carried in the Bergen patterned rucksacks supplemented by Everest carriers; climbing rope or cordage was carried as necessary.

Medical Equipment. A special scale of medical equipment and composite items for mountain rescue ambulances was issued by Air Ministry at the beginning of 1945.

Operational Control. By making use of available equipment, by improvisation and by the careful training of volunteer personnel, the medical officer at Llandwrog established a system of mountain rescue which became the basis of the modern mountain rescue organisation and by the end of 1943 the unit there had achieved the rescue of 33 survivors from 22 crashes involving 121 personnel; during that same year 571 aircrew members lost their lives in 220 crashes on high ground throughout the United Kingdom.

In July 1943, responsibility for the Mountain Rescue Organisation was delegated to the Director of Flying Control and Rescue at Air Ministry. Later it was transferred to the Deputy Director of Air Sea Rescue within the Directorate of Operations (Maritime). Air Ministry thus became responsible for:

(*a*) The general and training policy.

(*b*) Policy governing the distribution of all mountain rescue equipment.

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(*c*) Liaison with Service and civil Ministries concerned with mountain rescue.

Implementation of Air Ministry policy, and the organising and maintenance of individual teams at operational standard was the responsibility of the Commands at whose stations rescue teams were based; co-ordination of the actual operations of mountain rescue units was vested in the Rescue Control Co-ordination Centre at the appropriate Coastal Group Headquarters, while immediate rescue action could be initiated at station level should the Station Commander consider this to be necessary.

THE FLYING PERSONNEL MEDICAL OFFICER*

In the main, the work of the Flying Personnel Medical Officer (F.P.M.O.) in Flying Training Command was concerned with the flying training problems of instructors and cadets, and although lacking the stimulus afforded by the operational activity of combatant commands, his duties were of absorbing interest.

In addition to the medical supervision of the flying training of pilots, navigators, air gunners and air bombers, the F.P.M.O. undertook duties in aviation medicine at certain special establishments such as the Central Flying School and the Empire Flying School, the Empire Air Navigation School, the Central Gunnery School and the Empire Air Armament School, where the advanced arts of flying, of aerial navigation and of ballistics all raised problems which demanded special attention. In the later stages of the war he also became responsible for the supervision of aircrew engaged in test flying at the Armament and Aircraft Experimental Establishment and the Airborne Forces Experimental Establishment.

Actual flying training in the Command was usually carried out at altitudes below 10,000 ft. (apart from one routine height climb of short duration to 15,000 ft.) so that oxygen problems with their attendant interest arose only at the experimental units, which, however, carried not only all the normal hazards, apart from actual operational risk, of flying at altitude, but also the special risks involved in experimental flying.

Education in aviation medicine, which was included in the syllabus of flying training, constituted a large part of the F.P.M.O's. responsibilities, for he was expected to lecture both instructors and cadets at all the stations he visited. It was not always possible, however, for the F.P.M.O. to carry out this duty himself, and in order that the instruction given should be standardised throughout the Command, a complete set of lecture notes covering the subjects detailed in the syllabus was

* *See also* Chapter 1, Bomber Command—Problems of Aviation Medicine.

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produced by the F.P.M.O. and distributed to all medical officers in the Command.* On his visits the F.P.M.O. was then able to clear up any particular medical points which were causing difficulty and at the same time, through his knowledge of experimental flying, to add interest by suitable, if brief, references to those problems being met by test pilots. In this way the field of both instructor and cadet was widened and the minds of the latter prepared for their future training, on more modern machines, at the Operational Training Units.

VISITS TO UNITS IN THE COMMAND

The F.P.M.O. spent much of his time in visiting Royal Air Force units; an aircraft of the Command Headquarters Communication Flight was allocated for his use and enabled him to visit widely dispersed units. When the weather made flying impracticable, the F.P.M.O. used rail or motor transport as convenient.

In planning each week's visits the F.P.M.O. first sorted the problems referred to him by Air Staff; he got in touch with the Group concerned by telephone and discussed the matter with the appropriate staff officer, keeping the Group Senior Medical Officer informed of progress. If further discussion was necessary a visit was paid to the Group Headquarters for fuller briefing before arrangements were made for the F.P.M.O. to visit the units concerned; his weekly programme usually included also a number of routine visits of inspection. On a routine visit, a time and place for the aviation medicine lecture for cadets and staff was fixed, in consultation with the Chief Flying Instructor, to ensure that the lecture did not interfere with the flying programme and interrupted as little as possible the Chief Ground Instructor's classes. Thereafter any problems connected with the cadets, or with a member of the staff, were investigated.

FLIGHT INSPECTIONS

Having dealt with any specific problems, the F.P.M.O. and the unit medical officer would proceed to inspect the flights. In addition to giving the F.P.M.O. practical knowledge of the standards expected in these matters by the C.F.I. of the station, these inspections afforded him an opportunity to instruct the unit medical officer in the practice of aviation medicine by pointing out to him those things on the ground which bear on aircrew efficiency in the air—*inter alia*, comfort and convenience of layout of the flight offices and crew room, locker accommodation for personal flying aids and flying clothing and facilities for drying the latter, parachute storage and maintenance.

* These notes proved so popular that requests for copies were often received from other commands.

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The Safety Equipment section of the station was also visited and the exhibits of both personal and aircraft safety equipment, including such items as dinghy equipment, airborne lifeboats, survival aids and equipment, were reviewed. The F.P.M.O. checked on the time allowed in the ground instructional programme for swimming practice, wet dinghy exercises (Plate XLII) and emergency drills on ditching and parachuting. His advice was often sought on the medical aspects of survival, while comment might be made on the psychological aspects of evasion and escape.

The Chief Ground Instructor's province was not overlooked in the inspection of the station and all class rooms were visited, attention being paid to such factors as ventilation, lighting, seating accommodation and overcrowding.

If a Mountain Rescue Unit was established on the station the mountain rescue hut was always included in the routine inspection. The medical aspects of mountain rescue were always fruitful sources of discussion and experiment and the F.P.M.O. made a point of accompanying the Mountain Rescue Team on actual exercises on the mountains in the area.

On completion of the inspection and after discussing with the Section and Flight Commanders and the unit medical officer all points which had arisen, the F.P.M.O. prepared his report* and recommendations to the Officer Commanding; if necessary, the report would be discussed with the S.M.O. and A.O.C. when the F.P.M.O. visited Group Headquarters before returning to Command Headquarters.

The principle was adopted that whenever possible any necessary action should be taken on the spot and, apart from the usual record of findings and action taken, which was prepared on all visits for submission to the P.M.O., letter writing and minutes were reduced to a minimum. Where action was required at Command level this was expedited by a visit of the F.P.M.O. to the appropriate specialist officer, so that the matter could be fully discussed and decision made, if possible, at the time.

ACCIDENT INVESTIGATION

All accident notifications were referred by Air Staff to the P.M.O's. Department at Command. Any which presented doubtful or unusual features the F.P.M.O. followed up by visiting, with the investigators, the site of the accident and thereafter the unit, to ascertain the skill and flying experience of the crew members concerned and to inquire into any possible ancillary cause arising, for example, from lowered physical fitness or personal difficulties.

* Specimens of F.P.M.O's. reports on flying can be seen in the Appendix to the F.P.M.Os'. section of the Bomber Command narrative.

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Any fault in the aircraft equipment which was brought to light and appeared to have had a bearing on aircraft performance or on injury causation was specially taken up when the findings went forward to Air Ministry, the F.P.M.O. reporting on the matter at the same time to the R.A.F. Institute of Aviation Medicine so that further investigation from the medical aspect could be made.

SPECIAL TRAINING OF FLYING PERSONNEL MEDICAL OFFICERS

In order that the F.P.M.O. might be adequately equipped to act as responsible officer on the many particular points raised by the various categories of aircrew, practical training and experience in each of the flying rôles was a necessity, for it was considered that no medical man could advise competently on certain specialist problems connected with flying unless he had practical experience of the duties involved.

Accordingly, application was made for the F.P.M.O. to undergo training in air gunnery, air bombing and air navigation and courses in these subjects were taken at Air Gunnery and Air Navigation Schools and at the Empire Air Armament School at Manby and the Empire Air Navigation School at Shawbury.

Later, when the Airborne Forces Experimental Establishment, with its attendant problems connected with parachuting, was added to his responsibilities arrangements were made for the F.P.M.O. to attend a parachute course.

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CHAPTER 9

TECHNICAL TRAINING COMMAND

IN the rapid expansion of the Royal Air Force during the war, ground training in its broadest sense was the responsibility of Technical Training Command and with very few exceptions all personnel coming into the Service were, at least initially, under the care of this Command until they were sufficiently conversant with their duties or trade to be allocated to other Commands. With the large war-time influx of personnel it followed that Technical Training Command was the largest of the Commands and the problems arising correspondingly more acute than where there was a reasonably static population of trained personnel. Furthermore, the age range of the Command varied considerably for although the majority of trainees called to the colours were in the younger age groups, a proportion of the skilled tradesmen called up were necessarily older, so that an assortment of young and relatively old personnel had to be catered for simultaneously, with the obvious problems of adjustment to Service life in war-time.

In the following pages certain medical points will be amplified in relation to activities of the Command in which the medical authorities were especially interested or engaged in a preventive capacity. In particular, stress will be laid on the problems encountered in the training of large numbers of personnel in trades new or unfamiliar to the R.A.F. or which might be expected to carry a medical hazard. Little reference, however, will be made to the administration of hospitals and medical establishments and the training of medical officers and medical airmen and airwomen, which were all undertaken by the Command, as these aspects of its responsibilities have been fully described in Volume I of this History.

Scope of the Command

IN the preceding chapters of this volume, the *raison d'être* of each Command has been self-evident, but in dealing with Technical Training Command no clear-cut definition of function is possible. The Command, whose primary purpose is obvious from its title, was responsible for a large number of units whose activities would not normally be described as 'technical' and were often not directly concerned with training. The rapid developments in flying not only demanded an efficient organisation for the training of ground crews to service aircraft, but made

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specialised training for both flying and ground personnel increasingly necessary. The many incidental and purely 'domestic' needs of any large body of personnel led to the formation of such miscellaneous units as Schools of Administration, Cookery and Physical Fitness, the R.A.F. Service Police unit and the R.A.F. Central Band, all of which, together with Recruit Centres, Personnel Centres of various kinds, Record Offices, Hospitals and Medical Establishments, were included in the administrative responsibilities of Technical Training Command.

This diversity of function increased as the war progressed and the development of aircraft and of armament, navigational and wireless aids advanced in a manner undreamt of at the commencement of hostilities. Nevertheless, training remained the basic task, so that although the definition of 'technical' was stretched to include subjects ranging from pigeon keeping and training to the maintenance of decompression chambers, and although numerically it had grown beyond recognition, at the end of the war the Command was still carrying out the basic duties for which it had originally been formed during the First World War.

DEVELOPMENT AND HISTORY

THE WAR OF 1914–18

It is perhaps true to say that none of the commands in the Royal Air Force was created,* as a complete and 'ready-made' formation, on any particular date; rather did each from a practical point of view come into being gradually, to meet a specific need, finally being accorded the equivalent of Command status when it became obvious that a permanent organisation was needed. Military flying, which began seriously in the early stages of the First World War and developed very rapidly during its prosecution, demanded as it expanded some kind of training organisation which would provide a supply of qualified pilots, this requirement later extending to a variety of aircrew categories and skilled technicians, ranging from air observers to mechanics and riggers.

The first units organised to meet these needs were the Fifth and Sixth Army Brigades which were merged into one brigade, the Sixth, in April 1919 and renamed the Training Brigade in July of that year. In July 1916 the first large school for instruction was opened in a converted factory at Coley Park, Reading, and here 500 riggers and a similar number of fitters were trained and trade tested; by the end of the year twelve separate schools had been set up for the technical instruction in various subjects of both aircrew and ground personnel.

In 1917 the increase in size of the Royal Flying Corps and the complexity and variety of aircraft had necessitated considerable expansion in training facilities and accordingly three Groups—Southern,

* Officially the Commands of the R.A.F. were formed on particular dates in July, 1937.

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Northern and Eastern—were formed under the control of the Training Brigade; later, in August, these groups were designated Brigades and the original Training Brigade was renamed the Training Division. A Western Brigade was added in November. By October 1918 there were twenty-four different flying categories and training was carried out in over thirty training schools. On the formation of the Royal Air Force on April 1, 1918, all policy relating to training was vested in the Director of Training at the Air Ministry.

INTER-WAR CHANGES

Improvement in aircraft and in flying technique led to an extension of the training organisation during the period between the end of the First World War and the reorganisation of the Royal Air Force in 1936.

Great strides had been made in the development of aero-engines and airframes, and these advancements had increased the complexity of training of both the crews who flew the aircraft and the ground personnel who were responsible for the fitting and maintenance of equipment. Specialisation, therefore, became a marked feature of all branches and the necessary facilities had to be provided for such specialist training, as well as for refresher courses to keep trained personnel technically abreast with the continual advances in the field of aeronautics and the widening sphere of military aviation.

The rise of Nazism in Germany and the formidable growth of the German Air Force which was backed up by a commercial fleet of thinly disguised bomber and transport aircraft made it imperative that the aircraft performance, technical efficiency and personnel strength of the Royal Air Force should be rapidly increased. From 1936 the race for air supremacy was on. The expansion affected all branches of the force and in particular all facets of training, for top priority was given to the creation of a highly skilled body of aircrew to fly and technicians to service and maintain the increasing numbers of operational and training aircraft. Training was particularly important, since the specialisation of aircraft and their equipment was easily negatived if crews were not sufficiently trained to make full and correct use of the additional apparatus. Furthermore, if full use was to be made of the limited flying time available to personnel on the various Reserves, it was essential that a high rate of serviceability in aircraft should be maintained and this was largely dependent on the technical skill of ground crews.

POSITION AT THE OUTBREAK OF THE SECOND WORLD WAR

At the outbreak of war vast numbers of personnel were absorbed into the Command and an even greater number passed through the Command on joining the Royal Air Force and during periods of training. The intake comprised both trained members of the Reserves and recruits

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who had no previous link with the R.A.F.; some of the latter were familiar in civilian life with the duties they were to undertake in the Service, but many were completely ignorant of the trade to which they were allocated. It soon became apparent that the task of training all personnel to the required standards was too great to be undertaken by one Command. Accordingly, it was decided that in future flying and ground training should be separated and in May 1940 responsibility for the former was taken over by the newly created Flying Training Command.

TYPES OF UNIT

In few Commands of the Royal Air Force was a greater variety of units to be found than in Technical Training Command. From the earliest days the Command tended to be the experimental and testing ground of the Air Force, and in addition, when units did not appear to fit easily into other commands, they were usually placed temporarily or permanently under the aegis of Technical Training Command.

It will be realised that wireless and radar, to quote only two examples, made enormous strides during the war years and that considerable training time had to be devoted to instruction in these subjects, which became even more specialised as further inventions and modifications were made. Thus men who had been initially trained had to be given refresher courses to keep them abreast of the latest developments. This meant that during the latter half of the war training had to cater not only for the *ab initio* trainee, but also for the experienced operative, and if training programmes and facilities were not sufficiently flexible to satisfy these requirements, efficiency in the operational squadrons was considerably impaired. To achieve these aims it was also necessary to provide a large staff of experienced instructors as well as technical training apparatus and suitable buildings and class-rooms, all of which created problems in war-time when resources were stretched to the limit.

Again, difficulty arose in the correlation of demand and supply; there would perhaps be a requirement for a certain type of trainee, but in a relatively short time the situation might have changed to such an extent that output would exceed demand and the men coming from the training schools would be redundant; it would then be necessary for training establishments to switch to the production of some other type of trainee. All this demanded constant watchfulness to ensure that the production of trained material did not exceed demand to such an extent as to create a problem of unmanageable proportions.

In the following paragraphs a brief comparison will be made between the units under the control of Training Command in May 1940 and those under Technical Training Command in July 1940. It will be seen that all units directly concerned with the training of flying personnel

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had been shed between those dates to form the new Flying Training Command, although the connexion between the latter and Technical Training Command remained close, for so much of the technical work carried out in Technical Training Command had a bearing on the actual flying that a complete divorce of the two Commands was neither possible nor desirable.

TRAINING COMMAND—MAY 1940

As Training Command was the immediate predecessor of Technical Training Command it is appropriate that some idea of the scope of the former should be given. In May 1940 Training Command consisted of six Groups containing over one hundred units. These units, of many different types, were grouped geographically and to some extent according to their function; the division of responsibility is outlined below:

(*a*) *No.* 20 *Group*. This Group contained six Schools of Technical Training, five Recruit Centres, an Officers' Disciplinary Course* and an Equipment Training School (Officers).

(*b*) *No.* 21 *Group*. Administered the Royal Air Force College and Royal Air Force Hospital, Cranwell, four Flying Training Schools, No. 1 Practice Flying Unit, an Equipment Training School (Airmen), a School of Clerks Accounting and a Supplies Depot.

(*c*) *No.* 23 *Group*. This Group comprised the Central Flying School, the School of Air Navigation and nine Flying Training Schools.

(*d*) *No.* 24 *Group*. Such a miscellany of units came under this Group that only a few of them will be listed here to give some idea of the scope of the Group. The units included No. 1 R.A.F. Depot, three Recruit Centres, six Schools of Technical Training, five R.A.F. Hospitals, the Central Medical Establishment, the Institute of Pathology and Tropical Medicine, the Hospital Base Accounts Unit and Schools of Physical Training, Cookery, Aeronautical Engineering (Officers), Anti-Gas, Administration and Photography. Other units, to a total of forty, ranged from the Record Office to the R.A.F. Central Band.

(*e*) *No.* 25 (*Armament*) *Group*. This Group comprised the Central and Ground Defence Gunnery Schools, two Air Armament Schools and seven Bombing and Gunnery Schools.

(*f*) *No.* 26 (*Signals*) *Group*. Under this Group were four Electrical and Wireless Schools, two Supplementary Schools of Wireless Training, ten Air Ministry Wireless Telegraphy Stations and thirteen other units intimately connected with signals and communications, including the Code and Cypher School and the R.A.F. Teleprinter Exchange.

As will be seen from this summary, the Command had, as well as the control of a vast number of technical units, a very large commitment in

* This unit provided basic training in the general duties and standards expected from officers and was in no sense a corrective unit.

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relation to flying training, from the most elementary stages up to pre-squadron level, and the decision that some re-organisation was necessary was not surprising. Removal of the flying training commitment was the obvious step and enabled the Command to concentrate on its then main task of training personnel from the time they joined the R.A.F. until they could be allotted to the various operational groups. It is of special interest to note that the medical establishments which were under the control of Training Command remained the responsibility of Technical Training Command.

TECHNICAL TRAINING COMMAND—JULY 1940

In July 1940 the first official list of units comprising Technical Training Command was issued. The new Command comprised three Groups with a total of approximately eighty units which, although all associated both with training and with technical matters, covered a vast field of subjects ranging from aircraft maintenance and fitting to cookery. A brief survey of the Groups will show the variety of instruction provided.

(*a*) *No.* 20 *Group*. The eighteen units in this Group comprised six Schools of Technical Training, seven Recruit Centres, two Equipment Training Schools (for officers and airmen respectively), an Airmen's Convalescent Depot, a Hospital and an Aviation Candidates Selection and Medical Board.

(*b*) *No.* 24 *Group*. As before, No. 24 Group showed the greatest diversity of units—six Schools of Technical Training, two Recruit Centres, nine medical units (including the Central Medical Establishment, Medical Training Depot, and five R.A.F. Hospitals), two Aviation Candidates Selection Boards and many other units, varying from the School of Physical Training and the R.A.F. Service Police unit to Anti-Gas and Cookery Schools.

(*c*) *No.* 26 (*Signals*) *Group*. Responsible for the training of all personnel in subjects connected with signals, wireless and communications, this Group showed little change under the new Command. There were three Electrical and Wireless Schools, two Supplementary Schools of Wireless Training, ten Air Ministry Wireless Telegraphy Stations, a Code and Cypher School, five Air Ministry Communications Staff units, a Teleprinter Exchange and several miscellaneous communications units.

Although the new Command had only half the number of Groups administered by the former Training Command, the number of units had not been reduced by more than one fifth—from 100 to approximately 80. As hostilities continued and it became necessary to start and expand new training schemes, the number and diversity of units increased rapidly and by the end of the war totalled about 140.

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FUNCTIONS OF TECHNICAL TRAINING COMMAND IN THE WAR YEARS

As the previous sections of this chapter have emphasised, the scope of the Command was exceedingly broad and, as the war progressed, the advances in aircraft and their ancillary equipment forced further development beyond anything foreseen at the commencement of hostilities. Nevertheless, the Command was able to take this expansion in its stride, and by the end of the war the ramifications were such that nearly all technical subjects were taught within its framework. The basic tasks of the Command, however, remained clear cut and little altered.

With few exceptions, all personnel joining the Service reported to Recruit Centres, which were situated geographically throughout the country and related both to the location of established Service units and to the density of population. At these centres the volunteer or conscript was issued with the standard uniform and kit and had his first introduction to the ways of the Service.

To obtain an adequate flow of recruits close liaison was needed between the manning branches of the Air Ministry and the Ministry of Labour. When it is remembered that the intake was numbered in thousands per week, it is not surprising that this caused a considerable amount of staff work for all departments concerned, since any delay to a draft of recruits would result in accommodation not being available for the following draft and lead to a serious hold-up. Again, it was essential to provide suitable buildings through which at least some simple means of chain transfer could be operated, and this demanded considerable improvisation at a time when building materials were in short supply and the urgency of the situation abundantly evident. It was also necessary to vaccinate and inoculate personnel to Service requirements; this in practice involved nearly 100 per cent. of each intake, but it was considered to be preferable that a full state of immunisation among the recruits should be achieved as soon as possible in order that the possibility of reactions occurring during intensive training, with consequent disruption of the instructional programme, might be reduced to a minimum.

On completion of the recruits' course each recruit was allocated to the trade in which he would serve during his period in the R.A.F. By the end of the war the R.A.F. trades numbered well over two hundred and covered a wide variety of duties. Unfortunately, however, recruits could often be given only a very limited choice of trades, depending on the requirements at the time—for example, there was nearly always a need for cooks, clerks, nursing orderlies and M.T. drivers and if no other trade had vacancies the recruit would have to choose one of these, regardless of his civilian occupation or qualifications. This policy often aroused considerable discontent among recruits but it had to be adhered

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to in order to maintain a balanced force and only occasionally, in certain very special instances, could an exception be made. It will thus be seen that frequently men had no particular interest in or aptitude for the trade into which they had been drafted, for, apart from the limitations imposed by the vacancies available, in such a mass allocation of personnel little individual selection could be practised; in the later years of the war considerable improvement was achieved by the introduction of aptitude tests (*see* Appendix).

Before May 1940 the training of aircrew was the responsibility of Training Command, the progenitor of Technical Training Command, but on the formation of the latter the responsibility for flying training was transferred to the newly created Flying Training Command. Thus Technical Training Command, apart from undertaking the initial training of all entrants into the R.A.F., was responsible for the training of personnel in all ground trades. Accordingly a considerable and steadily increasing number of establishments had to be set up to cover the many technical subjects in which knowledge was required by members of a modern air force.

A further and very important commitment of the Command was the provision of the facilities and staff for all development work. This task, though relatively small at the beginning of the war, grew to one of considerable size and importance as the war developed and weapons were produced not only in vast quantities but also with continual change and improvement. Perhaps the most dramatic example of rapid advance was the radar group of aids and weapons, which in September 1939 were non-existent or only in the laboratory experimental stage but which by the end of the war was standard equipment on nearly all aircraft and in many ground installations; this advance involved the Command in a vast amount of training and development, all of which had to be dealt with in addition to the routine commitments and on a high level of priority.*

Technical Training Command, under the direction of Air Ministry, was responsible for all medical establishments in the United Kingdom and was directly responsible for the training of all entrants into the medical branch—namely, for the instruction in Service procedure of qualified practitioners and the complete training of airmen and airwomen enlisted as medical orderlies. Furthermore, the Command was responsible for medical experimental development both in the general field of medicine as at the R.A.F. Institute of Pathology and Tropical Medicine and in the particular study of aviation medicine at the Institute of Aviation Medicine at Farnborough. The Central Medical Establishment, which controlled the medical boarding of both ground

* *See* No. 60 Group narrative.

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personnel and potential aircrew, was a further medical commitment as also were other specialised medical units such as the Blood Transfusion Team (described later in this narrative) and Mass Miniature X-ray units (*see* Volume I, Chapter 6).

Early in the war it became evident that arrangements would have to be made for the holding of considerable numbers of trained men awaiting allocation to units in this country or transhipment to operational commands or training establishments overseas. The convoy system in operation meant that personnel might be supernumerary for a considerable time and Technical Training Command became responsible for the establishment, running and maintenance of suitable holding units.

At the Personnel Despatch Centres (P.D.Cs.), as these units were called, personnel who were awaiting posting overseas were issued with the kit appropriate to their destination and, wherever security regulations allowed, given some idea of conditions in the country to which they were proceeding. Medical documentation was of particular importance at these units, both in preventing the posting abroad of men of unsuitable medical category or who possessed some defect not noted on their documents, and in ensuring that the vaccination and inoculation states of all personnel were checked and brought up to the necessary standard.* Whenever possible a lecture was also given by medical officers who pointed out the main problems and dangers that personnel were liable to encounter in their overseas tour; it was considered that these lectures, if well delivered, could have a considerable deterrent effect in such matters as venereal disease and the contraction of dysentery and malaria.

The management of units which at one time would be holding several thousand personnel, and a few days later might be empty except for the permanent staff, offered many problems, ranging from the provision of rations and suitable bedclothing for the transients to providing recreation facilities for the staff and supernumerary personnel who had been in the P.D.C. for a considerable length of time.

The following indication in more detail of the functions of the Command will make it easier to appreciate the main differences between this Command and the others, for in those differences originated many of the medical problems of the former during the war years. At the end of the year 1942, Technical Training Command contained four Groups, viz., Nos. 20, 24, 27 and 28:

* In theory, no man whose medical category precluded overseas posting should have reached one of these units, and all vaccination and inoculation should have been carried out before individuals left their previous units, but errors and omissions of this kind were frequent and it was necessary to safeguard the position by additional examinations at the P.D.C.

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No. 20 *Group*. Contained 19 units, chiefly Recruit Centres, but no medical units.

No. 24 *Group*. Comprised 26 units, mostly Schools of Technical Training but also three large medical units, viz. Princess Mary's R.A.F. Hospital, Halton, the R.A.F. Hospital, St. Athan, and the large Medical Receiving Station (No. 50) at Wroughton.

No. 27 *Group*. Contained 15 units, mostly signals and radio schools previously in No. 26 Group.

No. 28 *Group*. Consisted of 55 units situated all over Great Britain dealing with the specialised training of personnel of all grades, but also the remaining 8 R.A.F. hospitals, 4 convalescent depots, the Central Medical Establishment and some other specialised medical units. In addition it contained various centres for training W.A.A.F. personnel in cookery and domestic science. It will be seen that the expansion of the Command since 1940 had been considerable.

At first glance, few of these units might appear to demand any special medical attention not required in other commands, but consideration of the numbers involved and the wide variation in age groups will make it obvious that the medical organisation of Technical Training Command had unique problems to contend with and needed to be even more flexible than was necessary elsewhere.

Expansion throughout the war years, though common to all commands, was both more rapid and more extensive in Technical Training Command than elsewhere. This was only to be expected, as all entrants to the R.A.F. passed through the Command, staying for a longer or shorter period according to their trade and to the war situation.

In direct relation to the expansion arose problems of accommodation. As in other commands it was possible at first to utilise existing stations which allowed a relatively easy expansion of training and other facilities but this soon led to overcrowding of living quarters. Such units, however, were soon stretched to the limit and it was necessary to look elsewhere for suitable premises, a variety of which were requisitioned, ranging from holiday camps, boarding houses and hotels in large seaside resorts and other towns to private houses in residential areas; while billeting was often resorted to in addition.

Initial training, demanding facilities for drilling and lecturing on a large scale, was fairly easy to cater for, but the teaching of technical subjects, necessitating the provision of much smaller class-rooms, apparatus, demonstration models and complicated machinery, was more difficult to arrange and this type of training was almost invariably carried out on the peace-time permanent stations which were easily expandible. (In passing, it must be mentioned that the provision of such equipment as machine tools created great difficulty, as these were a priority for the defence firms; consequently, courses of instruction in

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the Service had to be run with great expedition to avoid any waste of time or machinery.)

As the war progressed training became more complicated in many ways. In the early days the amount of training given had of necessity been the minimum compatible with efficiency, carried out as rapidly as possible, but when it became possible to devote more time to recruits, additional establishments had to be set up to provide a flow of trainees for the waiting commands. The war produced a considerable number of new or sub-trades that had not been in existence at the beginning of hostilities and relatively lengthy courses were needed.

MEDICAL ADMINISTRATION AND ORGANISATION

The medical organisation of the Command differed little from that of other commands and a detailed account of day-to-day administration will be found in Volume I, Chapters 1 and 2, on Medical Manning. Other medical problems have been discussed at some length in that volume, under appropriate headings, in the Chapters 5 and 6—'Hospitals and Special Services' and it is therefore proposed to deal only briefly with these matters in the present narrative but to elaborate on some of the problems peculiar to the Command.

At the outbreak of war the medical staff at Command Headquarters consisted of a Principal Medical Officer in the rank of air commodore, a Deputy Principal Medical Officer (group captain), four wing commanders responsible for hygiene, personnel, hospitals and statistics respectively, one squadron leader quartermaster and a medical warrant officer as chief clerk. This organisation underwent certain changes during the years of expansion but remained basically the same, apart from the statistical section, which opened up at Ruislip on August 27, 1939, as a separate unit, though remaining under the control of the P.M.O. Training (later Technical Training) Command; this unit became known as the Medical Statistical Office and was responsible for the documentation, tracing and general administration of R.A.F. invalids in civilian medical establishments.

Obviously the most important and perhaps the largest commitment of the P.M.O. was the overall administration and organisation of the General and Station Hospitals. Certain other medical and experimental formations were also under his control for general administration and supply purposes though still remaining under the direct control of Air Ministry (Medical Directorate) for technical matters. The best known of this type of unit were the Central Medical Establishment, the Institute of Aviation Medicine at Farnborough and small detachments of personnel such as those working at the Cavendish Laboratory, Cambridge; these have already been dealt with in some detail in Volume I of this History.

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The P.M.O. was, as in other commands, under the direct control of the Medical Directorate, Air Ministry, although it will be realised that a considerable amount of autonomy was essential. This was facilitated by the fact that R.A.F. hospitals tended to be self-contained units which, once organised and staffed, had few problems that could not be dealt with on the spot by the commanding officer or by general directives from Command. Nevertheless, the P.M.O's. task was of considerable magnitude, particularly as it was affected to a major degree by the tide of battle with little prior warning.

Medical manning, in respect of both skilled medical officers and nursing orderlies, proved a continual problem for the P.M.O. and throughout the war years it was not possible to allot as many personnel to hospitals and other units entitled to medical cover as would have been desirable. Every effort was made to satisfy the demands of Group S.M.Os. but there was a shortage of medical man-power throughout the Services and civilian organisations; in the very nature of things the Services tended to be prodigal of medical man-power and the provision of sufficient medical personnel was never satisfactorily achieved by the Command. The P.M.O., however, ensured that cover was provided on a strictly priority basis and that waste of man-power was avoided as far as possible.

Medical administration and instructions from Command to Group and thence to lower formations were carried out in the normal manner. At the same time semi-official information on certain matters of professional interest (e.g. suggestions for the use of alternative drugs and other materials in the interests of economy) was distributed by the Principal Medical Officer direct to individual medical officers. The Command also ensured that all medical officers were given the opportunity of attending courses in special medical subjects such as aviation medicine and anti-gas warfare. This in itself often created a problem as it was usually necessary to provide a relief while the officer was on the course, and in times of shortage this was a difficult matter.

As has already been mentioned, the P.M.O. exercised some degree of influence over the Central Medical Establishment (C.M.E.). He was, however, concerned rather with the supply of the necessary medical materials than with the direction of the work undertaken by the Establishment, for this, from a practical point of view, came under the direct control of the Director-General of Medical Services. This method of administration differed from the usual chain of administrative command, but the position of C.M.E. was peculiar in that the most senior R.A.F. specialists and civilian consultants were attached to the unit and the problems they broached were best dealt with by direct contact with the Director-General or his staff. Such an arrangement, though possibly open to abuse, worked well and allowed rapid decisions

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to be made in far-reaching matters of medical policy and administration. It must be recorded, however, that some difficulties arose from this direct approach, particularly when civilian consultants were concerned, for the latter, although owing allegiance to the Director-General, were not under the same disciplinary control as their Service colleagues and were thus in a stronger position when expressing their views. This position coupled with ignorance of, or disregard for, Service administrative procedure could, if special precautions were not taken, result in P.M.Os. being unaware of changes affecting their Command and might also lead to the promulgation of conflicting directives. Nevertheless, the policy of allowing a direct approach worked well on the whole and was undoubtedly responsible for the rapid progress made in certain medical specialities, notably in the field of orthopaedics and in rehabilitation.

Elasticity of medical organisation was a very important prerequisite in all R.A.F. formations, particularly in war-time, and in Technical Training Command it was even more essential if the policy of rapid expansion demanded by the increasing war potential was to be implemented to the full. The medical service had to be prepared to set up machinery, at very short notice, to cover the intake of recruits to newly opened centres in numbers running into thousands per week, and this at a time when suitable accommodation was practically unobtainable and improvisation on a large scale was necessary. This was particularly the case in most of the recruit and training centres set up in, for instance, the seaside towns and the problem was further complicated by the large numbers of female entrants necessitating certain extra facilities. The general lack of medical personnel experienced in the rudiments of Service documentation and routine, was an additional handicap and one for which it was impossible to find an adequate solution. Newly recruited medical officers, although thoroughly conversant with their professional duties, could not be expected to acquire any profound knowledge of Service background and organisation in the relatively short courses provided for them on entry at the Medical Training Establishment and Depot. That the medical branch was able, in spite of these obstacles, to provide the necessary facilities will be clearly seen in the later section of this chapter relating to recruit depots and training schools at Blackpool.

The P.M.O. had under his control certain very special units such as anti-gas schools where medical officers required, in addition to a thorough knowledge of medicine, certain other specialised knowledge, and the supply of suitably qualified personnel for posts at this type of unit was never an easy task, so that steps had to be taken to prevent such personnel, once obtained, from being posted elsewhere. Special difficulty occurred when such units, having been disbanded, were re-formed and the original medical officers were not readily available, some of them having perhaps been posted abroad.

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It will be seen that the medical responsibility of the P.M.O., apart from that centred around the administration and organisation of hospitals and special medical units, was largely that of providing medical cover for large training units, schools of instruction and such units as Personnel Despatch Centres and of ensuring that medical procedure and documentation was carried out in accordance with Command Headquarters' instructions. This responsibility was in the main little different from that in any other command, but it was considerably greater in scope and in the necessity for providing medical facilities at short notice on the opening of new establishments.

HYGIENE AND SANITATION

GENERAL

The problems that had to be faced by Technical Training Command in the field of hygiene and sanitation, when considered in their broadest sense, differed significantly from those of other commands only in respect of the large numbers involved and the fluctuating populations in Technical Training Command; this latter factor often necessitated the provision on a grand scale of facilities which were used only for a short period and then remained inactive for a considerable length of time—a procedure which was obviously both expensive and wasteful. These complications should be borne in mind when reading the following paragraphs.

Correct hygiene and sanitation is always of considerable importance in any community where large numbers of personnel are living in relatively close contact with one another; errors in policy or its execution can in such circumstances have disastrous effects on the health of large numbers of people. The Recruit Centres and training establishments of Technical Training Command provided, if there was any slackness in these matters, almost ideal conditions for the production of widespread disease. The most careful watch had therefore to be maintained on all accommodation and although it was usually necessary to make some departure from the normal medical standards this was only done after protest and in consideration of the urgency of the national situation.

ACCOMMODATION

It was considered that the ideal accommodation for units in Technical Training Command would have been camps housing 5,000 personnel, with workshops, lecture rooms and the necessary domestic facilities. Although, at the outbreak of hostilities, such premises existed in the form of certain permanent establishments (e.g. Halton) they were soon filled to capacity, necessitating expansion to the seaside towns

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which offered reasonable housing facilities, although with the disadvantage that personnel were often billeted out, thus making it difficult to create a suitable Service atmosphere.

At the end of 1939 difficulties in connexion with accommodation were already evident in Training Command. In a report the Air Officer Commanding-in-Chief stated that 'there was crowding everywhere' and the P.M.O. stated that 'the lack of heating and sanitary amenities is serious'. Despite these well merited criticisms little could be done to improve conditions as the numbers of entrants into the Service continued to increase. The full implementation of the policy of W.A.A.F. substitution, from the early months of 1940, led to further complaints relating to the inadequacy of accommodation for airwomen. (It is, in fact, noteworthy that the only real objection to the policy of W.A.A.F. substitution from the medical point of view was the difficulty of providing suitable accommodation.)

USE OF TENTED ACCOMMODATION

The position was further aggravated by the need to accommodate considerable numbers of Allied troops brought to this country after the fall of France in June 1940. This commitment involved finding at least some kind of shelter for personnel of many nations and services, and was complicated by the fact that a large number of the survivors were not only without their normal small kit and equipment but also lacking in such essentials as a complete uniform. Nevertheless, in a relatively short time the survivors had been dealt with satisfactorily and accommodation was again fully available for the training of R.A.F. and Allied personnel. By now, however, the entry rate had completely outstripped the provision of accommodation, including buildings which were not entirely suitable but which had been accepted as the best available. It was therefore decided to use tented accommodation on a large scale although up to this time tentage had not been used except in the summer months, and then only to a small extent. Preliminary arrangements were accordingly made for the temporary siting of tentage to house over 20,000 personnel; the following table shows the approximate distribution of numbers:

Station	Personnel	Station	Personnel
Cosford	3,000	Gloucester	1,190
Hednesford	940	Hereford	2,240
Kirkham	2,685	Locking	1,440
Melksham	2,175	St. Athan	940
Weeton	1,190	Bridgnorth	1,500
Padgate	2,000	Wilmslow	2,000
West Kirby	2,000		

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The object of these camps was to provide living quarters quickly but efforts were also made to achieve as much comfort as possible in the circumstances. Certain lines of policy were laid down concerning the siting of this accommodation: all camps were constructed on or in the immediate vicinity of already functioning stations or satellites so that the amenities of the latter could be utilised; each camp had a cookhouse more permanent than that usually associated with field cooking and wherever possible brick was used, a necessary precaution in view of the unreliability of the weather. Very close liaison was maintained with the Air Ministry Works Department and it was possible when selecting stations on which camps might be pitched to take into account the local availability of both materials and man-power, thus avoiding any 'bottle necks'.

Preliminary consultation was always held with the local medical officer of health and the conservancy departments, for wherever possible public mains were tapped and sewers utilised on the camps. With one exception (Cosford), none of the camps listed above had any difficulty in making these arrangements, which is remarkable considering that local conservancy systems were often already working to capacity or beyond because of the civilian evacuation schemes.

It should be remembered that these camps were for use purely as annexes to the already established stations and that the occupants, apart from sleeping and eating at the camp, attended the station for their lectures, demonstrations and other matters on the course. Though far from ideal the camps permitted a large number of recruits to be trained at a time when their services were badly needed, and allowing for the inherent difficulties of tented accommodation personnel were reasonably housed and with improvisation could make themselves very comfortable. Though the medical authorities were never happy over these large camps, particularly during the winter months, little ill-health could be attributed to their usage; after 1942 tents were rarely used but it was always helpful to know that if the need should arise large numbers of personnel could be accommodated in this way in a relatively short time.

LIGHTING AND HEATING

Although this subject has been covered in general elsewhere in this Volume, certain problems were peculiar to Technical Training Command. It should be borne in mind firstly that all possible economy had to be practised in respect of utilities and secondly that many items of plant were not easily available, so that apparatus and material had to be accepted that would not normally be approved for Service use. These factors, coupled with the necessity of opening training establishments quickly and of passing recruits through them with all possible

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speed, created difficulties for both the technical staffs and the medical authorities, the latter being compelled to allow, in the interests of the national situation, working conditions of a standard lower than they considered adequate for the safeguarding of health.

Lighting may be considered most conveniently in its three principal usages—on domestic sites, in class-rooms and in technical workshops (i.e. fitters' shops, instrument repairers' section, etc.). On the domestic sites every effort was made to keep to the officially laid down standards of illumination, though the whole problem was complicated by the blackout and the consequent difficulty of ensuring adequate ventilation. It is obvious that the standards had to suffer, though medical officers did all in their power to obtain suitable lighting in the communal rooms, particularly those used for reading.

In class-rooms and technical workshops illumination was usually satisfactory though improvement could often be effected by the re-positioning of lights and the introduction of blackboards with matt non-reflecting surfaces (also used in operations rooms). The foot-candle scheme which was adopted for the assessment of illumination has been referred to in Chapter 8 of this Volume. It was not always possible, particularly in the early days, to provide as good a standard as would have been desirable, owing to the use of unsuitable premises, particularly as class-rooms, again an unavoidable necessity.

Closely allied with the question of lighting was the supply of electricity to certain sections which used large amounts of high amperage current, as for example in the operation of radar equipment. Considerable numbers of such sections were set up in the various radio training schools and, as the power in all cases came from the civil supply, consultation with the local engineers was necessary to ensure that the amount of current required would not cause embarrassment to domestic utilities or local factories engaged in the production of vital war equipment. In certain circumstances the Service had to accept cuts in its own domestic supply to allow the full running of the radio schools.

The proper heating of establishments in Technical Training Command was a matter of interest to the medical authorities throughout the war; here again, lowered standards had to be accepted in view of the national shortage of both solid and liquid fuel and although improvements were made they could only be carried out in the light of this fact. Rigid standards were difficult to lay down and by and large a common-sense approach had to be adopted in view of the diversity of climate that was encountered.

Heating of domestic sites was provided mainly by slow combustion stoves which, as already stated in many sections of this history, proved unsatisfactory, dirty and wasteful of both fuel and labour. Ideally, central heating was recommended but in most of the war-time built

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stations this was impracticable owing to shortages of labour and materials. In certain establishments, however, it was installed in class-room blocks and technical buildings.* It was recognised that recruits sitting in cold class-rooms were hardly receptive to instruction and every effort was made to achieve at least a reasonable temperature in the winter months, but this was often not possible and recruits had to sit huddled in overcoats; on units where class-rooms and domestic sites were a considerable distance apart the coats might be saturated with rain, and this situation caused considerable concern to medical officers. In technical workshops and instrument sections it was essential that adequate heating should be provided, for otherwise it was not possible to manipulate the delicate tools.

A further obstacle to achieving satisfactory heating in training establishments lay in the intermittent use of the accommodation. Several days might elapse between the completion of one course and the beginning of the next and during this time it was necessary to discontinue the heating; this meant that it was some time before buildings could again reach the required standards of warmth. This factor, though causing considerable inconvenience in class-rooms, was of greater importance medically in living accommodation. If strict precautions were not taken, barrack Nissen huts and bedding became damp, creating a danger to trainees of whom many were in an age group in which rheumatic infections might be expected to occur.

The conservancy problems of the Command differed little from those of other commands and the need for utilising unsuitable accommodation caused the usual inevitable problems. (*See* individual Command narratives.)

MEDICAL PROBLEMS PECULIAR TO THE COMMAND

(With particular reference to R.A.F. Station, Blackpool)

The problems that affected the Command from the medical standpoint were very similar to those already discussed in Volume I of this History, in particular those dealt with under the heading of accommodation, hygiene and sanitation, and it is not proposed to deal with these matters here except where they were peculiar to the Command or of such medical importance as to warrant further discussion.

Most of the difficulties affecting the medical authorities resulted from the scale on which the Command's activities were carried out rather than from the actual problem, while the changes which occurred through advancement in knowledge in certain subjects taught in the Command made constant vigilance necessary to ensure that the medical implications of these developments were not overlooked. Radio Aids

* It is of interest to note that in many of the R.A.F. stations taken over by the U.S.A.A.F., the latter contrived, from their own resources, to install central heating in all communal buildings.

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is a good illustration of a subject practically unheard of at the beginning of the war for which training facilities had to be found speedily for large numbers of personnel, with the attendant problems of ventilation and eye strain, to give only two examples. It is under such terms of reference that the medical problems of the Command will be discussed.

In order to group the problems to some extent it will be convenient to consider the events at one of the larger stations under the control of the Command where the majority of the points of medical interest arose, and to outline the methods adopted to overcome or at any rate mitigate certain problems, mostly of a domestic nature. For this purpose R.A.F. Station, Blackpool, one of the largest of the training centres, has been chosen as being typical.

The reasons for selecting holiday resorts such as Blackpool for training purposes have already been outlined. There were many advantages in using such places. These resorts could offer accommodation on a grand scale if use was made of hotels, boarding houses and holiday camps; travel to and from them would be relatively simple, a point of some importance when recruits were moved by the thousand and often stayed only a few weeks at the centre; water supplies, lighting and conservancy would all be of civilian standards and certain amenities for off-duty periods would be available. On the debit side, the billeting of personnel over a relatively wide area would have certain disadvantages both from the disciplinary angle and in the amount of supervision that the medical authorities could exercise over billetors. Furthermore it was realised that some opposition to the scheme might be raised by the less patriotic of the civilian population when it was found that their towns were being used as vast training centres. Nevertheless, no other solution was possible and it was necessary to embark on the task of transforming these seaside resorts into virtually Service areas.

One further point of importance which must be mentioned is that the scheme of using the seaside resorts as training or billeting areas was adopted by both the Army and the Royal Air Force, while certain Civil Service departments also used the towns as 'reception areas' for their evacuated staffs. There was thus considerable rivalry for the best or most suitable accommodation and this factor, which remained throughout the war years, led to much acrimonious discussion and bad feeling at times; it was usually possible, however, to make mutually satisfactory arrangements among the authorities interested in the available facilities.

R.A.F. STATION, BLACKPOOL

Although Station Headquarters, Blackpool was not formed until October 1940, No. 3 School of Technical Training, No. 9 Recruit Centre, No. 10 Signals Recruit Centre and the Airmen's Convalescent

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Depot were fully functioning before this date and requisitioning had been carried out on a large scale. Throughout the history of Blackpool, in fact, requisitioning and de-requisitioning went on continually and all possible facilities were used: church halls, cafés, garages and even the town football field were taken over to provide sleeping, working, medical or teaching accommodation, not to mention the mass requisitioning and billeting affecting all hotels and practically all the 'apartment houses' in the district.

MEDICAL RESPONSIBILITY

Many thousands of personnel were stationed in or passed through Blackpool and suitable medical cover had to be provided for them all. This was a vast and complex commitment which provided continually changing problems demanding a rapid solution if the health of this crowded town was not to be jeopardised. It is proposed to outline the problems which arose in roughly chronological order and then show the action taken to overcome or reduce the difficulties.

ACCOMMODATION

Of all the questions which arose this proved the greatest problem and also the hardest of solution. It must be borne in mind that in the early stages of the Command's expansion it was not possible to carry out new construction work or even alter existing accommodation to any appreciable extent and the best use had to be made of what was available. At peak periods over 40,000 personnel had to be housed and although use was made of hotels and any other suitable buildings, the bulk of the personnel, comprising mainly young new entrants into the Service, had to be billeted in the fortunately large number of apartment house establishments, notwithstanding the obvious disadvantages which this dispersal of personnel through the town involved. Most of the landladies concerned responded well to this call to patriotism and the opportunity to assist the war effort, but unfortunately a large number caused considerable difficulty by their unsympathetic attitude to the personnel billeted on them, particularly to airwomen. Many of the rooms offered fell far below either normal civilian or Service standards of habitability and often the dirt and decay of years was all too evident; washing and lavatory facilities were ill-kept and many of the basement kitchens were infested by pests. The furniture provided was often the absolute minimum and personnel were faced with bare, chilly, but often overcrowded, bedrooms. The provision of blankets for bedding provided a further difficulty, for most of the landladies only catered for summer visitors and were ill-equipped to serve the billetees in winter, so that blankets had to be issued from Service sources, creating the additional problems of accounting for this large and scattered quantity of bed-clothing and arranging for its laundering.

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After a while, certain landladies with an eye to pecuniary advantage created difficulty for the authorities by attempting to obtain exemption from billeting on flimsy medical grounds or by allegations against the billetees. Such accusations were many and varied and involved time-consuming investigation by an already hard-pressed staff. In particular, the medical branch was affected by the number of landladies who accused billetees of bed-wetting; although justified in some instances, many of the charges, when investigated, proved to be untrue, the whole matter causing considerable embarrassment to all concerned.

A further problem inherent in this type of mass billeting was the unwillingness of landladies to permit personnel sick from relatively trivial causes to remain long in the billets, so that it became necessary to find accommodation in either R.A.F. sick quarters or E.M.S. hospitals for complaints such as bad colds and coughs; the civil hospitals were naturally reluctant to use beds for patients of this type and hence attempts had to be made to provide for them on a large scale in R.A.F. sick quarters.

Again, airmen who were ill usually managed to attend one of the M.I. rooms (of which at one time as many as seven were established) but there was always a certain proportion who from the nature of their illness, real or alleged, had to be visited in their billets by a medical officer until their disposal could be arranged. This was another time-consuming task in a town where billets were so widespread and in the hours of blackout medical officers experienced considerable difficulty in locating many of the less accessible billets.

MESSING

This problem was easier of solution than might have been expected for the town was well supplied with restaurants which normally catered for large numbers of holiday visitors and by a system of shift feeding an organisation was set up that was both rapid and efficient. The buildings lent themselves well to a high standard of cleanliness and many of them were fitted with the latest cooking appliances, so that good meals were provided. Cooking was carried out both by caterers under contract and by R.A.F. cooks and over the years of tenure little trouble arose from these arrangements—as evinced by the total absence of any food-borne epidemic. Some personnel were fortunate in having extra meals provided by their landladies or being allowed to use cooking facilities at their billets; such arrangements were entirely unofficial and were made only out of the kindness of heart of the landladies concerned.

CLASS-ROOM FACILITIES

As the majority of trainees underwent a considerable amount of instruction it was necessary to provide class-room facilities on a large

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scale and the attendant problems of suitable lighting, heating and ventilation were kept under continual observation by the medical branch. It was often possible to make recommendations for the increase or re-positioning of lighting, while special attention was drawn to the necessity for adequate ventilation during the hours of blackout, an important factor if epidemics of upper respiratory diseases were to be avoided. Many of the rooms used, however, were basically unsuitable and little could be done to improve matters.

FREE FROM INFECTION INSPECTIONS

With the large numbers of personnel arriving at and departing from the station it was very important to ensure a clean bill of health in each individual. Experience of war-time mass examination of a cross-section of the population rapidly brought to light the very low standards of personal hygiene adopted by certain members of the community; the great increase in the figures for such diseases as scabies noted during the war years resulted more from the methods of detection available than from an increase in the actual number of cases.

As recruits and trainees had to be examined in thousands, it was necessary to adopt a mass examination technique and this was achieved by the use of buildings such as church halls where large numbers of personnel could strip and file rapidly past medical observers. Personnel were frequently posted away from the station with little warning and the need for extremely flexible medical arrangements often created difficulties, for there was always a shortage of medical staff; special efforts were made, however, to carry out the necessary examinations without delay, as it was fully realised that any hold up in the flow of personnel might seriously embarrass the training schemes.

VACCINATION AND INOCULATION

Regulations required that all personnel should be vaccinated against smallpox and protected against typhoid and tetanus* and the initial protection of recruits was thus a further responsibility of the medical services at Blackpool. (Later, Blackpool also undertook the inoculation and vaccination of personnel being posted overseas and arrangements had to be made for yellow fever inoculation—this is dealt with below.)

Apart from the greater technical difficulties the problems raised were similar to those of the F.F.I. inspections. Whenever practicable, the policy of mass attendance by personnel at a specially prepared M.I. room was adopted so that large numbers of recruits could file past the medical officers, equipped with batches of syringes, while clerical staff

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* Statutory law provided that persons refusing vaccination or inoculation on conscientious grounds would not be liable to disciplinary action.

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made the necessary annotations to medical and personal documents.* Wherever possible it was arranged that the actual procedure could not be seen by those awaiting injection; this obviated a good deal of apprehension and reduced the number of fainting incidents.† With a little practice and strict observance of the routine laid down the medical staff were able to deal efficiently with very great numbers in a relatively short time.

A small but steady number of personnel suffered slight malaise from the after effects of vaccination or inoculation. These personnel were usually dealt with on the normal sick parade and a small percentage were excused duty on account of painful arms and mild rigors; rarely, a patient had to be admitted to sick quarters suffering from a bad slough following a vaccination, usually the first vaccination of the patient's life. (Approximately 75 per cent. of vaccinations were positive.) The warding of personnel for these causes was avoided wherever possible, firstly because bed accommodation was scarce and secondly because, if it was known that in-patient treatment was given for what usually amounted to only transitory discomfort, it was feared that the numbers of personnel reporting ill effects would increase to a marked extent.

PROTECTION AGAINST YELLOW FEVER

When, early in 1943, No. 5 P.D.C. was established on the station, arrangements had to be made for protection against yellow fever for personnel going overseas. Although the method of carrying out this inoculation was similar to that already described, special attention was paid to the possibility of serum jaundice infections and all apparatus was most scrupulously sterilised between cases. Again, additional clerical staff were necessary, as a special card had to be issued to all personnel who received protection against yellow fever.

VENEREAL DISEASE

In any large community problems relating to this disease will inevitably arise and Blackpool was no exception. As has been stated elsewhere in this History the highest incidence of the disease was found among operational aircrew and the number of cases at Blackpool therefore, with its majority of ground personnel, was not as high as it might have been. Nevertheless, the V.D. rate was high enough to keep the attention of the medical authorities continually focused on the problem. Posters and other methods of propaganda were used in an endeavour to reduce the incidence and regular lectures were given to recruits by medical officers. The position of the medical authorities was considerably

* Vaccination and inoculation states were entered in all airmen's pay books.

† Fainting on injection occurred in approximately 1 per cent. of the male personnel but was relatively rare in women.

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strengthened when Defence Regulation 33B was introduced and the powers given by this regulation were exercised on a number of occasions; it was considered that in the majority of cases the infection derived from casual sources rather than from professional prostitutes. The problems of both initial and continuation treatment increased considerably with the establishment of the P.D.C. The area for which the Special Treatment Centre was responsible was a very considerable one, for apart from the Service population of Blackpool, which always numbered 10,000 or more, the Centre catered for an area bounded by the Scottish border in the north, the Isle of Man on the west, Yorkshire on the east and the Mersey in the south; this necessitated a large medical staff and an administrative section of comparable size. A further commitment, that of dermatology, added to the S.T.C. problems, for the majority of the more insidious and chronic skin diseases only benefited from comparatively long in-patient treatment, which was difficult to arrange in view of the lack of bed accommodation.

MEDICAL BOARDS

The medical boarding of personnel provided one of the largest and most time-consuming problems on all Technical Training Command stations where recruits were received or where new and strenuous training methods were employed. Many personnel who had been classified by civilian medical boards as fit for the Service were found on arrival to be totally unsuitable and it was often necessary to regrade them to lower medical categories or even discharge them. The problem was most acute in training establishments where a high standard of physical fitness was demanded and the number of boards necessary at Blackpool became a continual embarrassment to the medical staffs. It was found that many recruits who were fit from a civilian medical point of view and classified Grade I broke down under training and had to be recategorised. (It is of interest to note that the number of men who suffered from painful feet constituted a very high percentage of the regradings and it was proved conclusively that long hours of drill training, which involved much walking on hard parade grounds in heavy Service boots, played havoc with feet accustomed to light civilian shoes. Instructors were keen on smart 'turn-outs' and demanded a certain amount of heel-clicking which, although no doubt excellent from the parade point of view, was productive of considerable pedal trauma, frequently necessitating the down-grading of the men concerned.*)

Apart from the number of medical officers required, who could ill be spared for these tasks, it was necessary for a large clerical staff to

* Officially heel-clicking and stamping were not permitted, but instructors did not appreciate the importance, from a medical point of view, of strict observance of this regulation.

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be available for the rendition of the board forms. Many delays occurred through the non-availability of essential medical documents without which the boards could not be completed; furthermore, the opinion of a specialist was often required before the president of the board could make his decision and this sometimes meant that the patient had to travel to a nearby Service hospital, such as R.A.F. Hospital Weeton, again causing delay.

The opening of the P.D.C. further increased the work in this respect, as many personnel sent to the P.D.C. for overseas posting were on examination found to be unsuitable and board proceedings had to be instituted. This was a considerable embarrassment to the medical authorities, but more especially to the administrative staff, who would find men withdrawn from drafts at the last minute, often resulting in waste of valuable shipping space. It was regrettable that such cases should arise, for all men had been examined by a medical officer before leaving their home station and had been certified as both free from infection and medically fit to proceed overseas.

EYESIGHT IN RADIO-OPERATOR TRAINEES

From 1942 onwards large numbers of personnel, both male and female, were required for training in the working of special radio equipment in connexion with radar development,* and some anxiety was felt by the medical authorities over the possible damage to the eyes of recruits in whom small sight defects had been detected but passed in initial examination or to whom the work proved especially trying. As a large amount of the initial training was carried out in the radio schools at Blackpool the problem was of particular concern at this station.

All recruits were carefully examined by a specialist in ophthalmology with particular reference to the type of work they were about to undertake. It was found that a small percentage had to be rejected, but that the majority of personnel in whom defects were present could be accepted if glasses were supplied. In 1942 considerable delay was encountered in the provision of glasses, as the specialist had to obtain Group authority before these could be ordered: it was found that this delay had serious repercussions on the training programme and after representations to higher authority permission was given for the specialist himself to authorise the issue of corrective spectacles to trainees without the prior sanction of the Group. This arrangement reduced the time taken to provide glasses from 14 to 7 days and was a great improvement on the former method. One interesting result of the close attention paid to the possibility of danger to eyesight was the

* *See* No. 60 Group, Chapter 11, for further information.

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number of recruits who complained of eye strain who, it was felt, would not normally have given the matter a thought; a very similar phenomenon was observed in No. 60 Group when a similar investigation was carried out.*

One comment made by the specialist concerned was that the documents which had been prepared at the civilian medical examinations on call-up usually contained little information about eyes, so that full examinations had to be conducted for each recruit; this omission was unfortunate, as it would have saved much time if some record had been available as a basis of examination and comparison.

MEDICAL FACILITIES AVAILABLE AT BLACKPOOL

In the above paragraphs the main difficulties encountered by the medical authorities have been outlined and some indication has been given of the steps that could be taken to overcome or lessen the problems which arose. It must be remembered, however, that although medical officers would in many instances have liked to make sweeping changes, which were from every aspect undoubtedly both justifiable and desirable, they had always to bear in mind not only the urgency for the rapid training of personnel, but the difficulties which war conditions inevitably produced in the matters of material, accommodation and staff, and compromise had to be the order of the day.

In 1939 and early 1940 the medical authorities in Blackpool were faced with the problem of providing rapidly medical facilities for approximately 10,000 personnel and the requisitioning of any civilian buildings which could be suitably adapted was the only course open to them. A café (Feldman's Café) was taken over as the main sick quarters (No. 1 S.S.Q.) but, although this building was centrally situated, facing the promenade, and provided 35–45 beds, it was at the best of a very makeshift nature. Corridors and staircases were narrow and stairs steep, so that manoeuvring any patient on a stretcher was a difficult undertaking. Offices and wards were small and unsuitable and the whole building was dingy and from a medical point of view ill-lit; nevertheless it provided some form of medical cover and a considerable amount of work was carried out in this café despite its unsuitability.

No. 2 Station Sick Quarters was located in the Carlton Hotel and was a considerable improvement on No. 1 S.S.Q., being more spacious and also allowing a better distribution of beds, of which there were 85 maintained. It was also possible to move patients easily as a large lift was installed in the building. The second floor, however, was devoted to specialist accommodation and this cut down the bed capacity, a great disadvantage in the early years of the station's existence when, as has been shown, the largest possible number of beds was required.

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* *See* No. 60 Group, Chapter 11, for further information.

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Sick W.A.A.F. personnel were cared for in a requisitioned house where it was possible to provide 20 beds. The accommodation was far from suitable and it was obvious that if the W.A.A.F. population on the station increased more beds would be necessary.

The three buildings mentioned above had the common disadvantage of being difficult to run and uneconomic of staff, for in none of them was it possible to organise any large wards. Furthermore, the amount of washing and lavatory accommodation, though adequate for normal needs, was far below that required for nursing the sick; some alterations were carried out to improve the situation but no really major changes could be made.

Medical inspection rooms were set up for individual units and at one time as many as seven were established, these being opened and closed as the situation demanded. It was possible to utilise church halls for this purpose, but although these provided sufficient space they lacked rooms which could be used for disrobing and examination, and office accommodation for the necessary documentation was inadequate and inconvenient.

In 1940 it was not possible to provide any X-ray or pathological service and use had to be made of the facilities at civilian hospitals. This was satisfactory from a medical point of view but it necessitated patients making extra journeys and, if the number requiring attention was large, delayed the final medical diagnosis with a consequent increase in the time recruits were away from their classes.

One of the immediate problems arising from this dearth of suitable sick quarters accommodation was the need to devise a scheme for dealing with any possible outbreak of infectious disease, as it was obvious that even a minor outbreak would completely swamp the existing beds. The possibility of using either or both of the nearby R.A.F. Station Hospitals at Weeton and Kirkham was explored, but as both hospitals had full commitments in their own areas, this idea was abandoned. Finally, after consultation with the civilian medical authorities (who were in every way most helpful) a sufficient number of beds in E.M.S. establishments in the North-west Region were made available; fortunately, however, there were no major outbreaks of illness on the station and little use had to be made of the E.M.S. accommodation. The main civilian establishments made available are listed below:

Major Infectious Diseases	Beds
Blackpool Sanatorium	70
Moss Side Isolation Hospital, Kirkham	64
Fulwood Isolation Hospital, Preston	45
Lancaster Isolation Hospital, Lancaster	82

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Minor Infectious Diseases

The Convalescent Home, Lytham Hall	100
Emergency Hospital, Breck Road, Poulton-le-Fylde* .	150

By the end of 1941 the numbers of personnel in Blackpool had increased so greatly that the medical accommodation had been stretched to its fullest capacity and it was necessary to seek further premises for the treatment of in-patients. On completion of the necessary formalities, therefore, the Park House Hotel was taken over to supplement the existing sick quarters accommodation.

The hotel was of relatively modern construction and was quite suitable in the circumstances. It faced the sea and had a good circular entrance drive which allowed easy access for ambulances. Heating was good, being provided by hot water radiators and gas fires and also by some electric panels which had been installed by the Ministry of Works; lighting and conservancy provision was that usual for a hotel although less than would be available in the normal hospital. The main defect lay in the absence of a lift, but as several spacious rooms on the ground floor lent themselves to use as wards, this was not as serious a disadvantage as it might have been; as in all hotels converted for use as hospitals the number of small rooms used as wards led to staffing difficulties.

It was possible to equip 160 beds in the Park House Hotel and when this hospital was opened the S.S.Q. at Feldman's Café was converted into a Skins and Special Treatment Centre at which 40 beds were available. This was a major advance, as it allowed the segregation of these conditions in one establishment, which was both medically and socially most desirable.

During the years that followed, expansion or redistribution of the available medical accommodation was often necessary to meet changing commitments but these variations are of little historical importance and the position can best be summed up by listing the available medical accommodation against the medical commitment as seen in August 1944, when the station was at the peak of its activity and importance:

Medical Accommodation

Large Station Sick Quarters (200 R.A.F., 40 W.A.A.F. beds).†
Venereal Disease Centre (R.A.F.).
Venereal Disease Continuation Centre (R.A.F. and W.A.A.F.).
N.Y.D.N. Centre.
E.N.T. Centre.

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* This was principally a children's hospital and accommodation was only available for Service personnel if not required for children.

† The S.S.Q. was divided in 1944 into Park House Hotel 160 R.A.F. beds, Feldman's Café (R.A.F. skins and V.D.) 40 beds and the Carlton Hotel 40 W.A.A.F. beds.

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Ophthalmic Centre.
Yellow Fever Inoculation Centre.
R.A.F. Medical Inspection Rooms (Two—one for the P.D.C.).
W.A.A.F. Medical Inspection Room.
Polish Medical Inspection Room.

The above medical accommodation catered for:

	R.A.F.	*W.A.A.F.*	*Totals*
No. 1 A.C.D. (P.S.)*	42	8	50
No. 1 A.C.D. (Convalescents)	500	—	500
Cleveleys Hospital (P.S.)	88	107	195
Station Headquarters Unit	457	410	867
No. 1 M.T. School (P.S.)	161	27	188
No. 1 M.T. School (Trainees)	167	—	167
No. 13 Radio School (P.S.)	95	139	234
No. 13 Radio School (Trainees)	302	804	1,106
No. 5 P.D.C. (P.S.)	204	64	268
No. 5 P.D.C. (Draftees)	6,000	—	6,000
Polish Depot	422	37	459
Polish Record Office	26	24	50
School of Air Sea Rescue (Approx.)	100	—	100
Totals	8,564	1,620	10,184
Officer Strength	329	35	364

Total Population: 10,548

SPECIAL MEDICAL UNITS IN TECHNICAL TRAINING COMMAND

Certain medical units over which Technical Training Command had control have already been mentioned in the text, but little reference has been made to specific types of such units and in this section it is proposed to outline the work of the most important of these.

HOSPITALS

The major medical commitment of the Command was undoubtedly the Royal Air Force General Hospitals, Station Hospitals and large sick quarters which at various stages of the war were given the status of station hospitals for short periods to fulfil specific requirements. The most important hospitals and station hospitals have already been discussed individually in Volume I, Chapter 5, and in this section only the general aspects of the problems of running and staffing the hospitals will be considered.

MEDICAL OFFICERS

For the smooth running of either general or station hospitals it was essential that strengths should never fall below a workable minimum

* P.S.—Permanent Staff.

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and it fell to the P.M.O. of the Command to ensure that all medical establishments were staffed to a satisfactory level. To this end an officer at Command Headquarters was detailed (by the P.M.O.) to keep a continual watch on the position, so that the P.M.O. could make representations to Air Ministry (M.A.1) as necessary in regard to postings to and from the Command. For descriptive purposes it is perhaps simplest to consider medical officers under two headings—those of specialist status or engaged in specialist work and the 'general duties' medical officer (equivalent to a general practitioner in civilian life).

Specialist Medical Officers. The posting and control of this group of medical officers presented the most difficulty. Although originally posted to the Command by M.A.1, they were under the direction of the senior specialist or consultant in their particular branch, who was liable to post his staff from one hospital or centre to another without regard to the usual posting procedure, thus leaving the P.M.O. ignorant as to the whereabouts of his medical officers. Many young medical officers entering the Service during the war considered themselves to be specialists or at least entitled to work on a speciality, which naturally entailed a hospital posting; on investigation, the claims to specialist status were often found to be based on the individual's 6-months post at a civilian hospital as houseman to a department; nevertheless such medical officers often managed to gain the support of the consultant in their claim for a special posting and the situation which arose further complicated the task of the Air Ministry and the P.M.O. The majority of medical officers were required for station duties to cater for the needs of flying personnel and to run the sick quarters, a duty in many ways analogous to general practice. It was understandable that young medical officers with a special bent for a particular subject were keen to further their studies and increase their professional status, but it was necessary for the authorities to resist such claims to specialisation often put forward on entry.

General Duties Medical Officers. This group made up the bulk of the medical officers in the Command who were to be found chiefly on the stations and at all establishments where medical cover was necessary—particularly at units such as the anti-gas schools. If he wished, the P.M.O. could move these medical officers from their own units and attach them elsewhere in the Command for short periods, but if a permanent posting was required the sanction of Air Ministry was necessary; this authority, however, enabled the P.M.O. to deal immediately with sudden shortages such as might be caused by illness.

When large numbers of medical officers were required for posting overseas, the majority were drawn from Technical Training Command and the P.M.O. had on occasion to make drastic economies at many

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medical establishments. He might easily be embarrassed by such wholesale depletion of his staff or by other similar large-scale postings and it was for such contingencies in particular that the P.M.O's. department had to watch. A very close liaison was maintained between the P.M.O. and the Air Ministry and it was customary for the staffing position of the Command to be reviewed at approximately 6-monthly intervals.

Medical officers were often stationed at a unit for a relatively short time and commanding officers often felt that they had been unfairly treated when a newly trained medical officer was suddenly posted away. If the entire manning problem is viewed in proper perspective, the necessity for such action and the wisdom of using Technical Training Command as 'training ground' for medical personnel becomes obvious; at the same time the reaction of the more senior medical officers commanding medical establishments can be easily understood and their feelings about the matter appreciated.

NURSING ORDERLIES

The provision, distribution and replacement of both airmen and airwomen nursing orderlies in hospitals and on stations was less of a problem. The supply of orderlies was the responsibility of the manning and establishment branches at Air Ministry, while their technical training was undertaken by the Medical Training Establishment and Depot (who were also able to assist the Air Ministry by forecasting requirements in the trade). Certain specially trained orderlies, such as burns orderlies, had to be screened from posting and the P.M.O. kept a check on the general manning position to ensure that all medical establishments in the Command were suitably staffed. Though difficulties arose over staffing, they never presented problems comparable to those relating to medical officers nor was the actual shortage as acute, mainly because conscripted personnel could be directed into the trade whenever an increase in numbers was required.

ANTI-GAS SCHOOLS*

Remembering the experiences of the War of 1914–18, the authorities had continually in mind the possibility of the enemy employing gas as an offensive weapon and precautionary measures against such a contingency were accordingly taken throughout the country. The civilian medical precautions have been covered in the History of the Emergency Medical Services (Volume I, Chapter 7) and some mention has been made in the R.A.F. Volumes of the steps taken against the threat of gas attack, but it is the purpose here to outline the work of the Anti-Gas Schools, where personnel received training which would enable them to organise the anti-gas defences on their stations. Personnel

* The subject of Chemical Defence Research is dealt with in Chapter 10 of the Medical Research Volume.

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in the Services, unlike many civilians, would be expected to carry out their normal duties during or immediately following a gas attack and it was obvious therefore that more elaborate precautions and equipment were necessary (as illustrated by the difference between the Service and civilian gas masks).

The majority of personnel entering the R.A.F. had a smattering of anti-gas knowledge acquired in their normal civilian capacity, but this was insufficient for Service needs and it was necessary to set up special training establishments at which initially potential instructors and eventually all personnel could be trained. It was the first instructors trained at the original anti-gas schools who became the key personnel in organising the anti-gas aspect of all station defence schemes. (*See* other Command narratives in this Volume.)

In September 1939 the peace-time anti-gas school at Uxbridge was moved to Rollestone Camp, situated on Salisbury Plain. Other anti-gas schools were set up under the aegis of Technical Training Command, the sites selected being those most suitable for the purpose of the schools and also located geographically to serve the greatest number of personnel. Throughout the war, however, the school at Rollestone Camp was the most important.

At these schools the first task was the training of key men who were then dispersed throughout the Commands to train station personnel in the normal anti-gas drill. When sufficient men had been trained for this task, however, the schools were able to organise courses which were attended by personnel of all branches and trades. The syllabus varied according to the needs and responsibilities of the various personnel attending the school, the airmen's course, for example, being of a very elementary nature, while a much more comprehensive course was arranged for station commanders and senior officers. Personnel of other Services (e.g. the Army and the U.S.A.A.F.) were also admitted to these courses.

Realism was one of the most important elements in all anti-gas training and naturally carried with it some degree of risk, although in most instances the danger was more apparent than real. To assist them in the all-important matter of identifying the various gases, all personnel during their course were required to enter chambers in which samples of the commoner gases were liberated; furthermore, the anti-gas schools were also used as experimental stations by those engaged in the study of lethal gases and these personnel in particular were exposed to considerable risk on occasion. One of the most impressive training methods employed was the 'attacking' of trainees in an open field by an aircraft dropping a gas which was noxious but not lethal; the men had to adopt the appropriate gas drill rapidly to escape effects of the gas and it was considered that this type of exercise brought home to

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them more effectively than any lecture could have done the importance of speedy and correct action in a gas attack.

At all anti-gas schools very dangerous chemicals were being continually handled and the possibility of a serious accident occurring had always to be borne in mind. Hence medical precautions were particularly strict and at all times a medical officer skilled in the treatment of gas casualties was immediately available. It was inevitable that, in duties requiring the use of such dangerous substances, a continual number of small incidents should occur, such as minor mustard gas burns, and the medical section gained considerable experience in dealing with these types of injury. The knowledge thus acquired was of great value in working out the normal precautions to be used on stations.

Not all injuries occurring on these stations were the result of accidents. Mustard gas burns, for example, were inflicted on certain personnel who volunteered to test the efficacy of treatment with new antidotes to various gases, for it was only by such drastic means that entirely reliable data could be obtained. Later in the war, information of this kind was also obtained from the treatment of men working in certain Maintenance Units who had received burns from leaking chemical weapon containers. Numerous precautions were taken to minimise this danger but often the men engaged on such work (many of them of a low mental capacity) disregarded warnings or did not trouble to wear protective clothing and thus provided an unsought but fruitful source of experimental material.*

Fortunately it never became necessary to put the anti-gas defences into operation or to make use of chemical weapons, but adequate preparedness was essential and much valuable knowledge was gained in the course of achieving this object.

DEMOBILISATION CENTRES

The process of demobilisation from the Royal Air Force, apart from the necessary documentation, involved a careful medical check of each individual—especially those returning from overseas theatres. To meet this requirement, special units were set up in strategic centres, such as Blackpool, where existing accommodation lent itself to a rapid flow of personnel through the various departments.

All personnel on leaving their parent station were given a release medical examination by their unit medical officer and the results of this were scrutinised by the medical staff at the release centre. The task was often rendered more difficult by the individual having contracted some illness in transit and it was the responsibility of the medical department to assess the condition of the patient taking this fact into account.

* Chapter 7, Maintenance Command.

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Most centres provided arrangements for mass radiography examination, and facilities were always available for Wassermann and stool tests; the latter were of particular value in the case of personnel returning from overseas and many chronic amoebic infections were detected in this way.

If discharged personnel at a later date contracted an illness alleged to be attributable to Air Force service, their claim against the R.A.F. would, in many instances, stand or fall on the evidence of the release examination and that carried out at the demobilisation centre.

CONVALESCENT FACILITIES

The convalescence of Service personnel produced several problems for the medical authorities. The majority of patients, after treatment in hospital, reached a stage where they could no longer reasonably occupy a hospital bed and yet were not fit to return to duty, and some suitable form of disposal had to be arranged. In some cases further treatment at a rehabilitation centre was the obvious solution, but for a large number of patients a different type of establishment was required.

It was sometimes possible to grant leave which the patient could spend at home, but this was not always practicable—particularly in the case of men of the Allied forces. The solution to the problem came from two distinct sources—Service and civilian.

(*a*) Service: Certain centres were opened to provide accommodation for convalescent personnel where they would be able to find amusement both on the unit and in the immediate locality. Discipline was relaxed as far as possible and everything done to accelerate both physical and mental recovery. The choice of seaside resorts wherever possible was an obvious one. Apart from the benefit of the sea air, suitable accommodation was easier to find. No. 1 W.A.A.F. Convalescent Depot at Torquay is an example of a seaside centre.

(*b*) Civilian: Many owners of large country residences in pleasant surroundings put these properties at the disposal of the Royal Air Force either directly or through the Red Cross or other charitable institutions. By this means it was possible to provide suitable accommodation and congenial surroundings for all ranks and both sexes.

APPENDIX

AIDS TO SELECTION OF SUITABLE TRADES FOR RECRUITS

The number and type of trades into which it was possible to place recruits were governed by several factors and varied considerably from time to time. The most obvious and limiting factor was the establishment of the trade; only in exceptional circumstances could this be exceeded and personnel

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desiring to enter a fully-manned trade could only do so by re-mustering if and when vacancies arose, being directed meanwhile into other duties. The establishment itself, moreover, was subject to alteration, for it was determined by the requirements of the war situation, so that the number of vacancies might fluctuate even from one week to another. (It was this fact that sometimes resulted in large numbers of personnel being re-mustered to another trade when they were half-way through their training. This waste of man-power and instruction time was strongly deprecated but there was no easy way round the problem.)

Further limitation was imposed by the standards of physical fitness required, for if a recruit's medical category was below that set for a certain trade it was uneconomical to attempt to fit him into that trade. Although many recruits expressed a preference for a certain trade, in which they had often gained considerable proficiency in civilian life, the majority realised that they had to be placed where the need was greatest.

In the early years of the war new entrants were, with certain obvious exceptions, drafted in batches into trades which urgently needed recruits. This policy proved reasonably satisfactory in the majority of cases, but a percentage of personnel were drafted into trades for which, after training, they were found to be quite unsuitable, while in some instances a man had to be transferred to a more congenial trade before his training was completed. It will be seen, therefore, that the method of allocating personnel at this time was far from perfect.

Up to 1942 the mechanism was that the recruit was interviewed by the Central Trade Test Board, who outlined the possible trades open to the recruit, summed up his capabilities* and assessed his past experience; then, taking his stated preference into consideration, the Board allocated him to the trade for which he appeared most fitted and in which there were vacancies.

Early in 1942 a professor working at Oxford University produced a series of aptitude tests designed to sort recruits quickly into the trades for which they were best suited and, in particular, to classify personnel as mechanically or non-mechanically minded (*see* Fig. 1). These tests were first applied in March 1942 to large numbers of W.A.A.F. recruits whom it was hoped to train as radio operators and M.T. drivers; the experiment met with considerable success, for it was possible to eliminate, before training, personnel who would have been unlikely to attain the requisite skill for these trades.

The tests were subsequently adopted throughout the Service and all recruits were subjected to them on entry. It was considered that the time spent in carrying out the tests was well worth while, but occasionally, when very large numbers of recruits were being received, a certain amount of delay resulted because of the impossibility of 'speeding-up' this method of testing. It also had to be realised that the tests were by no means foolproof and the task of the selection board, though eased, was still a very real one, for it was with this board that the ultimate responsibility for the placing of the recruit remained.

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* Selection boards adopted a classification known as the GVK where G = general, V = verbal and K = practical knowledge.

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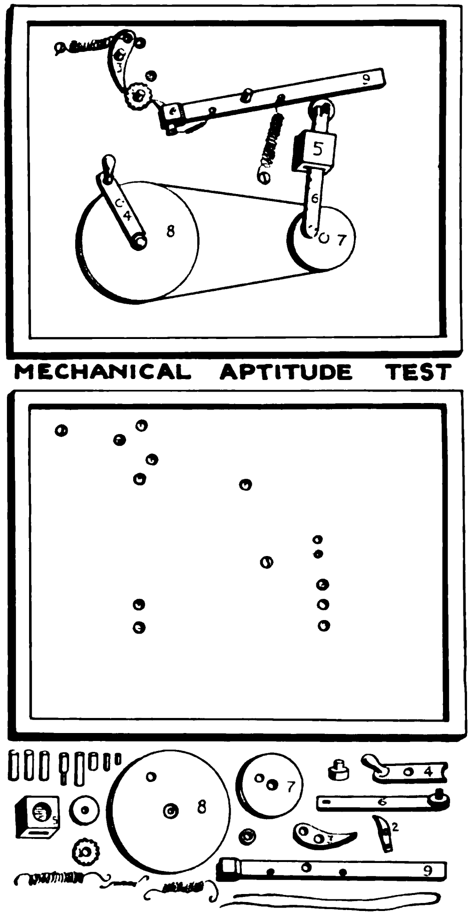

Fig. 1. Diagrams illustrating Mechanical Aptitude Tests.

Blood Transfusion

THE use of blood transfusion as a normal procedure not only in hospitals but in immediate resuscitative measures in the field may be considered one of the greater advances in medical treatment which was precipitated by the war. The importance of this subject is such as to warrant inclusion of the following account of the part played by the R.A.F. Medical Branch in this major development. The section has been included in the Technical Training Command narrative as it was this Command which had control of the R.A.F. Mobile Blood Transfusion Team, which was based on the Central Medical Establishment for ease of administration.

Details of other blood transfusion services will be found in other volumes of this History, viz. Surgery, E.M.S. Vol. I, Medical Research, Royal Naval Medical Services Vol. I, and Army Medical Services Vol. II (Administration).

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EARLY HISTORY

The attitude towards blood transfusion in the R.A.F., as elsewhere, underwent a considerable change in the eight years preceding the war. In 1931 a blood donor was regarded as a kind of hero, reward for whose services involved the payment of £1 per pint of blood given and the grant of up to 21 days' sick leave.* The expense of transfusion in the R.A.F. at these rates meant that the giving of, say, ten transfusions, as occurred in a case at the Princess Mary's Royal Air Force Hospital, Halton, in 1931, was a severe drain on funds. The British Red Cross Transfusion Service, which had been in existence since 1921, also demanded a fee of one guinea from patients able to pay it, to cover the cost of blood supplied. Quite apart from this, supplies were a difficulty, for in the instance quoted, out of a parade of 98 men only 8 volunteered as donors; two years later, however, inquiries showed that views on the giving of blood had changed and the R.A.F. now had no shortage of donors at home or abroad.

'Attributability' following injury resulting from transfusion came under discussion in 1933, when it was decided by the Ministry of Pensions that responsibility would in clear cases be accepted by the Service. An instance of medico-legal interest arising from this decision was the case of an airman donor whose blood saved the life of a haemophiliac, and who, developing pulmonary tuberculosis some years afterwards, made a claim for attributability, alleging lowered resistance as the result of giving blood.

Plans for blood transfusion and blood storage in the Royal Air Force were made before the war, it being understood, however, that technique and administrative arrangements, which in May 1939 were being examined by the Army Medical Advisory Committee, would be co-ordinated by the Ministry of Health on a national basis on behalf of the central medical authority and the Service medical authorities.

Immediately before the outbreak of war, with a view to settling the storage question, it was decided to instal electric refrigerators of 5 cubic feet capacity (supplementary to those already held for laboratory purposes) in ten of the major R.A.F. hospitals and large station sick quarters (later to become the so-called station hospitals) in which blood obtained from the Army Blood Supply Depot (A.B.S.D.) at Bristol would be held. Provision for such storage and delivery of the blood was only a small part of the larger problem: donors had to be found among serving personnel and tested; the relative merits of blood elements other than whole blood had to be assessed; transfusion facilities at station sick quarters had to be examined and medical personnel

* A later rate of payment was a bottle of burgundy and forty-eight hours' leave. (Nowadays it is a cup of tea, two biscuits and twenty minutes rest!)

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trained to make use of them. Little was known at that time of the extent to which transfusion would be required outside, or even inside, hospitals, while the practical outcome of the co-ordination between civil and Service authorities was a matter for speculation. The hand-to-mouth nature of the plans which were made and the difficulties encountered are reflected in the disconnected character of the narrative below, which attempts to show in chronological order as far as possible, the development of the blood transfusion service.

GENERAL PROBLEMS IN THE INCEPTION OF THE BLOOD TRANSFUSION SERVICE

On September 6, 1939, a bi-weekly service was instituted for the distribution of blood by aircraft of National Airways Communications from R.A.F. Station, Filton. Bulk blood amounting to 120 lb. was to be distributed to hospitals and sick quarters, and, if unused, returned to the A.B.S.D. Bristol, where it would be replaced by new blood which the air service could deliver within 2½–3 hours of issue. The amount aimed at was 10 pints for storage per hospital and large station sick quarters with a 'float' of 5 pints. Unfortunately, there were certain difficulties at the A.B.S.D. which delayed the commencement of these air deliveries from Filton. A small quantity of blood was flown during October 1939 but the scheme was abandoned at the end of the month, when it became clear that blood in quantity from Army sources would not be available for some time.

BLOOD DONORS

In the meantime the problem of donors among serving R.A.F. personnel had not been neglected and panels of officer and airman volunteers were formed, their blood group being entered on Forms 48 (medical history envelope) and stamped on the Service identity disc which was worn around the neck. The question of whether the taking of blood from serving airmen for *ad hoc* purposes was prejudicial to their efficiency had been under consideration and it had been agreed that airmen employed on ground duties might volunteer as donors, provided that they were not bled more often than once a month. It should be noted that at this time aircrew were not allowed to become donors.

While decision was pending as to the source of blood from which the R.A.F. as a whole would be supplied for storage purposes, the Edinburgh civil authorities had asked the Service for donors on a reciprocal basis—i.e. if the R.A.F. would provide donors from local units, these personnel would, in return, be 'grouped' and as much blood as was required by any R.A.F. station or hospital 'within a convenient distance of Edinburgh' would be supplied. Supplies of serum for grouping

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purposes were also offered by the Galton Laboratory Serum Unit at Cambridge and 250 ccs. of 'A' and 'B' group sera were in fact supplied on January 1, 1940.

NEGOTIATIONS WITH CIVIL BLOOD SUPPLY DEPOT

The urgent need for storage blood which followed the breakdown of arrangements with the A.B.S.D. resulted in negotiations being opened with the Civil Blood Supply Depot administered by the Medical Research Council at Luton, Bedfordshire. This depot was able to provide 20 pints of group 'O' and 10 pints of group 'A' blood every fortnight and serum for grouping was also available. It was decided to limit these facilities at first to R.A.F. hospitals and larger station sick quarters, calling on local Service donors if supplies from civil sources were found to be inadequate, while a reserve quantity of blood was earmarked for retention at each hospital in a 'danger zone' east of a line joining Edinburgh and Southampton until a panel of local donors could be formed.

Training for medical officers and airmen in the technique of transfusion was arranged and by the end of December 1939 courses of instruction at Luton had been attended by twenty-four Service medical personnel. The A.B.S.D. Bristol now agreed, despite previous difficulties, to provide supplies until the Luton arrangements were complete and thereafter to allow their depot to be called on when necessary. A limited number of 'taking and giving' sets was also obtained from Luton for distribution to R.A.F. General and Station Hospitals; it was possible to provide twelve sets each for R.A.F. Hospitals Cranwell, Littleport (later Ely), Halton, Henlow and Yatesbury; eight each to those at Uxbridge, St. Athan, Cosford and Padgate; four each to Locking, Hednesford and six other station hospitals, and two each to the hospitals in the Blackpool area. The fact that the number of sets was limited is in itself an indication of the scarcity of equipment available.

POSITION AT THE END OF 1939

A directive issued to the P.M.Os. of all commands at the end of 1939 summarised current blood transfusion arrangements, stating that Air Ministry policy generally was to rely on donor panels, but that a small quantity of blood would be held at certain vulnerable R.A.F. stations on which hospitals were located. An outline was given of the indications for, and estimated requirements of, blood transfusion; at that time it was estimated that out of 200 casualties, 50 of whom required operation, some 14 might be expected to need transfusion. Later experiences with civil air raid casualties in the London area, between September 1940 and May 1941, showed that in fact approximately 13 per cent. of patients

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admitted to hospitals received transfusion, amounting on an average to 1350 ccs. of blood each. 'Taking and giving' sets would be issued, and if in an emergency stored blood was needed, application was to be made to the Civil Blood Supply Depot at Luton or to the A.B.S.D. at Bristol; R.A.F. Station, Filton would arrange air delivery from the latter. Stored blood would be held in the five danger zone hospitals in the eastern part of the country (Cranwell, Littleport, Halton, Uxbridge and Henlow), which would be supplied fortnightly by Luton. Donors were to be typed to the scale of 25 for a hospital with 100 beds, 50 for a hospital with 250 beds and 100 for a hospital with 500 beds; samples of blood were to be sent to the Institute of Pathology, Halton, for the Kahn or Meinickes* test and the result entered on the donor's Form 48. One junior medical officer and one airman from each hospital and large sick quarters were to be detailed for transfusion duties.

The fortnightly supply of blood from Luton to the danger zone hospitals began on January 11, 1940, each hospital receiving four bottles of group 'O' blood drawn within forty-eight hours and safe for use up to 14 days after receipt; during April, the Luton depot modified the technique of blood preservation and was able to extend the period during which it could be used from a fortnight to three weeks.

At this time, in view of the keeping properties of liquid and dried plasma their potentialities were under consideration. The Medical Research Council was also investigating dried and re-constituted serum, but at this stage in development neither plasma nor serum appeared suitable to replace whole blood.

R.A.F. LIAISON WITH GALTON LABORATORY

In the R.A.F. the grouping of donors was again under review during April 1940. No. 1 Initial Training Wing near Cambridge had been in touch with the Galton Laboratory† which was prepared to group air-crew pupils passing through the Wing; these men would, on a voluntary basis, provide serum of groups 'A' and 'B' (for grouping purposes) and

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* A variation of the Sachs-Georgi Syphilis Test.

† This unit, which moved from University College, London, to Cambridge at the outbreak of war undertook, under Medical Research Council arrangements, to provide the greater part of the nation's blood grouping serum. In addition to its work with various R.A.F. units near Cambridge, it also had liaison with the R.A.F. Hospital at Ely and Littleport. Nearby R.A.F. stations, such as Honiton, Bassingbourne and Oakington, provided personnel for testing and in return grouping serum was made available to them and other stations for testing purposes. Early in 1940 attention was turned to the Initial Training Wings as a source of supply of blood for the making of testing serum and in August of that year the Galton unit sent a bleeding team to the Initial Training Wing at Babbacombe for this purpose. Later the scheme was extended to the Initial Training Wing at Stratford-on-Avon and in 1942, to the Aircrew Reception Centre in London. From the spring of 1940 to the end of 1941 the Galton unit had tested the blood groups of more than 50,000 R.A.F. personnel, mainly from I.T.Ws., and had obtained from each of 358 volunteers an average of 500 ccs. of blood for use as testing serum.

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in return the donor's blood group would be notified and stamped on his identity disc. Advantage was taken of this scheme, as a supply of high titre serum* was thereby made available to the R.A.F. for general issue, thus minimising the possibility of error in the grouping of donors. Local arrangements were also made by various R.A.F. units and formations; for instance, No. 3 Group, Bomber Command, made use of facilities available at an Army Transfusion sub-depot at Bury St. Edmunds (August, 1940) while Balloon Command had contacted the A.B.S.D. at Bristol, which sent a travelling unit to dispersed balloon flights and headquarters in the Bristol district and grouped a total of 437 volunteers. By September 1940, R.A.F. Northern Ireland had brought the strength of typed donors up to 5 per cent. at all station sick quarters, and in Scotland the National Blood Transfusion Association offered its services to the R.A.F. in return for supplies; the Association had 11 blood banks, each capable of storing 50–100 pints, which would be made available to the R.A.F. as and when required; in August 1940 the S.M.O. No. 18 Group was appointed R.A.F. liaison officer for blood transfusion in Scotland.

GENERAL POLICY ON STATIONS, 1940–41

During July 1940, the policy to be adopted by R.A.F. stations not having hospitals was defined by Air Ministry in a memorandum sent to the P.M.Os. of home commands, an outline of indications for and technique of transfusion being given for the guidance of medical officers in charge of sick quarters. It was envisaged that most serious cases injured at stations during air raids or from other causes would be rapidly transferred to civil or Service hospitals and that the medical officer would only be called upon to carry out an occasional transfusion; nevertheless, a donor panel of 5 per cent. of station strength was to be aimed at and a register of names to be kept. Volunteers were to have their blood grouped, and samples submitted for Wassermann, Kahn or Meinickes testing, the results of tests being stamped in Moss and International nomenclature on identity discs and entered on Forms 48. A positive Wassermann test or a history of malaria, tuberculosis or syphilis would exclude the volunteer from the panel.† Medical officers on entering the Service were to be given instruction in the technique of giving and collecting blood, and in blood typing, and stress was to be laid on the reactions to be expected in the event of an incompatible transfusion being administered.

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* Also supplied by the Depot at Luton.

† Following early experiences in the Middle East Campaign, infective hepatitis was also listed as an 'excluding condition'.

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POSITION AT THE END OF 1940

By the end of 1940 all R.A.F. hospitals had ample stocks of stored blood, and many had made reciprocal regional arrangements whereby they could call for supplies from civilian and Army blood depots when necessary. The number of hospitals storing blood was increased by the addition of Cosford, St. Athan, Weeton and Yatesbury. Other local arrangements included the supply of liquid plasma (pending provision of the dried product) to certain Bomber Command stations and to R.A.F. hospitals at Gloucester and Hereford from the A.B.S.D., Bristol, which was also prepared to supply apparatus. Towards the close of the year the Medical Research Council placed the facilities of the four London Blood Supply Depots at the disposal of the R.A.F. and these included the provision of liquid filtered plasma and serum. (*See* E.M.S. Vol. I, Chapter 11.)

DRIED SERUM AND PLASMA

As already mentioned, the advantages of dried material (serum or plasma) capable of being made up into solution on the spot had been considered in April 1940. Some difference of opinion existed as to the relative merits of made up serum or plasma as compared with whole blood; although these preparations were undoubtedly useful for treating shock when there was no loss of blood, it was thought that they would be less successful in cases of hæmorrhage and that for general purposes they could not take the place of whole blood transfusions. Moreover, both the dried products were still under trial, so that it was not known which was the better; neither of them was at that time in commercial production and, finally, special and complicated apparatus was required for their preparation.

Nevertheless, in spite of the alleged advantages of fresh or stored whole blood for transfusion, it was soon realised that the problem at station sick quarters was one which could be solved more easily by a dried product than in any other way, particularly as the dried material could be kept almost indefinitely without refrigeration and carried an almost negligible risk, provided that the solution was used as soon as it was made up and that specially careful precautions were taken regarding the sterility of the distilled water used.* In addition it was recognised that serum was a powerful agent in combating shock and could be given to all patients regardless of their blood group; clinical experience at Ely Hospital had already proved the value of dried serum. At first the serum

* It was, of course, realised that some risk was always involved, but the chances of reaction or the occurrence of homologous serum jaundice were so small as to be of little or no account and in any event far less than in whole blood transfusion.

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was given in double the normal concentration, but this practice was later abandoned, it being found that febrile reactions were more liable to occur with the stronger concentration and that there was no corresponding advantage.

In October 1940, it was decided that all R.A.F. stations at home should be supplied with dried serum to a scale of four (200 cc.) bottles, subsequently increased to six bottles; the dried serum was obtained *via* R.A.F. Hospital, Ely, from the civil authorities at Cambridge, and later stocks were held at the Medical Stores Depot, Hartlebury.

The priority requirements of R.A.F. stations in the operational commands were ascertained in November 1940 and by the beginning of the following year Ely Hospital had built up a stock of 700 bottles of dried serum. It was not, however, until the middle of 1941 that the serum had been distributed to the full scale of 6 bottles each to the 88 stations entitled to it. Later in 1941 the scale for all stations was increased to 12 bottles, demands to be made on the Medical Stores Depot, Hartlebury, which by now was drawing regular supplies from Luton *via* Princess Mary's R.A.F. Hospital, Halton.

R.A.F. requirements overseas were met by the Army, but a supplementary supply of 200 bottles of dried serum and 15 transfusion outfits was sent to Iraq towards the close of the year in response to the P.M.O's. request. At Habbaniya a panel of donors had been in existence since the outbreak of war and a small citrated blood bank had been built up. By the end of 1941 the proximity of Army units made it unnecessary to establish further blood banks overseas.

DONOR POLICY IN THE ROYAL AIR FORCE

During 1941, the R.A.F. donor policy was again discussed, to decide to what extent Service personnel should be bled. Up to the present, official opinion, influenced by the belief that efficiency might be adversely affected by the giving of blood, had favoured the exemption of R.A.F. personnel as donors, in view of the demands liable to be made upon them at any time, and particularly during air attack, by their ordinary duties. Owing to the shortage of civilian donors, however, especially in Wales and the Birmingham district, an order 'screening' all R.A.F. personnel from bleeding, issued in July 1941, was cancelled in October of that year; even so, Service donors were to be used only when civil sources of supply were inadequate and they were, as always, to be volunteers, while personnel engaged in operational flying or aircraft maintenance work or undergoing flying training, were still not to be bled. In 1942 a similar policy was laid down with regard to W.A.A.F. donors—i.e. they were to be volunteers and were, except in an emergency, to be bled only when the number of civilian donors was insufficient. Balloon operators were not to be accepted.

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FORMATION OF THE MOBILE BLOOD TRANSFUSION TEAM

At the beginning of 1941 a meeting was held by the Co-ordination Committee of the Ministry of Health at which the relation between the Service Departments and the civilian London Blood Supply Depots was considered and the supply of apparatus and development of drying and processing plant was discussed. Under civilian blood transfusion arrangements (excluding Scotland), thirteen depots were established; those at Luton, Slough, Sutton and Maidstone provided for London and the Home Counties and came under the Medical Research Council, while the provincial centres at Newcastle, Leeds, Nottingham, Cambridge, Birmingham, Liverpool, Manchester, Oxford and Cardiff came under the Ministry of Health. Hospital needs were catered for by the maintenance of stocks at various points and by quick delivery on demand, while the supply of blood in all districts was obtained from civilian donor panels adequate to cope with both regular and emergency demands; substances available included whole blood, liquid serum and plasma and, at that time, a limited supply of dried serum. The taking and giving sets were standardised.

The proposal that the R.A.F. should set up an independent bleeding and transfusion team had first been made at the end of October 1940, when shortage of civilian donor blood, coupled with the heavy demands which were expected as a result of enemy bombing, indicated the need for additional supply facilities. Experience in the United Kingdom had already shown the advantages of a whole-time mobile bleeding team, as distinct from a static centre staffed by part-time medical officers; a mobile team provided a higher standard of 'bleeding', kept in touch with recent improvements, obtained greater experience and consequently had greater educational value in all matters connected with transfusion.

In March 1941, therefore, it was decided to form a R.A.F. unit—the Mobile Blood Transfusion Team (M.B.T.T.)—for the purpose of obtaining blood and sending it to the civilian authorities for drying and subsequent issue to the Royal Air Force. The team came into being in April 1941, under the administration of the Central Medical Establishment; the following staff were to be established:

1 Medical Officer	
1 Sergeant	Laboratory Assistant
1 Corporal	W.A.A.F. Group M.
5 Aircraftwomen	W.A.A.F. Group M.
1 Aircraftman	Clerk G.D.
2 Drivers	1 Airman and 1 Airwoman

An ambulance, which was to be converted for carrying equipment (Plates XLV and XLVI), and a utility car were provided as transport. The civil depot at Sutton (Surrey) became the team's Headquarters and personnel were on the lodging list of the district. The first six weeks were spent in recruiting and training the staff, as delay in the completion of the necessary modifications and installations to the ambulance and in the provision of equipment made it impossible for the team to begin functioning until June 9, 1941. By this time the officer in charge, having trained his team and made the necessary contacts with the civilian authorities, was able to begin work in the bleeding of donors, mainly in civil first-aid posts in the Guildford, Godalming and Dorking districts.

USE MADE OF TRANSFUSION IN THE R.A.F.

Meanwhile, returns had been called for from the R.A.F. stations in Bomber, Coastal, Fighter and Flying Training Commands in order to assess the extent to which transfusion had been carried out at operational stations since the beginning of the war, thus including the period of the Battle of Britain. The result was surprising. In all stations under these Commands, up to June 1941, only 23 transfusions of blood elements had been carried out: fresh blood had been used on 6 occasions, stored blood on 2, liquid serum or plasma on 7 and dried serum or plasma on 8; the number of intravenous infusions of non-blood elements in the four commands was 7. Bomber Command's total of 16 transfusions (half of them with dried serum or plasma) was limited to 10 stations, Coastal Command had undertaken 7 (3 direct from donor and 2 of liquid serum and plasma), Fighter Command 4 and Flying Training Command 3.

In order that the situation at R.A.F. stations should be thoroughly investigated and the experiences of the officer in charge of the M.B.T.T. put at the disposal of the medical officers concerned, a series of visits to stations in Surrey and Sussex was arranged, a report being made in September 1941. It was found that although a number of stations had already made unofficial arrangements with the local civil regional transfusion officer for the supply of liquid plasma and transfusion apparatus, no transfusions had, in fact, been given, while in several instances where liquid plasma was held there were large clots in the bottles, even though these had been stored in a cool dark place. The stations visited (mainly those of No. 11 Group, Fighter Command, which had experienced considerable bombing during September of the previous year) had usually found that their casualties could be successfully evacuated to hospitals within an hour, and the medical officer had therefore seldom had either time or opportunity for administering transfusions on the spot. In one Flying Training Command station,

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where casualties were more likely to be the result of flying accidents and therefore to occur singly, there seemed to be more scope for transfusion and these visits by the officer in charge M.B.T.T. proved valuable, as not all medical personnel were fully informed on the technique of intravenous therapy and the ideal arrangements for the storage of apparatus.

WORK OF THE MOBILE BLOOD TRANSFUSION TEAM

By the end of December 1941, 5,000 civilian donors had been bled by the M.B.T.T. The practice was for the team to drive to the civilian panel, usually at first-aid posts and aircraft factories, draw blood and take it back to Sutton the same night. (Plates XLVII and XLVIII.) The rate of bleeding varied between 32 and 84 donors a day but was generally well above 60; it was found that the response to call-up of the panel for bleeding was seldom below 50 per cent. The drawing of blood was carried out on alternate days of the week, the other days being spent in treating the blood at the base before sending it to the Wellcome Institute at Beckenham (Kent) for processing.

During the six months July–December 1941, a total of over 600 litres of serum was handed over to the Wellcome Institute and in addition, blood from a number of group 'O' donors (628 in the last quarter of the year) was citrated and contributed to the depot's blood bank. During the third quarter of 1941 the Wellcome Institute returned 276 (400 cc.) bottles of liquid filtered serum and 46 (200 cc.) bottles of dried serum; during the last quarter of the year only dried serum was returned—413 (200 cc.) bottles.

REACTION TO TRANSFUSIONS

Some obscure clinical symptoms following the use of this dried serum in normal test subjects (i.e. individuals not clinically requiring transfusion) were noticed about this time. The rigors and low back pain reported caused some anxiety, and issue of the serum to R.A.F. units (and the use of dried serum already issued from this source) was suspended pending investigation. The matter was referred to the Medical Research Council and as a result of their inquiry the dried serum was again 'released' for use; it appeared that the symptoms experienced were not peculiar to the brand of dried serum employed and were likely to occur in any subjects other than those actually requiring such a transfusion.

In January 1942 the M.B.T.T., having met local needs at Sutton, was moved to Nottingham in order to continue bleeding in another regional area where facilities for obtaining blood locally had been inadequate.

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EVENTS IN 1942

By January 1942 transfusion arrangements throughout the R.A.F. in the United Kingdom had become more clearly defined. An adequate supply of dried serum was delivered regularly by the Medical Research Council to the Medical Stores Depot at Hartlebury, which was able to meet home demands without difficulty; serum for grouping was obtainable, on application, from the Galton Laboratory, Cambridge; in addition full use was being made of the facilities—amounting to an almost complete supply and maintenance organisation—provided by the civilian regional transfusion officers. Located in twelve different centres in England and Wales, and represented in the Bristol area by the Army Blood Supply Depot, these officers could be approached at any time by medical officers of R.A.F. stations for stored blood, liquid serum and plasma, and apparatus supplementary to that already held. In Scotland a similar organisation existed, with which arrangements were made later in the year. In Northern Ireland facilities were provided by the Army.

Each station and satellite sick quarters now had four sets of giving and taking equipment ready sterilised, cutting down instruments, and twelve bottles of dried serum with the necessary sterile water. As can be imagined, the provision of some 1,500 sets in England and Wales alone was no small undertaking.

THE MOBILE BLOOD TRANSFUSION TEAM AT NOTTINGHAM

On moving to Nottingham at the beginning of 1942, the M.B.T.T. was attached to the civilian North Midland Regional Transfusion Depot. For a time personnel of the unit were accommodated at R.A.F. Station Watnall, but they were later placed on the lodging list in Nottingham. The original medical officer, who had been posted overseas, had been replaced and work continued on lines similar to those followed at Sutton—namely, the collection of blood from civilian donors and the visiting, for purposes of inspection and instruction, of a number of R.A.F. stations within the regional area.

In the first six months of 1942 5,750 donors were bled at 66 sessions, varying from 600 in six sessions in April to 1,300 in twelve sessions in June. During the same period thirty-five R.A.F. stations and one R.A.F. hospital were visited; the majority of the stations were in Bomber, Fighter and Flying Training Commands, although Coastal, Balloon and Technical Training Commands were also represented. One outstanding fact revealed by these visits was that there were records of only six transfusions having been performed in all these stations between the outbreak of war and the time of the visit. This confirmed the findings of the 1941 inquiry—that transfusion was a rare event at station sick quarters, even in Bomber and Flying Training

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Commands. Apparatus and equipment were apparently adequate and were in any case simple, but still transfusion was not being carried out despite the fact that there must have been a number of cases in which such a measure was indicated.

Analysing the reasons for this apparent hesitancy on the part of medical officers at stations, the officer in charge of the M.B.T.T. attributed it to two facts—lack of experience in the latest methods of transfusion and the absence of any hard and fast rules on the selection of cases suitable for the operation. With a view to improving matters it was suggested that medical officers should be given an opportunity of witnessing transfusions in civil hospitals and of accompanying the M.B.T.T. on its bleeding sessions to gain practical experience in venepuncture.

ACTIVITIES DURING 1943-44

The M.B.T.T. remained at Nottingham throughout 1943, working in close co-operation with the Regional Transfusion Authorities in the bleeding of both civilian and Service personnel, blood then being either stored or processed; at this time a greater proportion of liquid blood was being processed into dry plasma in view of the increasing popularity of the latter and the additional plant which was available.

By April the Royal Air Force authorities were becoming apprehensive about the position of the M.B.T.T. and about the attitude adopted by the average Service medical officer to the whole subject of resuscitation, particularly with regard to immediate action on the site of aircraft accidents. Anxiety over the M.B.T.T. arose from the shortage of staff in the unit; it was uneconomical to run less than the usual four 'bleeding' couches at a time and therefore, although normally the personnel available would have been employed on two couches only, they were dealing with double that number, with a consequent slowing down of sessions to such an extent that employers and Service establishments were embarrassed by the time volunteers were kept away from their normal occupations.

Investigation revealed that the policies of civil and Service transfusion authorities were neither as closely linked nor as clearly defined as could be desired and that there was considerable variation from one area to another according to the individual keenness and ability of transfusion officers. Even more disturbing, however, was the outspoken report of the Royal Air Force Consultant in Surgery, who stated categorically that many unit medical officers were ignorant in the use of simple transfusion equipment* and in some instances did not even know where the apparatus was kept; that on examining the equipment

* Few teaching hospitals included the technique of transfusion as a set subject in the normal curriculum for medical students.

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he had found much of it to be unserviceable owing to poor storage and maintenance; that a number of patients were being sent on long and often rough journeys without any resuscitation measures being taken, and that many medical officers were frankly frightened to transfuse and hold severe accident cases in sick quarters until their condition improved sufficiently to permit safe transfer to hospital. It was felt that this last observation pointed to the main reason why in late 1941 and 1942 so few transfusions had been given at R.A.F. establishments (other than hospitals).

Whatever the reason might be, the position was obviously unsatisfactory and the medical authorities determined to examine closely every possible aspect of the matter, with regard to both the organisation of the M.B.T.T. and the general policy concerning blood or plasma transfusions on stations or at the site of crashes.

In the meantime, P.M.Os. were instructed, in an Air Ministry directive, to ensure that all medical officers in their Command were conversant with the technique of giving transfusions and the simple indications for their administration; all sick quarters were issued with a copy of a pamphlet illustrating the method of using the standard giving and taking sets, while the Consultants in Surgery were requested to visit stations in their area and check on the availability and efficiency of transfusion apparatus and the ability of personnel to use it.

Early in 1944, the M.B.T.T. underwent considerable reorganisation at the direct request of the Director-General of Medical Services, who took a great personal interest in the unit. A medical officer with an intimate knowledge of both the organisation and running of transfusion centres and the technical details involved was available for posting to the M.B.T.T. and from this date there was a marked increase in the amount of blood collected by the team. It should be noted, however, that apart from the advantage gained by having a 'specialist' in charge of the unit, the war situation was such that members of the general public were more inclined to offer blood, while the publicity concerning the urgent demand for donors was having its effect on persons who previously had taken little interest in the subject or perhaps had not appreciated how vitally blood was needed for both civilian and Service war casualties.

An incident which, although small in itself, caused considerable interest as well as alarm, occurred in March, when two W.A.A.F. donors were discovered to have blood groups different from that shown on their identity discs. Although it was obvious that with the numbers involved and the somewhat confusing group nomenclature mistakes were liable to occur, it was impossible to disregard the danger attaching to such errors and efforts were made to re-check, wherever possible, the grouping stamped on identity discs. This incident, however, had

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the salutary effect of providing an object lesson in the importance of cross-matching all blood before transfusion, except in the most extreme emergency—a fact which can never be too often reiterated.

BLOOD TRANSFUSION RESEARCH COMMITTEE—R.A.F. REPRESENTATION

Hitherto, the R.A.F. had been represented on the Blood Transfusion Research Committee by the officer in charge of the M.B.T.T., but in February 1944 it was decided to transfer this responsibility to a member of the Medical Directorate at Air Ministry; the new arrangement had many advantages, the most important being that the R.A.F. representative was now able, by reason of his official position, to present a fuller overall picture of R.A.F. policy and also, having a wider knowledge of forthcoming operational requirements, was better equipped to estimate the possible future needs of the R.A.F.

MOBILE FIELD HOSPITALS

The following month it was decided to issue a 'Blood Pannier' to all Mobile Field Hospitals, lest circumstances should arise in which they were unable to obtain blood from normal sources. In addition to 'giving' and 'typing' sets and a generous supply of dried plasma and pyrogen-free distilled water, each pannier contained apparatus for taking and matching whole blood, so that it was possible for small pools of local donors and staff to be matched in readiness for emergencies. It was felt that this virtual independence of the M.F.Hs. would be of great value, particularly in operational areas.

ACHIEVEMENTS

It will perhaps be useful at this stage to give some indication of the results achieved by the civilian regional blood boards and the quantity of blood collected from R.A.F. sources by these units. The figures below record the number of R.A.F. and W.A.A.F. personnel bled during the year ending March 1944, when stations were visited many times by the civilian collecting teams. Although representing only a proportion of the total number of donors, the figures leave no doubt as to the efficiency and drive of the civilian organisation:

	R.A.F.	W.A.A.F.
Balloon Command	2,113	1,007
Bomber Command	9,292	
Coastal Command	1,389	
Flying Training Command	3,566	
Maintenance Command	1,123	443
Technical Training Command	3,929	

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PLATE XLV: Blood which has been obtained from a 'Bleed' being loaded on to a R.A.F. Ambulance specially equipped to carry 'Fresh' Blood

PLATE XLVI: Loading Transfusion Materials on to a R.A.F. Dakota at Leeds, the Supplies were then flown direct to Normandy

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PLATE XLVII: Donors giving Blood in a typical Centre. Note Attendant supervising each 'Bleeding'

PLATE XLVIII: Standard Apparatus. Note Grip in Hand and Cage around the Bottle to prevent any danger of it being dropped

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By mid-June the effects of the reorganisation of the M.B.T.T. were beginning to be felt; as a result of efficient planning and hard work, the team was not only collecting a very considerable quantity of blood in the Nottingham region but had also gained the good will of the local factories and other organisations, who allowed 'bleeds' to be conducted on their premises. The following summary, based on a report from the officer in charge of the unit, indicates the position at this period:

(*a*) The primary function of the unit was to draw blood and to assist the regional officer in this task. Although instruction on transfusion and allied technique was always given to station medical officers on request, it was never allowed to interfere with the main task of blood drawing.

(*b*) All 'bleeding' was carried out in prepared premises such as first-aid posts, station sick quarters and factory aid rooms on batches of either civilian or Service personnel. This allowed for an orderly flow of donors and ensured that the maximum use was made of each couch.

(*c*) It was endeavoured to ensure a flow of 60 donors per 2½-hour session—that is, 6 per 15 minutes. Civilians on the blood panels were summoned by postcard, but considerable variation in the response was observed; for example, when the war situation was grave or a battle in progress, the response was always in the region of 50 per cent., but in the lull periods of hostilities it might drop as low as 33 per cent. It was also noticed that the response was considerably better in small towns and hamlets, owing largely to the efforts of the W.V.S. and the Red Cross.

(*d*) 'Bleeds' carried out at large factories and Service establishments were the simplest to organise and were carried out both rapidly and with the minimum of defaulting. It was particularly important at such places that there should be no delays which would antagonise the authorities against future visits by the team.

(*e*) Little difficulty was encountered in the handling of donors although some embarrassment was caused by an occasional vasovagal attack occurring during bleeding; the frequency of such attacks was directly related to the operator's skill in venepuncture, which is an art which cannot be learned in less than two months of continual practice on a variety of young and old donors.

The production figures of the R.A.F. M.B.T.T. compared very favourably with those of the civilian Regional Service, as the following table shows, although it should be remembered that there was no sense of rivalry between the two organisations, mutual assistance and exchange of ideas playing an important part in the functioning of

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each. The figures below represent the number of donors bled during the first six months of 1944:

Month	North Midland Regional Depot	M.B.T.T.
January	1,523	nil*
February	980	827
March	900	1,080
April	908	992
May	801	1,323
June	1,425	1,459
Totals	6,537	5,681

* Period of reorganisation.

Analysis of donors under M.B.T.T.:

(a) *Source:*

Civilian	2,813
Service	2,868

(b) *Location:*

Army premises	2,031
R.A.F. premises	837
Civilian factories	938
Civilian first-aid posts	1,875

Recruits and personnel under training provided the main Service source of donors, R.A.F. Station, Cranwell and the R.A.F. Regiment Depot at Grantham in particular supplying many volunteers. It should be noted that normally operational stations were still exempt from bleeding, but when large quantities of blood of a certain type were urgently required—as, for example, immediately before the opening of a major offensive—operational stations were sometimes visited after the P.M.O. and other authorities had been consulted regarding the advisability of such a step.

FURTHER DEVELOPMENTS

At this time the Rhesus factor was coming into some prominence and special banks were being formed with Rhesus blood available for surgical emergencies in which it was required; although there was little need in the R.A.F. for this type of blood, Service personnel were able to make a contribution comparable to that of the civilian population in this direction.

There had been little change in transfusion apparatus since the beginning of the war; a few minor alterations had been made in the

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filters of the 'giving' sets, but basically the apparatus remained in its simple form. An interesting development was the introduction of plastic tubing as a substitute for rubber in the standard giving and taking sets. The change was made for two reasons: firstly, to facilitate cleaning and secondly because the shortage of good quality rubber due to war-time restrictions created a supply problem. The plastic tubing, however, although practical and easy to clean, had the disadvantage that it was not as malleable as rubber, while anxiety was caused at first by a white dust, found on investigation to be harmless, which covered the tube after autoclaving. Although it was used quite extensively, plastic tubing never became as popular as rubber.

During the last six months of 1944 the M.B.T.T., in common with other similar units, was working with the aim of building up the largest possible stock of blood to meet the requirements of the Second Front and also for the needs of the large American hospitals in the immediate vicinity. The good feeling which the unit had built up in the area, together with the keenness engendered in donors by the Second Front and by the realisation that their blood was playing an 'active' part in winning the war, resulted in a steady increase in the quantity of blood drawn, while in a special drive instituted to collect 'universal' blood, donors were bled at shorter intervals than was customary and in every other way responded excellently.

The increase in the amount of blood drawn in the Nottingham area, both by the Regional Service and by the R.A.F. Team, is well reflected in the contrast between the donor figures for 1943 and 1944:

	1943	1944
M.B.T.T. . . .	6,645	13,086
Regional Service . .	8,655	13,331

In August, the Regional Service moved from Nottingham to Sheffield, which meant that all autoclaving of apparatus had to be carried out at Sheffield; this, however, did not adversely affect the efficiency of the M.B.T.T., which at the request of the Regional Board had continued working the Nottingham area and in fact remained there until June 1946.

It will have been seen that an interesting period of both medical and social history has been covered in this section. The medical implications of and interest in what was a relatively uncommon procedure for saving life have been dealt with; liaison between the M.B.T.T. and the civilian organisation in the common task of collecting blood from both Service and civilian sources has been outlined; and finally, with particular reference to the problems encountered in the Royal Air

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Force, some idea has been given of the difficulties inherent in all blood transfusion work, difficulties which had to be overcome in order to ensure that at least a reasonable chance of survival and recovery was afforded to the many badly injured Service and civilian casualties who would not otherwise have lived.

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CHAPTER 10

THE SECOND TACTICAL AIR FORCE

June 1, 1943 to June 5, 1944

The Second Tactical Air Force was formed on June 1, 1943, as the air component to participate in close co-operation with the Army in the Allied landing in Europe in 1944—Operation 'Overlord.'

The setting up of an organisation to plan and then carry out the invasion created tasks that had no precedent in the world's history, and the combined assault launched by the Allied Armed Forces, backed by the industrial power of their nations, is a familiar story. In this complex picture the Second Tactical Air Force was allotted an important rôle which was in itself twofold. Firstly, before the main assaults on the coastal defences of the Continent, aircraft of the Force were to engage the enemy coastal defences and liquidate them as far as possible and also to attack all transport and lines of supply to the defences, so that at the moment of attack the enemy should be in as disorganised a state as possible; secondly, after the main attack had been launched and the battle engaged, aircraft of the Force were to do everything possible to prevent supplies and reinforcements being brought up by the enemy and should also be available to co-operate in the strafing of strong points at the immediate request of the Army. It was to the attainment of these objects that the entire training of the Second Tactical Air Force was directed.

During the period covered by this narrative, Wings already trained were in action against the enemy, new units were being formed and trained in the particular rôle they were to play and the whole was being welded into a highly trained and mobile fighting machine.

FORMATION OF THE COMMAND

Army Co-operation Command was disbanded on June 1, 1943, the same day that the Tactical Air Force was formed, the conception being that the tactical reconnaissance and photographic reconnaissance formerly carried out by the Army Co-operation Squadrons would be undertaken by the Tactical Reconnaissance and Photographic Reconnaissance Wings in the composite groups, and that the whole force of fighters, fighter bombers and medium bombers should co-operate with the Army in addition to their other tactical and strategic tasks.

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The units and squadrons of the former Army Co-operation Command were transferred to Fighter Command, with the exception of No. 72 R.A.F. Regiment Group which went to Technical Training Command, and No. 38 Airborne Wing which remained in the Tactical Air Force until October 15, 1943; it was then disbanded, re-formed as No. 38 Group and transferred to the direct control of Headquarters Allied Expeditionary Air Force. No. 83 Group, originally named 'Z' Composite Group, had been formed in Fighter Command in February 1943 to take part in Exercise 'Spartan', associated with the First Canadian Army; during this Exercise the Group was entirely mobile and lived under canvas, and it was in June 1943 the only formation in the Command with experience of field conditions.

On formation the Tactical Air Force consisted of:
No. 2 (Light Bomber) Group (ex-Bomber Command)
No. 83 (Composite) Group (ex-Fighter Command)
No. 34 (Reconnaissance) Wing (ex-No. 10 Group)
No. 38 (Airborne) Wing (ex-Army Co-operation Command)

On July 15, 1943, No. 84 Composite Group was formed in the Command and towards the end of the year No. 85 Group commenced to form under the direct control of Headquarters Allied Expeditionary Air Force. This was a Base Group consisting of a headquarters, ancillary units and base wings which did not come directly under Headquarters Second Tactical Air Force until after D-day.

As the new units formed, the strength of the Command gradually increased from 25,126 in July 1943 to 59,461 in May 1944, by which time the Operational Wings, excluding the Naval and Observation Post Squadrons, occupied twenty-one airfields.

UNITS CONTROLLED DIRECTLY BY THE COMMAND

The following units came under the direct control of the Command Headquarters:

(*a*) No. 34 Reconnaissance Wing, consisting of one Night Reconnaissance and two Photographic Reconnaissance Squadrons;
(*b*) No. 3 Naval Fighter Wing (operational control only);
(*c*) Second Tactical Air Force Communication Squadron;
(*d*) Headquarters Unit;
(*e*) Mobile Ophthalmic Surgery.

Of the 59,461 personnel in the Command at the end of the period under review, 48,601 were British, 6,692 Canadians and the remaining 4,168 were distributed among 2 Polish Fighter Wings and 1 Polish Light Bomber Squadron, 1 Norwegian and 1 Czechoslovakian Fighter Wing, and 1 Royal New Zealand Air Force, 1 Royal Australian Air Force and 1 Lorraine Light Bomber Squadron.

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In February 1944 there were 1,272 officers and airwomen of the Women's Auxiliary Air Force in the Command and the following month large scale postings out of the Command commenced, the intention being that there should be no women in the Second Tactical Air Force. This was most unpopular with the W.A.A.F. personnel, the majority of whom were anxious to play their part in the invasion, and many and varied were the excuses put forward to avoid postings. In point of fact many of them were doing such excellent work that they were not posted from the Command, and over 200 of them remained on D-day.

At the same time the medical categories of all Royal Air Force personnel were checked, and those lower than A4hBh (including Western Europe)* were posted out of the Command. This was also unpopular, for the morale was magnificent and every officer and airman seemed to think he was indispensable.

FORMATION OF MEDICAL UNITS

Medical units in the Command were Nos. 50 and 52 Mobile Field Hospitals in No. 83 Group, Nos. 53 and 54 in No. 84 Group, and No. 55 in No. 2 Group.

Six Casualty Air Evacuation Units were formed in the Command to deal with the evacuation from both Advanced and Base Airfields on the Continent. Four of these units were transferred to Transport Command Forward Staging Posts to undertake the evacuation of casualties from the Base Airfields to the United Kingdom, leaving one in No. 83 Group and one in No. 84 Group to operate the forward shuttle from the Advanced to the Base Airfields. This arrangement was not a great success when put into practice after D-day. Much confusion was caused on the beach-head by the divided command between Second Tactical Air Force and Transport Command, and the latter Headquarters, based in England, could not maintain the very close personal contact with the hospitals and the air staff controlling the operations, so essential to the smooth evacuation of casualties during a battle. The single strip airfields were virtually within a few miles of the somewhat fluid front line and liable at extremely short notice to be closed to transport aircraft, because they were being shelled or were required for the use of the squadrons taking part in the battle.

Eventually a Casualty Evacuation Squadron was formed on the Continent in the Second Tactical Air Force, which controlled the evacuation of casualties from the operational area, Transport Command remaining responsible for their reception in the United Kingdom.

* Typical examples of excluding conditions were chronic ear and skin conditions.

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A R.A.F. General Hospital was formed in No. 85 Group and came under the control of Second Tactical Air Force when that Group arrived in Normandy.

FORMATION OF NO. 50 MOBILE FIELD HOSPITAL

No. 50 Mobile Field Hospital had taken part in Exercise 'Spartan' in 'Z' Group and came to the Command on June 1, 1943 with No. 83 Group.

The Unit first formed at the beginning of January 1943 as a section of Royal Air Force General Hospital, Wroughton, joined 'Z' (later No. 83) Group in the field on March 1, 1943, and, apart from a brief return to Wroughton for a fortnight after Exercise 'Spartan', remained with that Group.

This unit suffered many teething troubles on formation; for instance, forty-eight hours before the commencement of exercise 'Spartan' the unit was 50 per cent. under establishment and lacked such key personnel as cooks, sufficient drivers and fitters for the transport, a carpenter and an electrician; furthermore, the equipment arrived piecemeal instead of as a complete 'pack up'. However, one of the chief objects of the exercise was to show such defects, and the formation of other medical units in the Second Tactical Air Force was smoother in consequence of this experience. At the same time, it was felt that it might have been easier and more economical in man-power if the large hospitals in peace-time, or earlier in the war, had been given the necessary equipment and transport to train a number of their personnel to be 'shadow' Mobile Field Hospitals, which could become separate units at short notice, the vacancies thus created being made good by postings into the parent hospitals. (Plate XLIX illustrates a field dispensary.)

FORMATION OF THE REMAINING MEDICAL UNITS

The medical units commenced to form on the following dates and were fully manned, and the Mobile Field Hospitals equipped to 100 beds, approximately 3 months later:

No. 52 M.F.H.	August 28	1943
No. 1 C.A.E.U.	,, ,,	,,
No. 2 C.A.E.U.	,, ,,	,,
No. 53 M.F.H.	September 15	1943
No. 3 C.A.E.U.	,, ,,	,,
No. 54 M.F.H.	,, ,,	,,
No. 4 C.A.E.U.	,, ,,	,,
No. 55 M.F.H.	December 22	1943
No. 5 C.A.E.U.	,, ,,	,,
No. 6 C.A.E.U.	May 20	1944

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By March 1944 all the Mobile Field Hospitals were capable of expansion in an emergency to a capacity of 200 by the use of stretchers as additional beds. Attached to each Mobile Field Hospital was a Mobile Signals Unit, which was found to be an absolute essential during mobile warfare.

In September 1943, No. 52 Mobile Field Hospital was re-named No. 52 (Royal Canadian Air Force) Mobile Field Hospital and was eventually manned entirely by Canadian personnel. The Mobile Field Hospitals were so equipped that a surgical team with all necessary medical and barrack stores could operate and live apart from the main unit. The composition of such a team was:

1 Surgeon
1 Anaesthetist
2 Operating room assistants
8 Nursing orderlies (of whom at least 1 was trained in sanitation)
1 Cook (trained in hospital dietary)
1 Driver

The Mechanical Transport consisted of:

2 Heavy ambulances
1 3-ton tender

MOBILE OPHTHALMIC SURGERY

The Mobile Ophthalmic Surgery was an ambulance suitably converted and manned by an eye specialist and an optician orderly. It did not function before D-day, but after the move to the Continent gave valuable service, not only providing vision testing and specialist opinion, but also issuing new or replacing broken spectacles within half an hour; this was a somewhat unusual but very necessary task to be undertaken in the midst of a battle area.

ARRANGEMENTS IN NOS. 83 AND 84 GROUPS

Each Wing Headquarters was established to provide all technical and domestic facilities for three or four squadrons, so that the latter could be employed with maximum flexibility and operate at short notice from airfields occupied by different Wing Headquarters.

Each squadron in Nos. 83 and 84 Groups was established with only 16 to 18 non-flying personnel, including one medical officer, while the following medical personnel were on the strength of the Wing Headquarters:

Squadron leader	1
Flight lieutenant or flying officer	1
Flight sergeant	1
Corporals	2
Aircraftmen	5

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This arrangement worked well but it resulted in five or six medical officers caring for a population of approximately 1,250. Judged only by the amount of clinical work, this appeared to be a great waste of medical man-power, but it should be remembered that the main object of having a medical officer to each squadron was to enable them to get to know and gain the confidence of their aircrew; this put them in a much better position to observe and advise on morale, flying stress and other aircrew problems than would be possible to a medical officer on the strength of Wing Headquarters. Fortunately the value of this was appreciated by the air staff.

ARRANGEMENTS IN NO. 2 GROUP

In No. 2 (Light Bomber) Group the situation was different because the need for the squadrons to change from one Wing Headquarters to another was not so great and in November 1943, all the medical officers and airmen were established on the Wing Headquarters:

Squadron leader	1
Flight lieutenant or flying officer	1
Sergeants	2
Corporals	2
Aircraftmen	5

By March 1944 all Wing sick quarters were established for 20 beds.

PRIORITY GIVEN TO SECOND TACTICAL AIR FORCE BY HIGHER COMMAND

During its formation Second Tactical Air Force was undoubtedly given a very high priority by those responsible for posting personnel into the Command, and as an example of how far the resources of the Service were stretched it is of interest to note that in February 1944 only 120 Clerks G.D. fit for overseas service remained in all the other Commands in the United Kingdom.

The department at Air Ministry controlling the posting of medical officers was most co-operative, and whenever possible, carried out requests with remarkable rapidity. The following is an example: one medical officer wrote to his P.M.O. by the evening mail to ask for a posting into Second Tactical Air Force. The P.M.O. received the letter by the first post the following morning, and, knowing the writer to be both efficient and suitable, he telephoned the Air Ministry department responsible for medical postings. At 10.00 hours the same morning the medical officer telephoned the P.M.O. to ask him not to take action on his letter because, by a 'remarkable coincidence', he had just been told by his Commanding Officer that he was posted to Second Tactical Air Force!

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OPERATION 'OVERLORD'

PLANNING AS IT AFFECTED MEDICAL UNITS

Broadly, the task allotted to the Second Tactical Air Force in the detailed plans for the operation was to provide air cover for the assault, to prevent the enemy moving up reinforcements, and to establish wings on the airfields which were to be constructed on the Continent as soon as possible. In the early stages an Emergency Landing Strip and two Refuelling and Rearming Strips were to be constructed on the beach-head.

The movement of the units from their locations in the United Kingdom to the points of embarkation was to be in three stages :

First Stage: From unit locations to the concentration area at Old Sarum, near Salisbury, where briefing and the first stages of waterproofing vehicles were to be carried out.

Second Stage: From the concentration area to the marshalling areas at Hiltingbury and Roche Coast camps near Portsmouth where the next stages of waterproofing of vehicles were to be effected and units were to be issued with rations for use on the far shore and 'marshalled' into landing craft and ship loads.

Third Stage: From the marshalling area to the embarkation area at Portsmouth or Southampton where waterproofing was completed and personnel, vehicles and equipment embarked.

It was arranged that as soon as airfields were established on the Continent the necessary medical personnel for their 'opening up' should be flown over. These personnel were fully aware of the tasks to be performed and the facilities that needed to be available before the main body could be accepted on the airfield.

The phasing of the different units, equipment and reserves was very complicated, and an inter-Service organisation known as 'Build Up Control Organisation' (B.U.C.O.) was specially formed to exercise detailed control of the build up through the various Services concerned, and to effect alterations to the priority of movement of units in accordance with the requirements of the Force commanders.

No. 83 Group was to be the first to operate from the beach-head and the advance surgical team from No. 50 Mobile Field Hospital was to land on D-day and be in position on the Emergency Landing Strip immediately it was possible to accept aircraft. This team was to provide specialist surgical and medical attention for all Royal Air Force personnel in the vicinity. When the Strip ceased to be used, the team was to rejoin No. 50 Mobile Field Hospital which was due to land on D-day + 4.

The advance surgical team from No. 52 (R.C.A.F.) Mobile Field Hospital was to land on D-day + 2 and be located between the two

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Refuelling and Re-arming Strips and then rejoin the Mobile Field Hospital when it landed on D-day + 10. In addition, two parties, each consisting of 2 medical officers, 4 nursing orderlies and 2 ambulances drawn from airfield resources, were to land on D-day and D-day + 1 respectively for duty on these two strips.

The senior medical officer from one of the airfields was also to land on D-day to act as the co-ordinating medical officer of advanced elements until the Group Senior Medical Officer arrived with the Group Headquarters. Unfortunately the officer selected, Squadron Leader R. G. S. Grant, was killed during the landing. After he had disembarked, his craft was hit by a floating mine. He returned without hesitation, and while aiding the injured, was blown overboard by a second mine. He was being helped aboard when a third mine exploded and killed him.

The evacuation of casualties before the airfields were ready to receive transport aircraft was to be carried out by the Army and Navy, using the empty ships returning to the United Kingdom. The arrangements made were estimated to be sufficient to evacuate up to 50 per cent. of personnel on the beach-head in the early stages of the invasion; it was considered that if the number of casualties was greater than this, the operation would in any event be a failure. The evacuation of casualties by air has been dealt with in a separate chapter (*see* Volume I Chapter 10, Air Evacuation of Casualties).

MEDICAL STORES

All units were to take their medical equipment with them and replacements were to be obtained from the Base Hospital and Mobile Field Hospitals; these hospitals were to draw in bulk from the Army Medical Stores Depots except for those medical stores peculiar to the Royal Air Force, which were to be demanded from the Royal Air Force Medical Stores Depot, Hartlebury, for delivery through the appropriate Air Stores Park.

Each Hospital was to hold one complete set of Z.1 equipment in reserve for issue to units in the event of their mobile Medical Field Equipment being lost through enemy action. Oxygen containers were to be re-filled at the nearest airfield. Blood was to be flown out from the United Kingdom, and the Army was to attach a Forward Distributing Section of a Base Transfusion Unit to the Royal Air Force Forward Staging Posts on the Continent.

DIVISION OF RESPONSIBILITIES BETWEEN THE SERVICE MEDICAL BRANCHES

It was agreed between the Service Medical Directors that the responsibilities of each Service should be clearly understood both for simplicity of direction and also to avoid duplication. After careful

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consideration the responsibilities were agreed and are shown in an abbreviated form in the Appendix.

OPERATIONS AND TRAINING FOR 'OVERLORD'

R.A.F. operations in preparation for 'Overlord' were part of the general effort to 'soften up' the enemy defences on the Continent and to prevent the movement of reinforcements which would oppose the planned landing and build up on the beach-head. They consisted of fighter sweeps, day and night intruder sorties, escorting day bombers, 'scrambling' to escort returning fighters and bombers reported to be in difficulties, attacks on V.1 and V.2 sites, railways, marshalling yards, shipping and other selected targets, defensive patrols, air sea rescue searches and escorting air sea rescue launches, shipping protection patrols and photographic and tactical reconnaissance sorties.

While units of Second Tactical Air Force were based in England, operations over the Continent were frequently controlled by No. 11 Group in Fighter Command, because the static sectors had greater radio telephony range and control facilities than those available in the Second Tactical Air Force Mobile Group Control Centres. It was also planned that No. 11 Group should take control while the Group Control Centres were moving to the Continent and until radio telephony communication was set up and fully tested. (It is of interest to note that during this period a number of medical officers took advantage of the opportunity to fly on occasional bombing sorties and thus gain first-hand experience of the conditions under which their crews worked.)

Operational tours were limited to 200 hours, but group and squadron commanders had complete freedom to withdraw individuals from operations before they had completed the 200 hours if necessary; this latitude enabled the number of sorties, which many considered more important than the number of hours, to be taken into account; for example the Photographic Reconnaissance Squadrons were doing 200 hours or 50 sorties, and some of the Mustang Fighter Reconnaissance Squadrons 30 sorties, about 10 of which were exceedingly hazardous, being under 3,000 ft.

In addition to normal squadron training including night flying, interception, air to ground firing, etc., numerous exercises took place, both independently and with the Navy and Army, Nos. 83 and 84 Groups being affiliated to the First Canadian Army and the Second British Army. Units of Second Tactical Air Force were exercised in moves to the concentration and marshalling areas, and in providing air cover and elements for practice landings on beaches in the South of England. There were also escape exercises, casualty air evacuation practices, moves at night involving pitching tents in the dark, and groups moving with the armies preparing and using advanced landing grounds.

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The composite Groups moved by wings on the rear airfields 'leap-frogging' over those on the forward airfields to the new and more advanced landing grounds; this method ensured that the air effort was maintained at full strength. Without at least two mobile field hospitals per group moving in a similar manner it would not have been possible to keep pace with the wings and at the same time provide satisfactory medical cover.

All the units lived under canvas for a substantial part of the training period. The majority went into winter quarters early in November 1943, and moved into the field again during the end of March and early April 1944, when the wings occupied airfields in Kent, Hampshire and Dorset in readiness for the invasion. Every precaution was taken to prevent units becoming static and accumulating more equipment than their transport could carry. Between June and November 1943, one of the wing headquarters occupied eleven different airfields.

It was obvious that the new inexperienced units had very little idea how to make themselves reasonably comfortable in the field, and at that time there were even senior N.C.Os. in the Service who had never lived under canvas. One Senior N.C.O. in a newly formed unit, for instance, was seen with a party of airmen trying to erect a dining tent with the poles and main guys in position and the men standing on tables attempting to drape the canvas over the poles. The men learnt very rapidly however and by D-day were capable of looking after themselves under the most adverse conditions likely to be experienced during the coming campaign.

PROGRESS OF TRAINING IN OPERATIONAL FLYING UNITS

The operations and training were gradually increasing the efficiency of the wings, and on January 21, 1943, No. 83 Group celebrated the shooting down of its hundredth enemy aircraft.

In the early part of 1944, No. 2 Group was able to report two of the most accurate low level precision bombing attacks of the war. The first of these, which was carried out by Mosquitoes, was the demolition of a portion of a prison in Amiens in such a manner as to allow the prisoners* to escape, without killing them in the process. The attack took place in daylight on February 18, and was so successful that 75 per cent. of the prisoners escaped, a number of Germans were killed, and there was little or no damage outside the target area. Two Mosquitoes and two of the fighter escort were missing. Unfortunately it was learned later that most of the escaped prisoners were recaptured.

The second task was the destruction of a house in the built-up area of the Hague. The house was believed to contain the only records of

* The part of the prison attacked was that in which prominent members of the Resistance Movement were being held by the Germans.

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Dutch citizens whom the Gestapo intended to arrest and execute as soon as the invasion began. On April 11 faultless navigation brought the six Mosquitoes detailed for the operation on to the target, and five of them completely demolished the house with a mixed load of high explosives and incendiaries, the leader's bombs going straight in through the front door. A few bombs overshot into the German barracks beyond, but the houses on either side were intact although somewhat shaken. This operation was carried out without loss.

MEDICAL PREPARATIONS FOR 'OVERLORD'

The Principal Medical Officer's administrative staff originally consisted of:

1 Group Captain	Principal Medical Officer (P.M.O.)
3 Wing Commanders	Deputy Principal Medical Officer (D.P.M.O.) Flying Personnel Medical Officer (F.P.M.O.) Inspecting Dental Officer (I.D.O.)

In November 1943, the Principal Medical Officer's appointment was upgraded to the rank of air commodore, and in January, a group captain was added to the establishment as D.P.M.O. (Hygiene). It was unusual for the D.P.M.O. (H) to be established in a rank senior to that of the D.P.M.O., but it was considered justifiable on account of the Command's mobility.

After D-day it was found necessary to add a wing commander to the Advance Command Headquarters, for casualty air evacuation duties, and a medical quartermaster and a flight lieutenant to assist the D.P.M.O. at Rear Headquarters.

The three Group Headquarters were each established with a wing commander as Senior Medical Officer, and a flight lieutenant as Deputy Senior Medical Officer. Headquarters No. 85 Group, forming outside the Command directly under Allied Expeditionary Air Force, had a group captain as Senior Medical Officer and a squadron leader as Deputy, and after the campaign started Nos. 83 and 84 Groups had similar establishments.

When the Command and Group Headquarters split into Advanced (Operational) and Rear (Administrative) Headquarters, it was found essential for the Principal Medical Officer and the Group Senior Medical Officers to be with the Advanced Headquarters in order to keep in touch with the rapidly changing operational picture and moves of units, which called for medical arrangements liable to be overlooked by the Air Staff.

The Headquarters of the Command and of Nos. 83 and 84 Groups, were always situated close to the Headquarters of 21st Army Group,

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2nd British and 1st Canadian Armies respectively, and the R.A.F. Principal Medical Officer and Senior Medical Officers and their staffs maintained very close liaison with the officers holding similar appointments in the Army formations.

The medical staff officers maintained contact with all units by frequent visits, after which they reported verbally to the Principal Medical Officer. Written reports of visits were only made when items of unusual interest arose. At the end of each month the Principal Medical Officer, Deputy Principal Medical Officer (H), Flying Personnel Medical Officer, Inspecting Dental Officer and the Group Senior Medical Officers wrote reports, of which copies were forwarded to the Director-General of Medical Services, Air Ministry. The Deputy Principal Medical Officer (H) found these reports of great value when he came to write the Annual Health Report at the end of the year.

The Medical and Dental Administrative Instructions were re-written before D-day to include all past relevant policy letters, and entitled 'Second Tactical Air Force Medical and Dental Procedure Overseas'; henceforward letters were only written to units on matters relevant to the individual unit. Correspondence on subjects of interest to all units was handed by members of the air staff to the Deputy Principal Medical Officer, who, at intervals which varied according to the urgency and number of articles, produced a 'Routine Medical Directive' for circulation. Each Directive had a serial number and date of issue, and the paragraphs were numbered to follow those of the previous directives. When an Air Ministry letter was included, the date and reference was quoted. Units were instructed to keep these directives in a loose-leaf folder and maintain an up-to-date index. Medical officers appreciated this arrangement because it gave them a readily accessible source of reference, and considerably reduced the number of files they had to carry on their many moves.

The Principal Medical Officer, Deputy Principal Medical Officer (H), Flying Personnel Medical Officer, Inspecting Dental Officer, the Senior Medical Officers of the Groups and selected officers from the hospitals attended the Combined Operations Course at Largs, at which instructors from three Services explained in detail the methods of assaulting the beach-head and the problems likely to be encountered.

MEDICAL ASPECTS OF AIRCREW TRAINING

Night vision testing was carried out by teams of orthoptists on all aircrew personnel in No. 2 Group and No. 34 Reconnaissance Wing who had not already been tested, and those who did not obtain a satisfactory score were posted to other units. It was decided that it was not necessary to test the pilots in Nos. 83 and 84 Groups. The aircrew personnel of No. 2 Group attended the 3-day night vision courses at Royal Air Force

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PLATE XLIX: A Field Dispensary

PLATE L: Assembling a Large Field Kitchen suitable for a Field Hospital. Improvised Flues are made out of Vegetable Tins and the whole carefully camouflaged

[facing p. 624

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PLATE LI: Airman learning to cook for a Small Formation on an Improvised Oven

PLATE LII: Mass Inoculation and Vaccination of Second Tactical Air Force Personnel prior to D-day

facing p. 625]

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Station, Bicester, until a Group Support Unit was formed, when arrangements were made for night vision training there.

The aircrew of Reconnaissance Squadrons were all tested three times in a mobile decompression chamber to the equivalent height of 37,000 ft. for two hours, with at least one day between each test. Sixty-nine per cent. passed; the 31 per cent. who failed were posted to other squadrons. The failures were due to:

Central (C.N.S.) bends .	7·46 per cent.
Severe (Joints) bends .	68·66 „ „
Persistent mild bends .	17·91 „ „
Persistent gas expansion	Nil
Otitic barotrauma .	1·49 „ „
Severe sinus pains .	1·49 „ „
Miscellaneous . .	2·99 „ „

LECTURES AND FILMS

It was possible for medical officers and flying personnel medical officers to arrange both lectures and films on days when the weather was too bad for flying. The purpose of the lectures was to refresh members of aircrew in the medical aspects of their job and also to give all personnel some idea of the type of medical and field problems that might be encountered in the imminent campaign; for it must be remembered that many of the younger members of the Force had never before left England and were ignorant of even the simpler aspects of field sanitation and personal hygiene abroad. The following lectures were arranged :

(*a*) First Aid and the use of the 'Personal First-aid Pack'.
(*b*) Effects of Altitude—including care of the ears, nasal sinuses, prevention of frostbite, use of oxygen.
(*c*) Flying Clothing.
(*d*) Effects of Gravity and the Sutton Harness.
(*e*) Survival during escape and on ditching.
(*f*) Venereal Disease.
(*g*) Personal Hygiene.

Films were shown on:

(*a*) Oxygen.
(*b*) Gravity.
(*c*) Night Vision.
(*d*) Sanitation in the Field.
(*e*) The Louse.
(*f*) Venereal Disease.

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USE OF THE FRANKS FLYING SUIT

In April and May 1944 one of the Spitfire IX Wings carried out trials of the Franks Flying Suit, Mk. III,* to determine whether this Anti-'G' suit was practicable for use by Tactical Air Force fighter pilots under mobile airfield conditions.

Sixty-six experienced fighter pilots, after careful briefing, were given pre-operational practice flying in the suit and an assessment was made on the degree of protection afforded against the onset of symptoms due to 'G' (grey out and blackout). It was found that the average blackout threshold of 53 pilots was raised so that 83 per cent. of them successfully withstood 6·5 'G' without blacking out.

Twenty-four pilots then used the Franks Flying Suit on 36 dive-bombing sorties over enemy territory. It was not used on any but dive-bombing sorties because most of the pilots felt they wanted to avoid meeting enemy aircraft while wearing the suit owing to the restriction it placed on searching behind. The clumsiness of the suit on the ground and the difficulties of servicing and maintenance under field conditions were two further disadvantages and the conclusion was reached that although the use of the suit raised the blackout threshold, this advantage was outweighed by the disadvantages in the air and on the ground; it was decided that it was not practicable for general use in Second Tactical Air Force.

Another interesting research was carried out in the field during the invasion period on fighter pilots, who had recently suffered from gastro-enteritis, and it was discovered that the effects of this condition could be shown to lower resistance to 'G' some three or four days after apparent clinical recovery.

TRAINING OF MEDICAL PERSONNEL

A number of courses of a very intensive nature were organised for medical officers in the Command during 1943–4 and every officer contrived to attend at least two of the courses. It was felt that such courses would assist considerably by showing the specific application of medicine and surgery in the field to the problems of the Royal Air Force. The courses were:

(*a*) Treatment of burns.
(*b*) Anaesthetics.
(*c*) War Surgery.
(*d*) Aviation Medicine.
(*e*) Orthopaedics.
(*f*) Venereal disease.
(*g*) War Gases.

* The principle was that of having a 'water jacket' surrounding the lower part of the body to offer a peripheral resistance to blood that was forced into the legs by gravity. The suit was made of double skinned non-extensible rubberised fabric, the cavity thus formed being filled with water through a central nozzle.

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Similarly courses were organised for selected key medical orderlies as follows:

(*a*) 14 day course in station sick quarters administration.
(*b*) 7 day course on the water tender.
(*c*) 21 day course in Field Sanitation and Hygiene.

The last two courses were specially designed for the needs of Second Tactical Air Force, and the Officer Commanding, who was a man of considerable experience, informed the Principal Medical Officer that he had never met airmen so keen and eager to learn as those who attended them. During this period unit medical officers concentrated on training their nursing orderlies at every opportunity; naturally, the amount of training given in each sick quarters varied with the individual medical officer's drive and ability, but on the whole the standard was high and the majority of medical officers did their best to get their staffs fully trained before D-day.

The Mobile Field Hospitals and Casualty Air Evacuation Units, like all other formations in the Command, had to train their personnel in rapid movement by day and night, embarking and disembarking, etc., in addition to their technical training.

TRAINING PROGRAMME IN A MOBILE FIELD HOSPITAL

The Mobile Field Hospitals, once formed, accepted patients, but they occasionally closed down for several weeks for training. No. 50 Mobile Field Hospital, for instance, was located at Fontwell Race Course near Chichester, when it closed down for training at the end of December 1943. The unit's Form 540 (on which the history of events was recorded) dated January 1, 1944 gives an outline of the training programme and preparations:

(*a*) Complete tent maintenance and camouflage.
(*b*) Complete mechanical transport training—individual driving instruction, convoy work (night and day) and embarkation practice in tank landing craft.
(*c*) Physical training—football, assault course, etc.
(*d*) Reception scheme—practice in receiving up to 30 cases at once.
(*e*) Stretcher-bearer instruction—aircrafthands and mechanical transport personnel.
(*f*) Visits to neighbouring Army medical units.
(*g*) Practice in pitching and striking tentage—trying various 'pack-ups'.
(*h*) Chemical warfare scheme.
(*i*) Security.
(*j*) Aircraft recognition.
(*k*) Complete courses for medical personnel in medical and other subjects.
(*l*) Camouflage.
(*m*) Complete inoculations and vaccinations of all personnel.

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(*n*) Bringing stores and personnel up to 100 per cent. readiness.
(*o*) Training selected personnel in water and sanitary duties.
(*p*) Blood grouping of all personnel.

As mechanical transport drivers were not established for all the vehicles in Second Tactical Air Force, officers and airmen of other trades were trained as 'B' Class drivers.

The disembarking of vehicles through water from landing craft and down ramps was practised, using artificial lakes for the purpose.

It was left to the discretion of the Commanding Officers of Mobile Field Hospitals whether to conceal and camouflage their camps or site them in the open and display a 30-ft. Geneva Cross on the ground.

TRAINING IN CASUALTY AIR EVACUATION (EXERCISE 'SHUTTLE')

The Casualty Air Evacuation Units practised loading, unloading and documentation of patients and arrangements were made with Transport Command for the Sparrow aircraft which were to operate the forward shuttle to visit all Second Tactical Air Force airfields, in order that the medical personnel could be given practical instruction in the loading and unloading of these aircraft.

On May 23, 1944, Exercise 'Shuttle', a live exercise in the evacuation of casualties, was carried out, all the patients in No. 52 (R.C.A.F.) Mobile Field Hospital being transported by road to an airfield where No. 5 Casualty Air Evacuation Unit was in position to receive them and transfer them by air to Royal Air Force Hospital, Wroughton.

FIELD SANITATION AND HYGIENE

Accommodation. Sleeping accommodation in the field consisted of 160 lb. single ridge tents with fly-sheets, each of which was intended to house 12 men, but was found in practice to be suitable for only 8, this number seldom being exceeded. A straw-filled palliasse and four blankets were issued to each man (though most men managed to acquire extra blankets); the airmen were encouraged to improvise beds and displayed much ingenuity in their construction. While in winter quarters in England from the end of October 1943 until April 1944, the men lived as lodger units on permanent and semi-permanent stations.

Heating. Heating in the tents was chiefly by various portable stoves, a method not entirely satisfactory in these conditions. Some units heated their mess tents by means of a fire outside with ducts made of tins dug into the floor of the tents. Hydra-burners used for cooking proved excellent if given regular maintenance, though they were extravagant in petrol fuel.

Disinfection. All sick quarters carried one portable box type disinfector, while units of a strength of over 400 and the Mobile Field Hospitals had in addition a large portable disinfector. It was intended

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to use the large disinfectors for the disinfection and disinfestation of blankets, in view of the reports which had been received of large numbers of cases of typhus among displaced persons on the Continent; in practice however, they proved to be unnecessary, because anti-louse powder containing 5 per cent. D.D.T. became available shortly after the move to Normandy, and the units managed to get the blankets washed by the Army Mobile or civil laundries. The large disinfectors were bulky, heavy and difficult to load on to the lorries and in the interests of rapid movement many were left behind on the airfields in France.

Laundry. There were no Royal Air Force laundries in the field, and the number of Army Mobile Laundries was insufficient to cater entirely for the other Services; airmen were therefore issued with an extra 4 oz. of soap per week to do their own washing, but this was not a very satisfactory arrangement and much difficulty was experienced in drying the clothes owing to the camouflage restrictions. In practice most of the airmen made private arrangements with nearby householders, who were pleased to carry out the tasks for a small remuneration.

Ablutions. The ablution facilities on static stations were satisfactory, but in many instances placed too far away from the dispersed sleeping sites to encourage cleanliness.

For use in the field many of the large units were issued with mobile bathing apparatus which provided good hot showers, but was rather bulky. Other units improvised showers, the best of which was the one produced by No. 55 Mobile Field Hospital (*see* Figs. 1 and 2); this was built into a 3-ton lorry, and had the advantage of taking up very little room when the unit was on the move.

The most popular method of producing hot water for washing was the 'Lazy Man's Boiler', made from a 50-gallon oil drum on its side with a fire or hydra-burner underneath. The exit pipe was a few inches from the top and the inlet pipe was carried down to the bottom side of the drum so that hot water could only be obtained by pouring a corresponding amount of cold water into the inlet pipe; this ensured that the boiler was never empty. The boilers were well lagged with sods of earth, and when heated last thing at night produced hot shaving and washing water first thing next morning.

Water Supplies. All water was filtered and treated with two parts per million of chloramine. The majority of the water tenders were 350 gallon Bedfords with a few 200-gallon tenders. It was thought that they would all have been improved if fitted with a four wheel drive, as in wet weather such heavy vehicles were easily bogged. Furthermore, many of them were not fitted with mechanical pumps, and it therefore took two men approximately one and a half hours using the hand pump to fill the 350-gallon Bedford. However, this rarely caused any trouble because

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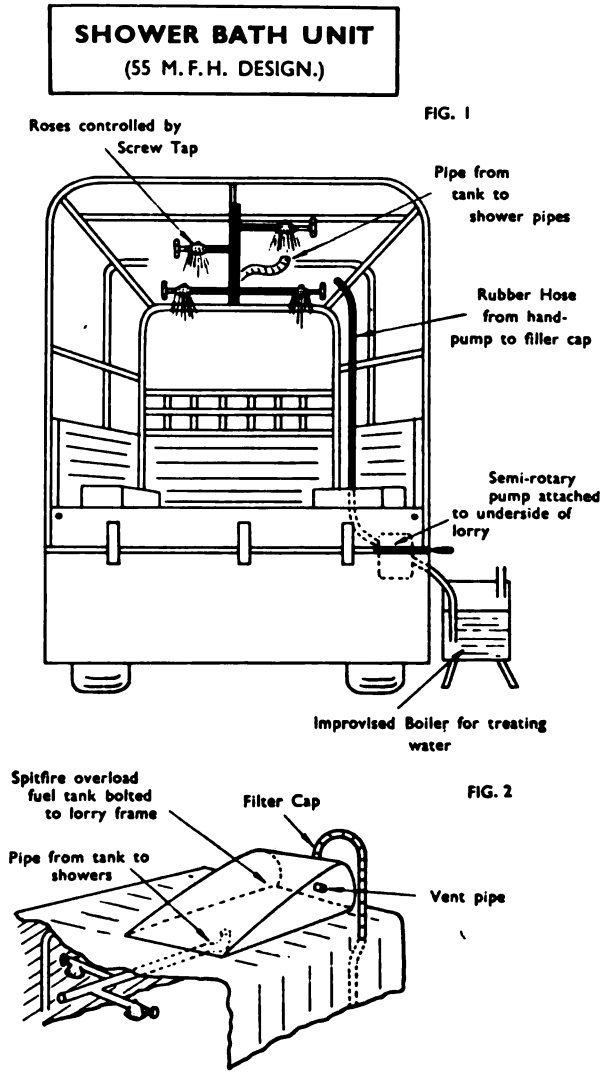

FIGS. 1 and 2. Shower Bath Unit.

in England the tenders were filled from the nearest piped supply and the chloramination done by hand, and on the Continent the Army water points with Patterson's Water Purification Sets gave excellent service, and pumped filtered and chloraminated water direct into tenders at the rate of 3,000 gallons an hour.

As an emergency measure all officers and airmen were issued with an individual water sterilizing outfit, with full instructions for its use.

Messing. Before D-day all units were drawing the normal home scale of rations, which was considerably more generous than the civilian

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ration, and on the whole the standard of messing was high, though there were many variations due to the individual skill and enterprise of unit cooks (*see* Plates L and LI). Aircrew drew the same extra rations as in other Commands.

Food storage in the field was a matter of some difficulty, and the flimsy portable food safes soon became damaged and functioned more as fly traps than as a protection. It was felt that there was a real need for a special tender for food storage fitted with well made fly-proof larders and a built-in refrigerator; had it been possible to supply such tenders they might well have reduced the extensive outbreak of dysentery which occurred on the beach-head in August 1944.

Sewage Disposal. Latrine buckets with fly-proof seats were issued to all units, and authority was obtained for airfields where dispersal was very great to draw buckets and seats in excess of the approved scale. The contents were emptied into nearby manholes if this was acceptable to the local sanitary officer, or alternatively Otway pits were constructed. A few units constructed deep trench latrines, but it was found that the necessary superstructure was too heavy and bulky to carry on moves, and the amateur carpenters had difficulty in making them fly-proof owing to the inevitable hard usage. Urine soakage pits were used whenever it was found necessary.

The Royal Engineers had 'pack-ups' of wooden framework for the rapid construction of latrine shelters, which they built for a small proportion of Royal Air Force units; these were, however, unsatisfactory, as after being erected several times they became damaged and useless.

Swill and Refuse. Swill was sold to local farmers whenever practicable. Swill bins were not included in the scale of mobile equipment but were easily improvised from used oil drums. This was not a very satisfactory arrangement, however, and it was felt that bins of sturdy construction with lids one inch greater in diameter than the bins, and made in graduated sizes to enable them to be packed in 'nests' of six, would have been a great improvement. Refuse was salvaged, burnt or buried as the situation demanded.

Hours of Work. The working day for men not engaged on operations or shift work was from 08.00 hours to 20.00 hours with one day off in seven, staggering being used to avoid any department closing down for a complete day. In the late Spring of 1944 it was discovered that on some units several officers and airmen had not taken a day off for many weeks, and in some instances months, and it was necessary to instruct heads of sections to ensure that personnel under their command did take one day off a week.

Recreational Facilities. There was a well qualified staff of the Welfare branch at Command and Group Headquarters. All units had some form of cinema and those of sufficient size were visited by E.N.S.A.

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Games were arranged whenever possible and some units were able to use recreational facilities at the nearest Royal Air Force Station. Organised physical training parades were not held as it was considered that sufficient exercise was obtained by the walking necessitated by the widely dispersed sites.

VACCINATION AND INOCULATION

It was of the utmost importance that every member of the Force should be adequately protected against the likely epidemic diseases. (Plate LII illustrates mass inoculation being carried out in the field.) Every effort was made to see that vaccination and inoculation states were up to the prescribed standards and the following extract taken from the directive entitled 'Second Tactical Air Force Medical and Dental Procedure Overseas' shows the policy of the Command:

'(*a*) *T.A.B.C.* .	Initial protection by two doses of 0·25 cc. and 0·5 cc. (0·2 cc. and 0·4 cc. for women). Interval between doses not less than fourteen days and preferably three weeks. Annual re-inoculation 0·25 cc. (0·2 cc. for women).
(*b*) *A.T.T.* .	Initial protection by two doses of 1 cc. with a period of six weeks between doses. Annual re-inoculation 1 cc.
(*c*) *Typhus Vaccine*	Initial protection as recommended by the manufacturers, usually 3 doses of 1 cc. with 3 weeks' interval between each dose. Reinforcing dose 1 cc. three months after initial protection, and further doses of 1 cc. when called for in Second Tactical Air Force Medical Directives.
(*d*) *Vaccination* .	Successful vaccination once every three years or proven insusceptibility. Instructions for more frequent vaccination will be issued in Second Tactical Air Force Medical Directives if units are operating in localities where smallpox is present.'

GENERAL HEALTH OF THE COMMAND

The general health of the Command was very satisfactory, the average incidence of sickness for the period July 1943 to May 1944 inclusive being 348·54 per 1,000 per annum. It should be realised that this figure was a very low one in view of the fact that all the Command personnel at some time or other spent a considerable period under canvas and were initially inexperienced in camp craft.

The morale among the aircrew of the Command was high as was evinced by the very small occurrence of psychological and allied

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disorders. During the year July 1, 1943, to June 30, 1944, No. 2 Group carried out 14,532 sorties with 136 (9·4 per 1,000 sorties) casualties. During this period only 46 aircrew personnel (3·1 per 1,000) were taken off flying for the following causes:

(*a*) 9 aircrew as confirmed cases of 'Lack of moral fibre' (0·6 per 1,000).

(*b*) 5 aircrew as borderline cases where there was a doubt between true medical and psychological explanations (0·3 per 1,000).

(*c*) 32 aircrew as cases of neurosis, flying stress etc. (2·2 per 1,000).

INFECTIOUS DISEASES

There was a small epidemic of a mild form of influenza during November and December 1943, involving 1,031 cases of which few required hospitalisation.

During May 1944 there was an outbreak of 45 cases of *Sonné* dysentery on one of the airfield units living under canvas; this was controlled when there was a 'general tightening up' of camp hygiene, including siting the cooks' latrines in a position where they could be seen by the N.C.O. in charge of the cookhouse, who was instructed to take disciplinary action against any member of his staff who, after using the latrine, failed to wash his hands and rinse them in a weak solution of lysol provided on a table placed outside the latrine. The outbreak was finally traced (by means of rectal swabs) to two airmen employed in the kitchen who were found to be carriers. Unfortunately the laboratory reports were delayed for some weeks, during which time the carriers continued to work in the kitchen, but it is of interest to note that they did not apparently cause any fresh cases; this emphasises the efficiency of and necessity for simple hygiene measures.

VENEREAL DISEASE

The incidence of venereal diseases during the period July 1943 to May 1944 inclusive was 6·96 per 1,000 per annum. This figure included a large number of cases among Allied personnel, for whom the rate was 32·67 per 1,000 per annum; the British and Canadian incidence was 4·24 per 1,000 per annum. Intelligence reports indicated that there was a very high incidence of V.D. on the Continent and that the modern drugs necessary for the treatment of this disease were not available to the civil population in German occupied countries. This information and the likelihood of numerous cases occurring were supported by the fact that two men taking part in the Dieppe raid in August 1942 found time to become infected, though the raid lasted for only nine hours!

The A.O.C. in C. realised the vital need for commanding officers to be alive to the importance of the subject and instructed all unit commanders to arrange for suitable lectures to be given to all officers

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and airmen. The policy for the prevention and treatment of venereal disease was included in the 'Second Tactical Air Force Medical and Dental Procedure Overseas' directive, from which an extract is given below:

'(*a*) All officers are to be instructed in their responsibilities concerning the welfare of airmen under their command, and in addition to routine lectures by medical officers, commanding officers will address their men on this subject.

(*b*) Every effort will be made to increase facilities for healthy entertainment and games.

(*c*) All brothels will be placed out of bounds and such restrictions rigidly enforced.

(*d*) Officers and airmen are to be kept informed of the prevalence of venereal disease in districts in which they are stationed. This information can be obtained from the local civil medical authorities.

(*e*) The position of the P.A.Cs. in the district is to be posted on unit notice boards, and also the fact that additional rubber sheaths can be obtained at the P.A.Cs. [Prophylactic Ablution Centres].

(*f*) Prophylactic Treatment Rooms are to be maintained on all units and rubber sheaths are to be made available to all ranks in such a manner that officers and airmen can help themselves without embarrassment. On no account is there to be any compulsory issue of rubber sheaths.

(*g*) Groups are required to show in list form monthly the names of units and the number of venereal cases where they consider that such cases are excessive.

Treatment Policy

(*a*) All cases of venereal disease will be admitted for treatment to the nearest mobile field hospital, Royal Air Force General Hospital or Army V.D. treatment centre.

(*b*) Cases which are not responding satisfactorily are to be transferred to a Royal Air Force General Hospital at the earliest opportunity.

(*c*) The weekly surveillance of gonorrhoea and urethritis will be carried out by the unit medical officers and tests for cure will be made at mobile field hospitals, Royal Air Force General Hospitals or Army V.D. treatment centres.

(*d*) The surveillance or continuation treatment of syphilis is to be carried out at the nearest mobile field hospital, Royal Air Force General Hospital or Army V.D. treatment centre.

(*e*) Laboratory investigations beyond the capacity of mobile field hospitals are to be passed to the Royal Air Force General Hospital or Army establishment as notified in Second Tactical Air Force Medical Directives from time to time.'

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APPENDIX

The following division of responsibility for services affecting the medical branch was agreed between the Air Ministry and the War Office:

Army	R.A.F.
(i) *General arrangements for sick and casualties*	
(*a*) Full responsibility back from casualty clearing station, including provision of casualty clearing station ambulances (except air ambulances), hospitalisation and field bacteriological and hygiene sections as necessary, but not including provision of special drugs equipment not contained in A.F.I. 1248 (list of medical stores and equipment).	(*a*) Full responsibility forward of Army casualty clearing stations. (*b*) Supply of medical stores peculiar to the R.A.F. (*c*) Provision of R.A.F. hospitals in established theatres when required.
(ii) *Air evacuation of sick and casualties*	
(*a*) Transport of casualties to the special R.A.F. mobile field hospitals or sick quarters at or near airfields used for the evacuation of casualties by air. (*b*) Transport of casualties from airfield after deplaning to Army medical units.	(*a*) Full responsibility for the treatment of casualties from admission to R.A.F.mobile field hospitals and/or sick quarters or casualty air evacuation units on or near airfields used for emplaning of casualties until deplaning and despatch from the airfield of arrival. This responsibility will include the provision of special R.A.F. mobile field hospitals at or near the airfields of departure and arrival, and the final decision as to the suitability of casualties for air evacuation. (*b*) Notification to Army of arrival of casualties to allow for the provision of ambulance transport as required.

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APPENDIX (cont.)

	Army	R.A.F
(iii) *Water*	Full responsibility for establishment of water points and for provision of bulk water installations, including bulk storage and decision as to consumption rates. Carriage of water for Army units from water points.	Carriage of water to R.A.F. units from water points.
(iv) *Water purification*	(*a*) Units, full responsibility. (*b*) Bulk, full responsibility. (*c*) Food analysis, full responsibility.	(*a*) Units, full responsibility. (*b*) Bulk, nil. (*c*) Food analysis, nil.
(v) *Identification of poison by Units*	Full responsibility.	Full responsibility.
(vi) *Sanitation*	(*a*) Units, full responsibility. (*b*) Field Hygiene Section, full responsibility.	(*a*) Units, full responsibility. (*b*) Field Hygiene Section, full responsibility when on loan to R.A.F.
(vii) *Malaria*	(*a*) Unit area,within one mile, full responsibility. (*b*) At a greater distance, full responsibility.	(*a*) Unit area, within one mile, full responsibility. (*b*) At a greater distance, nil.
(viii) *Disinfection*	(*a*) Units, full responsibility. (*b*) Centres outside units, full responsibility.	(*a*) Units, full responsibility. (*b*) Centres outside units, nil.
(ix) *Inoculation*	(*a*) Unit, full responsibility. (*b*) Provision of vaccine overseas, full responsibility.	(*a*) Unit, full responsibility. (*b*) Provision of vaccine overseas, nil.
(x) *Recommendations concerning rations.*	(*a*) Full responsibility.	(*a*) Full responsibility.
(xi) *Blood transfusions, fluids, and equipment*	(*a*) Full responsibility.	(*a*) Full responsibility.

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CHAPTER 11

No. 60 GROUP

Radar

TECHNICAL apparatus and administrative procedure are not described in this account, except where this is necessary for the appreciation of aspects of medical interest and to give meaning to the many medical problems which arose both before and after the formation of No. 60 Group.

The account is divided into three sections: a general narrative giving the history of Radar and expansion of No. 60 Group with descriptions of representative stations; a description of the general medical arrangements and administration before and after the Group's formation; and a medical commentary in which the medical problems of the Group are discussed.

GENERAL NARRATIVE

The development of two very different processes began in 1935: one, in Germany, the organising and equipping of a large offensive army and the other, in England, the research into certain properties of wireless waves. The first could not be kept secret and in fact it was part of a determined policy not to keep it so, but the second was guarded with every possible precaution. Two of the results of these processes were the establishment of a large and dangerous German air force and the development by Great Britain of means of locating units of that force approaching or in action over this country. At the time of the Battle of Britain it was impossible to make public the secrets which this country so fortunately possessed, but since that time it has been admitted on all sides that, after honour has been given to pilots, ground personnel and manufacturers of aircraft, the battle could not have been successfully fought without the enormous tactical advantage which was put into the hands of the smaller British air force by the intercepter technique.

The discoveries and developments of the period between 1935 and 1938 were themselves an extension of the great advances during the War of 1914–18. From 1918 to 1935 research was continued steadily and its benefits were felt mostly in peaceful pursuits; wireless sets were soon to be found in many households and further advances were continually expected.

The Air Ministry realised at the same time that the military use of aircraft had completely altered the strategy and tactics of the defence of

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Great Britain. The Navy was still considered the major bulwark against attack, but a few far-sighted men realised that aircraft were to make such progress that, unless some new system of warning against enemy attack was introduced, the interception of hostile aircraft, which had hitherto depended upon sight and sound, would become very difficult and in many instances impossible. It was natural, therefore, that these authorities, and the Air Ministry in particular, should be very interested when the investigations in hand showed that it might be possible to use wireless waves to secure adequate warning of the approach of hostile aircraft.

EARLY EXPERIMENTS IN RADIOLOCATION, 1936–37

The first experimental demonstrations were carried out in 1935; they had an immediate success, although many technical shortcomings of the apparatus were shown at the same time. By 1937 it was thought that enough progress had been made to start limited trials and four radiolocation stations were proposed and erected. These stations were called Air Ministry Experimental Stations (A.M.E.S.) and they were controlled technically by Air Ministry through Fighter Command. All the stations contained similar equipment, though the apparatus was mobile to a certain degree at one station. Each station was manned and maintained by civilian specialists except for half a dozen picked airmen. Two separate wooden buildings were constructed to hold the receiving and transmitting equipment of each station, but all personnel were housed and fed in billets. The security of each station was in the hands of two Air Ministry wardens. The trials were successful and a chain of such stations covering the eastern and southern approaches to Great Britain was approved, their construction being spread over the next few years.

Stations formed in 1938–9. New stations were built rapidly during 1938 and 1939, while the international situation steadily deteriorated. They were always sited to provide the necessary radar cover, though if possible any concessions to local amenities were accepted when the sites were initially chosen, provided that these did not interfere with the operational function of the stations. Many stations, however, were located in singularly isolated positions well away from any habitation, building or even made-up road.

Each station was placed for administration under a Royal Air Force Station, which was frequently a considerable distance away and might itself be administered by any of the Royal Air Force Commands.* The co-operation between the personnel of the A.M.E.Ss. and those of the

* This created an invidious situation in which the commanding officer of the parent station was often too far away to be able to exercise the supervision which was his responsibility.

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parent stations was satisfactory on the whole if tact was used on both sides; however, the security standards of the A.M.E.Ss. were so strict that neither commanding officers nor the senior signals officers of parent stations were allowed inside the technical buildings. Demands for technical stores and equipment, as well as the normal demands made by any unit, were made through the parent station.

FORMATION OF NO. 60 GROUP

The organisation had grown so large by the beginning of 1940, that the stations could only with great difficulty be maintained technically by Fighter Command Headquarters. To overcome this, authority was given in February, 1940 for the formation of No. 60 Group, to take over the technical maintenance of the stations then in existence and control of the Base Maintenance Headquarters, the Training Centre, No. 2 Installation Unit and the Special Calibration Unit and Flight at Martlesham. The Air Ministry continued to control the technical policy regarding developments, modifications, equipment, training and personnel. Fighter Command remained entirely responsible for all radar operations and raid reporting, security, defence and works and accounting services. Liaison between Air Ministry, the War Office and the commands overseas was a No. 60 Group responsibility under the control of the Air Ministry.

The personnel continued to be administered by parent stations after the formation of the Group, but the position by then was not as satisfactory as it had been, because officers at parent stations were even more tied to their own R.A.F. station responsibilities in connexion with their flying operations and technical and domestic administration. Difficulties arose chiefly over administrative and technical matters, as officers at No. 60 Group Headquarters had no method of ensuring that any necessary improvements or modifications on their stations were carried out, other than by the usual channels of communication between commands.

The programme for increasing the number of A.M.E.Ss. along the west coast of Great Britain had been intended to occupy two or three years, but when France collapsed and the invasion of England seemed imminent, the need for new stations became imperative. Thus construction of Air Ministry Experimental Stations was given top priority and the personnel on many Royal Air Force stations suddenly found themselves responsible for units at which the technical blocks were the only completed buildings.

At this time the Group administration, which had always been difficult, was found to be over-cumbersome. Proposals were put forward by the administrative and technical sections to increase Group control over the stations, and plans were made to form Radio Servicing Sections

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(R.S.S.) for technical maintenance, so that demands for and care of special equipment could be carried out from a centrally placed unit through the regional Radio Servicing Sections. These proposals were accepted and in July 1940 eight Radio Servicing Sections were sited at Wick, Dyce, Usworth, Church Fenton, Duxford, Biggin Hill, Filton and Speke and numbered 1 to 8 in that order.

REORGANISATION FOLLOWING THE BATTLE OF BRITAIN

The Battle of Britain began soon after the formation of the radio servicing sections; fortunately it was possible to use many of the incomplete Air Ministry Experimental Stations in the battle, but the need for more was clearly apparent and by January 1941, No. 60 Group had expanded to nearly three times its size on formation. Much had been learned from 'the Battle' and modifications of the equipment were being continually carried out, but it was soon realised that these modifications and the general growth of the organisation placed too great a burden on the radio servicing sections, although the system had worked well during the last half of 1940.

A new plan was produced early in the year whereby what was best in the old organisation could be retained without any limitations of size. It was decided that the whole administration of the stations should be made the responsibility of No. 60 Group and to this end the radio servicing sections were converted into Signals Wings in February 1941; from this time on parent stations ceased to have administrative control in relation to the Group's stations, although they continued to provide certain essential services and facilities, e.g., Medical, Rations, Works, Fuel, P.O.L., etc. Two more wings were added to the original eight during 1941, one in June and the other in September. Wings were not necessarily sited in those areas where the radio servicing sections had existed; instead wing headquarters were set up at convenient centres in the areas to be administered. A special wing, No. 79, was established in Northern Ireland with headquarters at Portadown, to meet the needs of all authorities concerned with the 'Battle of the Atlantic' which was in a critical phase at that time. (*See* Map 1.)

Group administration was soon firmly established and it proved satisfactory in all respects. It was not found necessary to alter the policy laid down at the time the wings were formed, although establishments at wing headquarters grew as the number of stations increased, and at stations as the extra equipment and personnel to operate it were added. The 'Battle of the Atlantic' reached a more favourable phase in the summer of 1942 and the commitments of the stations in Northern Ireland consequently decreased; it then became possible to re-organise the wing areas on a more economical basis, and on August 1, 1943, the following changes were put into effect. Numbers 71, 74, 76

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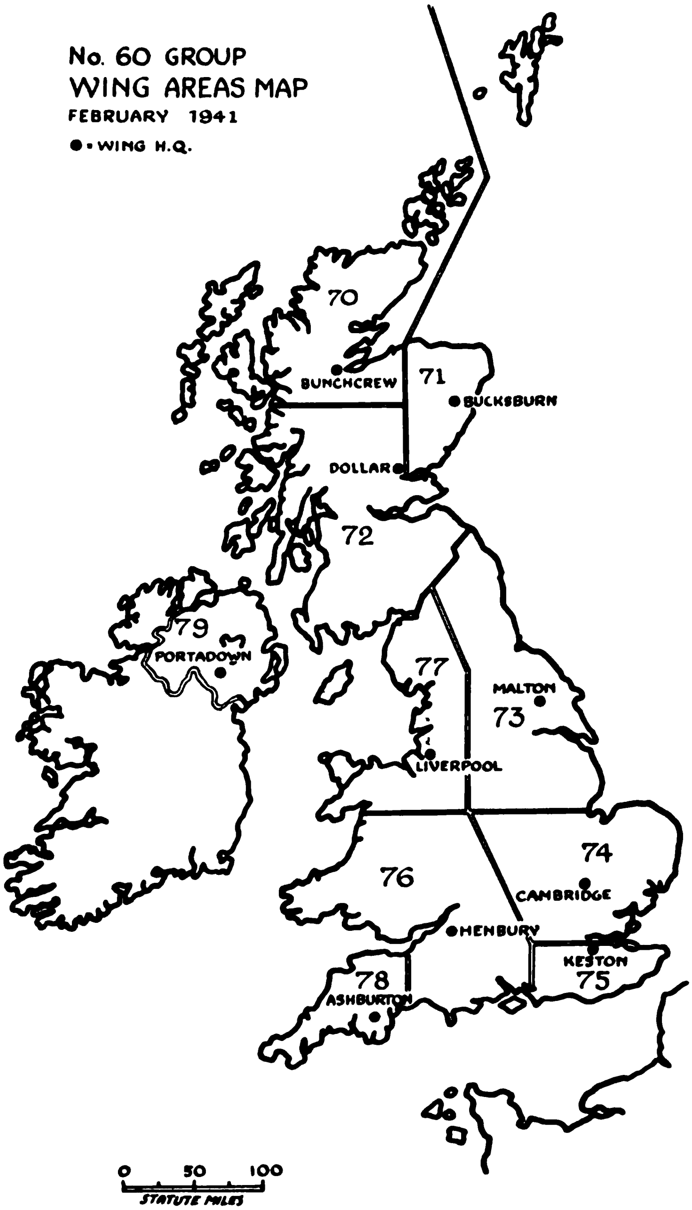

MAP 1. No. 60 Group Wing Areas. February 1941.

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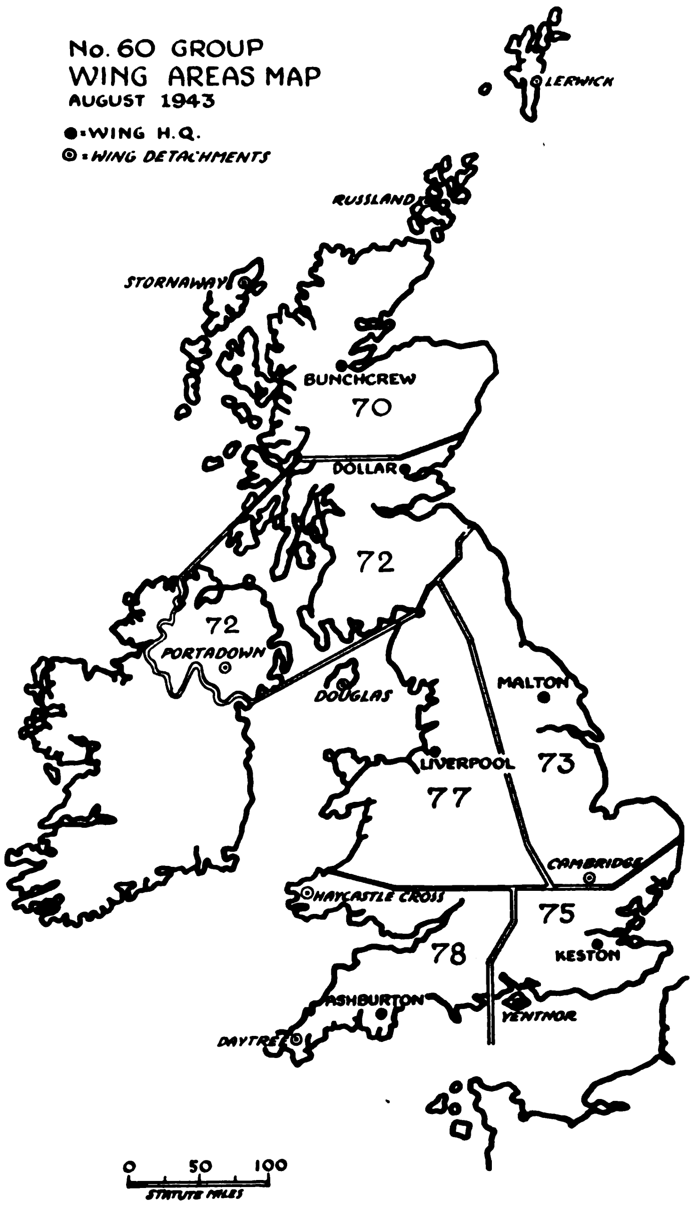

MAP 2. No. 60 Group Wing Areas. August 1943.

and 79 Wings were disbanded and the wing areas distributed among the remaining six. Wing detachments were set up in places where local geography demanded some administrative centre nearer a number of stations than the wing headquarters. (*See* Map 2.)

TYPES OF AIR MINISTRY EXPERIMENTAL STATIONS

Air Ministry Experimental Stations were of varying types according to their different functions, but medical problems arose more from their wide geographical distribution, which included some of the wildest areas in the British Isles, and the consequent accommodation, sanitation and welfare difficulties, than from the specialised nature of the work carried out. Nevertheless the latter did give rise to certain troubles which will be discussed later in the narrative.

The technical equipment and the buildings housing it varied, but there were characteristics shared by all stations. These will be described generally.

Defence of A.M.E. Stations. Air Ministry Experimental Stations were small with establishments of between 50 and 150 personnel, depending upon the size and type of equipment. Except on the very isolated and bleak stations in the Scottish Islands and North Scotland, the substitution of airwomen for airmen had progressed steadily since the formation of No. 60 Group, and at the end of 1943 radar operators at a large number of stations were all airwomen. A small defence force was attached to each station. The defence of A.M.E.Ss. was at the beginning of the war a Home Guard commitment and local commanders decided on the size of the force that they thought essential. In many instances far larger forces were employed than were necessary, with consequent overcrowding of accommodation. The guard consisted of Army personnel in 1940 but replacement with personnel of the Royal Air Force Regiment proceeded steadily, and at the end of 1943 no Army personnel were left in the Group except on four stations in the outer Scottish Islands. The average number of men in each defence contingent was 30; they were responsible for guarding the station against ground and air attack and were armed with rifles, light machine guns and 20 mm. Hispano cannons.

It became the policy when the newer types of equipment were produced to site them, if technical requirements would allow, on or near existing stations, so that amenities could be shared. Where stations were sited in this manner a collective station name was given to the various types of station operating on the same site, though each section continued to work separately. The defence and security of such a station was naturally a more difficult task, and the defence forces often consisted of an entire squadron of the R.A.F. Regiment; the total number of personnel working at a composite station of this type might be as much as four or five hundred.

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The work of radiolocation was carried out in two specially designed buildings on the technical site; these buildings were called transmitting and receiving blocks, and their design depended upon whether the station was built before or after the Battle of Britain. Those built before were situated fairly close together, above ground and protected by double brick walls, a five-foot thick roof and a large earth rampart; those built after the Battle of Britain were more dispersed, half sunk in the ground and covered with a mound of earth. The former type was built along the east and south coasts, the latter on the west coast of Britain; owing to this geographical distribution, the two types came to be known as the east and west coast types of station. The earlier type of west coast station was larger than east coast stations, but only a few were built, the remainder being similar in size to the east coast type.

The Chain Home Station. There were between 100 and 150 personnel on a typical Chain Home (C.H.) station, excluding soldiers or members of the R.A.F. Regiment, who numbered between 30 and 60. There were two Royal Air Force and two Women's Auxiliary Air Force officers, one of the latter being an administrative officer.* Other ranks numbered from 50 to 75 airmen and 50 to 60 airwomen, of whom about 20 were radar operators. The rest of the personnel were made up of 10 to 13 aircrafthands, 8 to 10 cooks, and 4 nursing orderlies, of whom 2 were airmen and 2 airwomen; one of the male nursing orderlies was a corporal.

The distance between the various technical and domestic sites was sometimes several miles. Concrete paths were laid round the technical blocks to reduce the amount of dust and dirt carried into the buildings; this was most important because the serviceability of the equipment was seriously affected by dust. The transmitting block was divided into a main transmitting room, two or three accessory rooms containing automatic switch-gear and other equipment, a small telephone exchange, and a nearby washroom with lavatory. The floors were covered with heavy waxed linoleum and a vacuum cleaner was provided; lighting was electric, the ventilation effected by a forced feed duct system and the heating supplied by thermostatically controlled electric panels. The larger wireless valves and items of equipment which generated heat were either air or water cooled. Water from the cooling system was conducted away to a fan cooled radiator outside the building in the main blast wall and rampart. The heat from the air cooled valves was dissipated in the room. Work was carried out on a shift basis and no more than four or five persons worked at one time in the building.

The receiving block was built on a very similar plan, with the same main and accessory rooms. The receiving room was called the operations room and was usually about 18 ft. wide, 20 ft. long and 9 ft. high; it

* Non-specialist.

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contained the receiving apparatus which could be divided functionally into two parts, the receiving equipment on one side of the room and special maps, a plotting map, desks and special telephone equipment collectively called the console, on the other side. The console was used to collect, interpret and transmit the information obtained from the receiving set. The latter was a large cabinet-shaped piece of equipment, approximately 6 ft. in height, 7 ft. in length and 2 ft. in depth. A space for maintenance was left between the back of the receiver and the wall. Four to five operators worked at the equipment; one sat at the receiver and obtained grid references which were passed by telephone to two other operators called plotters, who sat in front of the plotting map at the console. Beside them one or two other operators, called tellers, collected the information plotted on the map, recorded it, then transmitted it by telephone to the filter rooms where it was sorted and sent on to the control rooms. An experienced operator, called the radar supervisor, moved between the operator at the receiver and the operator at the console, and monitored the information both when it was collected and when it was transmitted. This supervisor held commissioned rank.

The equipment was maintained during operations by one or two radar mechanics. Normally there was only one receiving set in an operations room, but when modifications and new types were introduced, two sets and an enlarged console were installed at some stations; in such circumstances up to twelve persons worked in the room at one time. Heating, lighting and ventilation was similar to that of the transmitting blocks.

The Chain Home Low Stations. The Chain Home Low (C.H.L.) station was approximately half the size of the C.H. station. The establishment varied between fifty and seventy-five, excluding the defence personnel who numbered thirty, but the percentage of airwomen employed was far higher than on a C.H. station. The commanding officer held the rank of flying officer, and although provision was made for a Women's Auxiliary Air Force administrative officer, the post was seldom filled, and her work was done by the radar supervisors in turn; a W.A.A.F. administrative warrant officer was established at such stations. There were nineteen airmen and twenty-nine airwomen at stations of average size; most of the eighteen radar operators were airwomen. The rest of the personnel consisted of five cooks, seven aircrafthands and two nursing orderlies, one W.A.A.F. corporal and one aircraftwoman.

Only at a few stations were separate technical blocks built, because the equipment was small and was operated on different principles. High aerials were not required and it was possible to place both receiving and transmitting equipment in separate rooms in a single

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building. Three types of technical buildings were used at different stages of the war; the earliest was of wood and was divided into two rooms for transmitting and receiving. Each room was 20 ft. long, 18 ft. wide and 9 ft. high. Later, strongly constructed brick buildings were erected, but in 1943 Nissen huts were built and surrounded, like the wooden huts, by a 13½ in. brick blast wall.

The operations room contained two different pieces of receiving equipment on one side of the room, and the plotters' map and tellers' equipment on the other. Five or six people worked in the operations room at one shift. Lighting was artificial, but during maintenance hours it was possible to open the windows and work in daylight. Ventilation was provided by slatted louvres, and exhaust fans were added later; heating was supplied by thermostatically controlled electric pipes or panels.

Gee and Oboe Stations. The Gee type A.M.E.S. differed from other types of station chiefly in its function. Gee A.M.E.Ss. consisted of a 'master' station and two or three 'slave' stations, situated considerable distances apart, the 'slave' stations sometimes being over 100 miles distant from the 'master' station. The commanding officer of a 'master' station held squadron leader rank and was also responsible for his 'slave' stations; he had six officers under him, one of these being a Women's Auxiliary Air Force administrative officer. There were between 30 and 40 airmen and 75 and 85 airwomen; the 50 to 55 radar operators were all airwomen. Five cooks, nine aircrafthands and four nursing orderlies completed the establishment. The 'slave' stations had establishments similar to those of C.H. A.M.E.Ss.

The establishment at an Oboe station was about the same, but there several units of equipment were housed and worked independently; the size of the station depended on the number of units installed. On the earlier Oboe stations the technical block, housing both the transmitting and receiving equipment, was very similar to that of the C.H.L. stations, although smaller. Wooden or Nissen huts were used to provide an operations room twelve ft. square and nine ft. high. New designs for the technical block were introduced later, in which six Nissen huts were arranged in two rows connected by a central passage. A high brick blast wall surrounded the whole block.

Hutted domestic camps with the usual facilities were built. Provision had to be made for an unusually large defence force, not so much because of the size of the station, but because security requirements demanded a separate system of defence for each section of the technical site.

The Chain Home Extra Low (C.H.E.L.) Station. This was the smallest type of station in the Group, and had an establishment of one officer, 16 airmen and 17 airwomen. There was no establishment for a W.A.A.F.

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administrative officer and administration was the responsibility of the senior technical officer at the station. In certain instances, the equipment was housed in a wooden container something like a small railway goods wagon. The whole of the transmitting equipment and two pieces of receiving apparatus, rather smaller than those used on a C.H.L. station, were placed inside. The container revolved on a central turn-table controlled by one of the operators; a small mirror type of aerial was attached to the roof. A circular hole in the floor acted as an air inlet and another in the roof, shielded by a light trap, as an outlet. Two radar operators, a plotter, a teller and a radar supervisor were wedged into the spaces left between the pieces of equipment. A small defence force of between fifteen and thirty men guarded the site and were housed in nearby Nissen or wooden huts.

It was realised that the arrangement of the equipment was very unsatisfactory and it was transferred into huts as soon as they were available. Exhaust fans and small grid apertures were installed to improve the ventilation while the huts were being built. At the same time electric heating panels were provided and, if possible, the plotter, teller and radar supervisor were moved to a small wooden hut, often no bigger than the original container, where they worked in telephonic communication with the two operators on duty.

MEDICAL ARRANGEMENTS AND ADMINISTRATION

The large increase in the number of radar stations and the need for efficient technical maintenance and closer technical supervision led to the changes that occurred in the organisation of Air Ministry Experimental Stations, both before and after the formation of No. 60 Group. The framework of the medical administration evolved by a process of adaptation to the situations demanded by the various technical organisations formed within the Group to maintain the efficiency of the increasing number of stations in Great Britain and Northern Ireland. The dispersal of the stations made necessary the employment of local civilian medical practitioners, who required some form of central medical supervision by Royal Air Force medical officers as their numbers increased. Full control by the Group Senior Medical Officer over all medical matters was not obtained until his administration had passed through three phases, which are divided for the purpose of description in this narrative into the periods 1937 to July 1940; July 1940 to February 1941; and February 1941 to the end of 1943.

1937 *to July* 1940. Radar stations were always sited so as to provide the essential radar cover and with regard to local amenities and facilities for the staff. It rarely happened, however, that an A.M.E.S. was sited close enough to a station sick quarters for the latter to provide daily attention and in-patient treatment. It was usually necessary therefore

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to make arrangements for attention by a local medical practitioner under contract to the Air Ministry, and to restrict the responsibilities of parent stations to compiling and rendering medical statistics and returns.

The practitioners who looked after isolated stations held daily sick parades and arranged the transfer of patients either to a R.A.F. station sick quarters or to hospital according to the distances involved and the severity of the illness. Service ambulances were used wherever possible, but as they were seldom available, patients were usually transferred in civilian ambulances.

In February 1940 a Senior Medical Officer of wing commander rank was appointed to the new Group and became responsible for the 37 existing stations; he had a staff of a flight sergeant and a corporal. The responsibilities of parent station medical officers were then limited to liaison between the units and the practitioners, and the general supervision of medical arrangements. Any problems which arose on stations were investigated by the parent station medical officers and, provided security was not prejudiced and supervision was efficient, satisfactory solutions were usually found. However, the Senior Medical Officer at Group Headquarters soon discovered that satisfactory administration from parent stations was not always possible, and when suggestions were made or action was needed there was no sure method of enforcing execution through the Command and Group of the parent station.

Numerous problems were arising on both domestic and technical sites, and great difficulty was experienced in correlating and co-ordinating them for investigation as a whole rather than as individual station matters. Difficulties of this kind were an anxiety to the technical officers of the Group Headquarters, and requests were already being made that the Group might have more direct control over the administration of its stations, to avoid the lengthy and uncertain channels of communication through parent stations.

On the collapse of France and the subsequent formation of the Radio Servicing Sections in July 1940 the Group was able to supervise the technical maintenance of stations without having to work through the parent stations, and the possibility was opened up of increasing the general medical control by the Group Senior Medical Officer. It was eventually agreed by the Air Ministry after requests from the Principal Medical Officer of Fighter Command that a medical officer should be posted to each Radio Servicing Section; they were to be directly responsible to the Group Senior Medical Officer and each was to have a staff of a medical corporal and a medical orderly.

July 1940 *to February* 1941. The new system relieved the pressure of work on the Group Senior Medical Officer and he was able to delegate to his medical officers questions of minor medical importance requiring

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co-operation between them and the local authorities and the parent station. Such matters as the supervision of and suggestions on the hygiene and sanitation of stations were dealt with in this way.

The duties of these radio servicing section medical officers were considerable and they were responsible for seeing that Group policy was carried out and that action was taken by the parent stations on suggestions from No. 60 or parent Group headquarters; that frequent visits were paid by the medical officers to the stations served by their radio servicing sections; that practitioners were fulfilling their obligations efficiently, and that there were adequate medical stores on the stations to carry out normal treatment and to meet any emergency.

Constant liaison with the local hospital authorities had to be fostered, so that no difficulties arose over admissions to hospital and the correct disposal of documents. Defence schemes incorporating procedures for giving first aid to the injured in the event of air attack had to be drawn up for each station and contact made with the A.R.P. organisation of the district.

Although practitioners treated the sick, the Service medical officers had to act in an advisory capacity to commanding officers on all matters concerning the health and welfare of personnel under their control. A sanitary diary had to be written up on each visit, so that there were permanent records of the state of hygiene and sanitation. When a visit to a station had been completed, a full report had to be sent to the Group Senior Medical Officer, who was able in this way to obtain a comprehensive picture of the conditions and problems on individual stations. Much hard work was done by these medical officers in looking after up to fifteen stations at one time; the Group Senior Medical Officer considered that their services, which played a major part in placing the medical administration on a secure foundation, were more than satisfactory.

Parent stations were still responsible for medical statistical returns as well as for carrying out the authorised recommendations of the medical officers at radio servicing sections; medical administration, therefore, was not carried out entirely by the Group, but was a shared responsibility between the Group and the parent stations' chain of control. This dual responsibility was unsatisfactory, not because the planning and execution of the scheme had been bad, but because by the time the eight radio servicing sections had been formed, the total organisation had become too big for both the technical and medical control. It was therefore fortunate that the Group authorities were at that time making every effort to obtain as full a measure of control over all aspects of their work as possible; in medical matters a preliminary step in this direction was the successful attempt to develop a medical stores organisation at each radio servicing section.

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It was planned that each section should act as a central depot and that stores should be issued on loan to each A.M.E.S. and held on charge at the Radio Servicing Section Headquarters. It was arranged through commands and groups that the stores thus held at stations, as well as those to which they would be entitled for the next six months, should be made over to their personnel; this allowed the radio servicing section six months in which to demand and receive medical stores from the Depot at Hartlebury for future issue to the stations under their control. The transfer of stores from parent stations to A.M.E.Ss. took place without difficulty on August 1, 1940, and, during the months which followed, additional arrangements were satisfactorily made to hold reserve stocks at both radio servicing sections and stations. The arrangement which has just been described was found to be one of the most important single factors in ensuring the success of the wing formations which were shortly to follow, at least as far as medical matters were concerned.

February 1941 *to December* 1943. It has already been shown that the radio servicing sections could not deal with the increasing number of stations after the end of 1940. The authority given for the formation of the signals wings in February 1941 gave an opportunity to centralise all medical matters at Group headquarters; the medical administration was then re-organised and full control over it was vested in the Group Senior Medical Officer. He thus controlled his medical officers, his medical stores, all group sick quarters and in part the practitioners whose services were necessary at nearly all of his units.

The Group Headquarters medical establishment was raised in April 1941 to a warrant officer, a sergeant, two airmen and two airwomen, and that at each wing headquarters to a sergeant, a corporal and one airman. The extra work included the rendering of medical statistics and returns and the control of stores. The medical officers at radio servicing sections were transferred to wing headquarters with all medical stores and a new stores procedure was put into effect, making provision for the issue by wing headquarters, to all types of A.M.E.Ss., of the appropriate medical requirements, emergency reserves and replacements.

To knit the new wing organisations into a whole, each wing headquarters was regarded as a station sick quarters to which the A.M.E.Ss. were attached for medical administration. Forms 38* and Forms 39* were compiled by the wing medical officer from the Forms 41* received from the stations. Facilities for the treatment of patients were reviewed when the wings were formed, and sick quarters of varying designs

* Form 38 : Weekly Sick Return (for headquarters).
Form 39 (Flimsy): Transcript of F.41 (for Form 48—Medical History envelope).
Form 41: Case-sheet.

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were provided on all C.H. stations; they consisted of from three to five beds for airmen and two for airwomen until the combined type of station sick quarters approved by the Director-General of Medical Services was built. The C.H.L. stations, unless very isolated, had no sick quarters accommodation, but only a medical inspection room for sick parades and treatments. A.M.E.Ss. on which several types of apparatus were sited, had combined station sick quarters of appropriate size.

Medical boards and medical examinations for fitness for commission, aircrew duties, and overseas service were carried out by Royal Air Force medical officers at nearby Royal Air Force stations or by wing medical officers on their visits. The raising of the establishment of medical officers at wing headquarters at the end of 1942 from flying officer or flight lieutenant to squadron leader, with the addition of one other medical officer holding flying officer or flight lieutenant rank, made the work easier, and overcame most of the difficulty of completing the medical boards.

PROVISION OF PERSONNEL FOR OVERSEAS SERVICE

Problems were seldom encountered over the routine examinations, except those for fitness for overseas service. Radiolocation was being carried out almost entirely by No. 60 Group, so that when stations were required overseas, a proportion of experienced personnel had to be provided from within the Group. The constant influx of new operators, the postings between stations, the dispersed nature of the Group, and the smallness of the stations themselves, made the work of the postings staff very difficult if men required urgently overseas were found to be temporarily or permanently unfit. At one time no less than 13 per cent. of the personnel were in this category. Action was taken to avoid future difficulties; all personnel were examined for fitness for overseas service, and a register of names, grades and fitness was raised on all the stations, with duplicate registers at wing headquarters.

It became the responsibility of the orderly rooms to forward to their new stations information about the grades and fitness of personnel on posting from one station to another within the same wing; a similar responsibility was laid on the orderly rooms at wings when the postings were from one wing to another. New postings into the Group were easily checked after all Group personnel had been examined, because all newcomers had to report to wing headquarters before going to their stations. This system was excellent, but its application could not solve all the problems. Unfortunately there were two grades in the trade of radar operator; new operators were assessed as Grade IV until they had completed three to four months at a station; thereafter the successful candidates were raised to their full grade and were ready for training for service overseas.

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Personnel warned for overseas service required further training both in their trade and concerning conditions of life abroad, especially in war-time; this further training was carried out at their own stations until August 1942, when a special training centre was opened at Rensombe Down. The course lasted nine weeks and much advantage was gained by training together all the personnel who were to form one complete overseas station. The men were trained in their own trade on the apparatus which they were to use, and given a knowledge of at least one other trade. Every man was taught to drive, to do elementary field cooking, and to understand the principles of hygiene and sanitation. At the end of their instruction they underwent an assault course in Scotland,* after which they were either sent overseas or posted back within the Group, where they formed the build-up for future operations.

DUTIES OF MEDICAL OFFICERS

Clinical medicine was a small part of the work of the medical officers of No. 60 Group, who were more concerned with hygiene on their stations, particularly the medical aspects of conditions of work in technical buildings; some of the problems which arose were very like those of industrial medicine. The supervision of the domestic sites required no special qualifications, but an understanding of the principles involved in maintaining the health of personnel working in radar operations rooms depended on a knowledge of the technical application of the equipment.

During the first half of 1940 the only medical personnel on the Group establishment were the wing commander (Senior Medical Officer) and a staff of two: they were responsible for medical administration. All medical work was done by the medical officers of the parent stations and local practitioners. The administrative burden on the Senior Medical Officer was far too great in these circumstances, and it was found that when the radio servicing sections were formed in July 1940 and medical officers posted to each of them, there was plenty of supervisory and administrative work for them to do. Then, each medical officer, under the control of the Senior Medical Officer, was responsible for between six and eight stations during the twelve months from July 1940 to July 1941.

The strength of the Group increased by approximately 30 per cent. and the formation of the wings in February 1941 made little difference as far as numbers of medical officers were concerned. Those who had been on radio servicing sections were simply transferred to the appropriate wing headquarters. In 1942 there were eleven medical officers,

* Such courses assisted in training for combined operations. Their strenuous nature usually revealed personnel whose medical grading was too high.

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excluding the Senior Medical Officer and his assistant; a woman medical officer had also been working for some time on the special problems raised by the large numbers of airwomen in the Group. There was then one medical officer to just over 1,000 airmen and airwomen, and although his duties were mainly administrative, the wide geographical distribution of the stations made the work difficult and arduous. The continued increase in the size of the Group in the next year made a corresponding increase in the numbers of medical officers essential, and by the spring of 1943 certain wing headquarters had a staff of two medical officers. By the summer the average medical strength was twenty-three medical officers, of whom two were the Senior Medical Officer and his assistant; however, six of these were employed at training centres and the remainder were responsible for the 22,000 personnel of the Group.

The work of looking after so many units in such wide areas was considerable and some anxiety was felt at times about the supervision of certain A.M.E.Ss. difficult of access. The formation of the radio servicing sections was a great help, and when the medical officers there were transferred to the wings, equal benefit might have been expected had there not been such a great expansion of the Group.

Medical Officers of Radio Servicing Sections. The life of the medical officer at the radio servicing sections, and later at wing headquarters, was one of travelling interrupted by inspections and interviews. His aim was to visit each of his stations at least once a month, but when numbers rose, sometimes to fifteen, this became impossible, particularly during the winter. He travelled by train to the nearest railway station and by unit transport from there on. Bad weather and impassable roads often necessitated alterations to his time-table, and as at some A.M.E.Ss. it was impossible to provide accommodation for him he sometimes had to spend the night in a local hotel. After the formation of the wings, the work of explaining conditions at stations to medical personnel at parent stations ceased, but the visits to practitioners did not. Often medical officers remained at headquarters only long enough to write their reports to the Senior Medical Officer; some felt the loss of contact with other medical officers very keenly, quite apart from the discomforts of almost constant travelling. Matters were greatly improved, however, when a second medical officer was posted to each wing headquarters.

Nursing Orderlies on Isolated Sites. The nursing orderlies at the time of the formation of the radio servicing sections were of great assistance to the new medical officers in giving information on all problems of maintaining the general health standards. It was soon realised that nursing orderlies held a position of great responsibility, for they were the only medical personnel left on the station after the local practitioner had held the daily sick parade. It became the responsibility of the duty nursing

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orderly to decide when it was necessary to call in the doctor, who was naturally not anxious to travel several miles to visit a case that could have waited until the morning sick parade; he had also to decide what first-aid treatment was necessary before the arrival of competent medical assistance in all instances of emergency.

It was essential therefore that with the rapid expansion of the Group and the posting of necessarily inexperienced nursing orderlies to stations straight from the Medical Training Establishment and Depot, some method of further training should be found. When the wing areas were formed and the Senior Medical Officer obtained full authority over all medical matters, the question was investigated and a system introduced whereby all new nursing orderlies were attached to wing headquarters for a short time to be trained in their duties and to learn the more elementary medical stores and documentation procedures.

Additional training was arranged by the wing medical officers in conjunction with the local hospitals; nursing orderlies were sent in turn for one week's training, during which they spent two days in the medical wards, two days in the surgical wards and two days in the operating theatre. The senior nursing orderly, holding the rank of corporal, completed their training by teaching them the practical application of the principles of hygiene and sanitation, with particular reference to the type of station to which they were posted. First-aid lectures were given to all ranks by the nursing orderlies until the station had been fully trained; emphasis was laid on the responsibility of each man in taking all necessary precautions in the event of air attack, so that the operational efficiency of the station would be impaired as little as possible.

MEDICAL COMMENTARY

With the exception of one other specialised Group and, to some extent, Coastal Command, the preventive medical problems with which No. 60 Group was faced were unique in the Royal Air Force. At the peak of its expansion the Group administered in the neighbourhood of 200 units. Usually small in size, only a few of the latter were self-contained and all possessed their own problems. They were manned mostly by men and women of education and intelligence accustomed to the highly civilised life of the big cities. They were to be found in every situation from the relative luxury of the South Coast to the bleak coasts and windswept hilltops of South West England, Wales and Northern Scotland. The Hebrides, Orkneys and Shetlands had their quota. Many were miles from even a small town, over roads that were scarcely more than rough tracks. Some were regularly snowed up in winter—in one station snow shoes were issued to enable personnel, including W.A.A.F., to cross the

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drifted valley between the living and the working site. On at least two occasions supplies had to be dropped by air to stations cut off by blizzards. On one hill-top station in the north, life-lines were permanently rigged between the buildings, and a sixteen stone 'rugger' forward tells of being blown off his feet and hanging almost horizontal in the air while he clung to the life-line. For all these communities, whatever the difficulties, a reasonable standard of accommodation, food, sanitation and amenities had to be provided. The medical authorities were faced with the exacting, if intensely interesting, task of ensuring that the requirements of preventive medicine were met.

ACCOMMODATION

The standard of accommodation provided for personnel on stations directly affected nearly all aspects of station life; the degree of dispersal, the types of technical blocks, and the position and isolation of the buildings themselves influenced the hours of work, the recreational facilities and the means available for obtaining sound and hygienic living conditions. No. 60 Group, in common with all other branches of the Services, suffered difficulties during expansion, particularly as the success and expansion of the Group on such a large scale, in so short a time, was unforeseen. The shortage of labour and materials arising from the demands of all Services influenced the design and construction of war-time building, and, although the immediate requirements were met, the future requirements, both on the older stations built in 1939 and 1940 and on the newer stations, could not be adequately provided for; when the amount of equipment on stations was increased, either new construction had to be provided or overcrowding had to be tolerated on the grounds of expediency. It was quite by chance if facilities for domestic life at stations were naturally available on the operationally chosen station sites; in consequence the problems of housing, cooking, hygiene and sanitation were made doubly difficult and required constant supervision.

Personnel were housed by one of two methods depending upon the size and position of the unit. If the establishment was small and the station close to some village or town, billeting was the usual method adopted. If, on the other hand, the station was very isolated or considered important enough, even though there was village accommodation nearby, a hutted camp was built and sited separately. Stations which had hutted camps were divided into two main sites: the technical or A site and the domestic or B site; on some stations in 1940, the defence personnel were housed on a third site, but this policy was soon altered and accommodation was built for them on the technical site, so that they would be within the main perimeter defences close to the buildings they were to guard.

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The domestic site had a cookhouse of standard pattern, with either separate or communal messing rooms, a N.A.A.F.I. and two separate domestic sites for airmen and airwomen. Officers were usually messed and housed separately.

The A.M.E.Ss. of the pre-war period were usually quite satisfactory and the comfort of personnel well considered; the buildings were soundly constructed either of wood or brick, with adequately lit and ventilated barrack huts, sufficient ablutions containing baths as well as showers, and waterborne conservancy. The transmitting and receiving blocks were roomy and ventilation was satisfactory for the small numbers of personnel employed in working the apparatus.

The hutted camps built after the war began were without exception designed for establishments which were exceeded, though until the end of 1940 the problem of overcrowding did not arise. The huts on the domestic sites were of Laing, Jane or Nissen construction, but defence personnel on the technical sites were sometimes housed in corrugated asbestos huts surrounded with low brick blast walls. Some stations had Army pattern huts on the anti-aircraft sites; these were less satisfactory than the huts built to R.A.F. design and were replaced as soon as possible.

The Nissen huts built in the autumn and winter of 1941 and the spring of 1942 were not so satisfactory as those which were built at both earlier and later dates, largely due to the inferior materials used and their construction being accomplished by semi-skilled labour; in consequence many huts were not weather-proof. Four and a half inch brick buildings were built on some of the more northerly and exposed stations, but they gave continual trouble because they were not impervious to the combination of high wind and driving rain. Special solutions with various water sealing properties were tried on the outside walls to exclude the rain; one solution was found to be effective but it was exceedingly expensive.

All huts were heated by slow combustion stoves which were far from satisfactory and the ventilation was effected by louvres placed above the door at each end of the hut, or by dormer windows. Drying rooms were always provided close to the sleeping quarters and were much used in the north of Scotland and the outer Scottish Islands. This was very much in contrast with drying rooms on large stations which were rarely used for fear of pilfering.

Billeting. Billeting was adopted on most C.H.L. stations and on some of the larger stations, as a temporary measure, where technical operations had started before the hutted camps were habitable. Great care was taken by all administrative staffs to obtain a good standard of billets throughout the Group, but in the most isolated areas the billeting situation was never entirely satisfactory. The position grew worse in 1941 and, although the hutted camps remained satisfactory, billets deteriorated

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and varied greatly from place to place. In the Scottish Islands, parts of Scotland and some districts of Wales, the standard of living among the local population was so low that it was impossible to provide the hygienic conditions desirable, and recourse was necessarily had more and more to requisitioned houses and hotels over which a greater degree of supervision could be exercised. The accommodation provided in this manner frequently required extensive and costly works services, and on stations where operations had to be started at the earliest possible moment, the personnel billeted out or accommodated under these conditions did, in fact, suffer hardship until it was possible to complete the necessary alterations to the buildings.

Overcrowding. Overcrowding did not become a problem until 1941 when the establishments on stations were increased, and the Group IV partially trained operators and personnel awaiting overseas drafting had to be housed without the provision of additional accommodation. Double-tiered bunks were used as an emergency measure in the old-fashioned type of house with ample air space but awkwardly shaped rooms, and a reserve of them was held at C.H. stations for use as single bunks when the overcrowding was no longer acute. The problem ceased to be of any real importance in the middle of 1942, because of increasing overseas commitments.

At that time the programme for the west coast stations was partially completed; these stations were dispersed far more than those on the east coast, and it was common to site the technical and domestic buildings as much as two or three miles apart, there being no alternative arrangement. Transport had to be provided for shift workers and when there were heavy falls of snow it was sometimes very difficult to maintain the time table; in fact on a few stations personnel could not walk between the A and B sites until paths had been dug.

SANITATION

Surface Drainage. The surface drainage of the sites was often very poor and though concrete paths were laid around the technical blocks, no such luxury was provided for buildings on domestic sites at the more rapidly constructed stations. Personnel housed in partially completed B sites made paths of a kind with cinders and bricks, until concrete was put down. Duckboards had to be laid, and Wellington boots issued to all ranks at stations built on peaty subsoil or peat bog. One station in particular, in No. 70 Wing, was outstandingly badly drained; in addition the buildings were all of poor quality and the station had been condemned by the naval authorities. For two years matters were far from satisfactory; when a new station was built in the vicinity of these buildings, personnel were temporarily housed of necessity on the condemned site until accommodation was ready.

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Sewage Disposal. Sewage was disposed of by the usual methods* according to the size of the stations and local conditions.

The disposal of excreta in the Western Islands of Scotland was singularly difficult to arrange where stations were built on peaty soil over rock foundations or peat bogs; the provision of a sewage system of any kind involved great expense and technical difficulty. Elsan or bucket latrines were used at such stations, and small sanitary squads were made up from station resources.

Water Supplies. One of the greatest difficulties which confronted the medical branch was the inadequacy of safe water supplies to stations, the more northerly stations in 1940 and 1941 being less well supplied than most. Reports on the water at these stations showed that it was often of doubtful purity, though local communities had used it for years without adverse effects. Water purification trailers were scarce, and in their absence all drinking and cooking water was boiled. Sources of supply at some stations dried up in the summer and water had to be carried from a distance.

Little headway had been made in solving these problems by the end of 1941. There was little trouble at the older established stations, as water was supplied from mains or from approved deep wells, but at the newer stations, where the supplies were questionable, it was hard to obtain chlorination plants and Bell sterilisers were issued in their place. Several stations were provided with running water in living quarters, but this was not drinking water and until chlorination plants were installed this method of delivery was a great potential danger for it was impossible to ensure that no one would drink the water or clean his teeth with it. Fortunately these stations were situated in relatively unpopulated areas where the chance of pollution was small.

The water supply in billets in the more isolated parts of the country left much to be desired. Instructions were given that all water should be boiled, but it was quite impossible to be sure that this was done. There were isolated cases of non-specific enteritis, but no cases of illness occurred which could definitely be attributed to the water supply. One airwoman developed paratyphoid A at one station where water was obtained from the local mains, but tests when carried out on this supply were satisfactory.

In 1942 water trailers and chlorination plants were less scarce, and by the end of the year water supply problems had been solved at all but a few stations.

LIGHTING

General. The problems which arose over the working conditions in the operations rooms on Air Ministry Experimental Stations were very

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* *See* various Command narratives.

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similar to some of those in industrial premises, where the lighting was artificial, the heating electric, the ventilation effected by a forced feed system with air ducts, and the hours of work for personnel arranged on a shift basis. Factory managers and inspectors understood these problems, but it was not until 1943, when the Markham Committee had investigated working conditions in the Services and compared them with those of industry, that the experience gained in factories was applied to buildings such as operations rooms.

Lighting Arrangements at a C.H. Station. The difficulties experienced over the lighting of operations rooms varied from station to station and from one type of station to another, but the variations were usually of minor degree and due to the placing of apparatus rather than to any new problems in the rooms themselves. The operations rooms on C.H. stations presented all these problems in a typical manner, and they have been chosen for descriptive purposes here. It has been shown in describing them how the work was divided into two parts: the receiving of information and its interpretation and transmission. The former process was carried out by a radar operator sitting at the cathode ray tube of the receiver, and the latter by plotters and tellers on the other side of the room; the whole, except in the very early days, was monitored by the radar supervisor. The lighting problems would not have arisen if it had been possible to conduct the operations effectively without the help of the radar supervisor, because the two processes, each requiring very different intensities of illumination, could then have been carried out in separate rooms; it was from the constant conflict between the two standards of illumination required that the lighting problems arose.

The radar operator's problem was to recognise salient features in a flickering, undulating line of light of relatively low intensity. She had to align pointers and read scales quickly and accurately if her information was to be of value. Reflections from other sources of light in the room or glass or shiny surfaces in the instrument made her task more difficult. In the early days the direct lighting used to illuminate her scales increased the problem. Other personnel working on maps and records had to have adequate lighting for the purpose.

Position from 1937–40. When the first trials were taking place in 1937, light was provided from four ceiling lamps which were all turned on for maintenance purposes; during operations the two over the receiver were extinguished, and the two over the console left on and shaded. At that time the operator at the tube had difficulty in reading the echoes because of the light reflections from the shiny tube face caused by the two lights left on over the console; the illumination was therefore diminished and the room plunged into semi-darkness except for several pools of light at the console from table lamps. It was soon realised that the low and uneven level of illumination was unnecessary and depressing;

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in consequence the general light level was again raised throughout the room, the lamps being hung in such a manner that the plotters and tellers had enough light and the operator was satisfied that there were no reflections from the tube face. Unfortunately, this policy was not made general at the time, and when the number of stations increased during the expansion period, operators who had been trained in semi-darkness at their training centres objected to any increase in illumination; wherever such an increase was tried and a small or faint echo on the tube missed, the extra light was blamed rather than human fallibility, and the illumination was again reduced on the grounds of operational necessity. This state of affairs existed on nearly all the stations in operation at the time of the Group's formation and on numerous others constructed between 1940 and 1941. Personnel at some stations had persevered in operating at the higher light level, but usually as soon as the station commander responsible had been posted, the rooms reverted to their previous condition of gloom, unpleasantly relieved by pools of bright light from table lamps of numerous designs, shapes and sizes, dotted here and there.

Ophthalmic Survey of Lighting Conditions. It was undoubtedly true that such conditions of gloom were very satisfactory for seeing the echoes, but the workers at the other tasks were not so well suited. There had been complaints of eye strain for a considerable time but they became far more numerous between March and August 1940. It was then decided that a specialist in ophthalmology should visit a representative number of stations to examine the eyes of operators, and to recommend any change in lighting which he might think necessary. It was somewhat unfortunate, though natural, that most of the operators saw a good opportunity in this investigation to have their eyes tested for entirely personal reasons. The investigation showed that difficulties were arising from several sources:

(*a*) In the first place the system of training radar operators involved a time on the tube which was long for trainees. Personnel suffering from errors of refraction were found either to have incorrect lenses in their existing glasses, or to require an initial issue of spectacles. A surprising number of the operators who complained of eyestrain* had very small errors of refraction for which, in all probability, they would not have required glasses if attention had not been drawn to their eyes by the type of work they were doing.

(*b*) Secondly, operators working in the low light level became dark adapted to a considerable degree. The dark adaptation acquired by working at the tube was altered not only by the tube operator chang-

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* Many of the operators visited cinemas in off-duty periods, which imposed further strain on their eyes.

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ing to one of the other processes carried out in the room, but also by going outside in daylight to get a breath of fresh air; this alternation between two extremes of illumination caused additional eyestrain in those naturally sensitive to glare.

(*c*) Thirdly, it was found that operators at the receiver were having to alter their focal distances while working, to accommodate the ciliary muscles to the changes in light intensity when using the receiver, trace, and the goniometer scale.*

(*d*) Though not allied to the three factors mentioned above boredom was considered to be of major importance. Personnel might have to spend hours scanning a tube on which no evidence of enemy action was seen; wherever possible operators were informed when their observation had led to interceptions of enemy aircraft.

Modification following Survey. New methods were adopted at the training centres in the autumn and several modifications made to the equipment to correct the faults. All operators under training were examined for refractive errors; any found were corrected before training, and personnel who had excessive heterophoria were re-mustered to other trades. A maximum of one hour at the tube was decided upon for both operations and training, this period to be followed by a break of at least two hours on some other kind of work. For operators on Gee stations whose work entailed greater concentration, it was considered that the maximum time at the tube should be half an hour, with a similar two hours' break. This observation was confirmed in the Cambridge Physical Laboratories.

The radar operator's difficulties were tackled in various ways. It was found possible to alter the angle of inclination of parts of her instrument without interfering with accuracy and ease of working. This measure, combined with re-positioning of room lighting, cut out the reflections previously so annoying. Indirect lighting of varying intensity was used for scale illumination on the same principle as a car dashboard. Another successful device was a moving transilluminated scale with a fixed pointer and magnifying glass attachment. These modifications, gradually introduced throughout the Group, together with further education, ensured that eyestrain was not caused by work on the tube. Between September 1940 and May 1942, only a few minor complaints were received and it was possible during this period to pay more attention to improving standards of lighting in operations rooms.

Lighting in Operations Rooms in General. It was decided at a conference at Air Ministry in May 1941 that it was not in the best interests of personnel as a whole to base the lighting conditions in the operations room entirely on the requirements of the operator, and it was agreed in

* An instrument for measuring solid angles.

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principle that the general lighting level should be increased as much as would be consistent with operational efficiency. Any methods used in screening the tube operator from the console operators were deprecated, because it was decided that the radar supervisors were not to be restricted in their movements by any form of partition between the two sides of the room.

No standard form of lighting was adopted and it was left to commanding officers and medical officers to find suitable schemes. The first problem was to overcome the fixed idea that good operating could only be carried out in the dark. The resistance to any increase of light was less apparent than before, because operators recently posted to the Group had been trained in rooms in which the higher lighting level had been used; however, the more experienced operators were as strongly prejudiced as they had ever been. Certain stations overcame some of the difficulties by hanging blankets between the tube and the console operators with the unfortunate result that the ventilation, which was never entirely satisfactory, was even worse than before. Gradually, however, the resistance was overcome; the blankets and other forms of unofficial screening were removed and the level of illumination raised.

At four stations in particular, the problem was very thoroughly investigated, and a system of lighting was evolved which was far superior to anything used before. It was accepted that the general illumination should be as high as was consistent with efficient work, and it was agreed that the light level was not to be reached by starting in darkness and increasing the amount of light to the optimum limit, but was to be found by starting with full lighting and examining the position and size of reflections from the tube face, and eliminating them by trial and error by altering the positions and shading of the lights themselves. It may appear that there was not much difference between the two methods, but a far higher light intensity level was reached by the second plan than by the first.

Use of Coloured Illumination. Other stations experimented with different coloured lighting, red and yellow in particular, but personnel objected to them and complained that they seemed oppressive. Walls and shiny parts of equipment at some stations were painted with black matt paint and the rooms made very cheerless; the scheme was never completely adopted for this reason, although some success was obtained by painting half the room or covering half the walls with black cloth. The experiments vindicated the principle of high-level lighting and showed the necessity of having cheerful working conditions. This was perhaps the biggest step in the right direction and a very pleasing colour scheme of light cream and eau-de-nil for ceilings and walls became the standard for all new and redecorated stations, with the stipulation that the finish should be matt rather than glossy.

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Indirect Illumination. The next step was the introduction of various forms of indirect lighting, using normal electric light bulbs, the brightness of which was made adjustable by the incorporation of a rheostat in the circuit. Separate block inspection lights for maintenance purposes were provided as accessories. At a later stage fluorescent strip lighting was introduced at one station and an extremely effective result obtained. The room was divided into two by a small plywood drop screen along a dividing line midway between the receiver and the console; the screen was eight feet long and between twelve and sixteen inches deep, and a long fluorescent tube with a metal reflector was fixed on the console side. The tube and screen were adjusted so that no direct light fell near the operator at the receiver and there was a gradual fall in foot-candles towards the receiving end of the room. (*See* diagrams below.)

Investigation by the Royal Aircraft Establishment. The R.A.E. was asked to investigate certain lighting problems in the autumn of 1942. A representative experimented during the next fourteen months to produce a lighting system which could be standard on all C.H. stations. The lighting was arranged so that there was no peak illumination in any part of the room, this being achieved by means of a venetian blind behind the operator at the receiver. It was placed longitudinally, rising from the floor with the upper edges of the slats directed towards the top of the receiver and the lower towards the foot of the console. A specially designed scroll-shaped reflector painted white was attached to the ceiling above

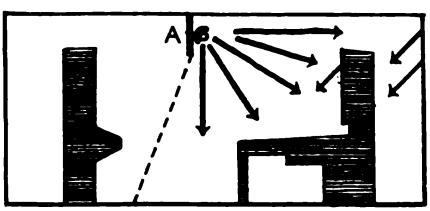

FIG. 1

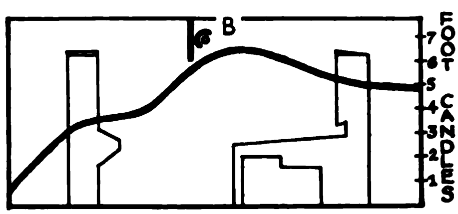

FIG. 2

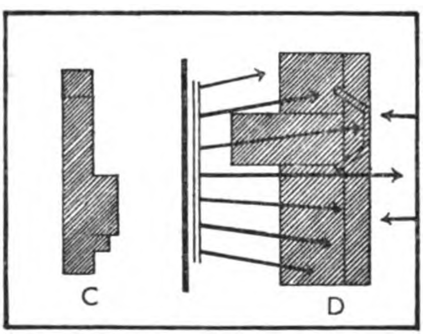

FIG. 3

FIGS. 1–3. Diagrams of indirect lighting in operations room.

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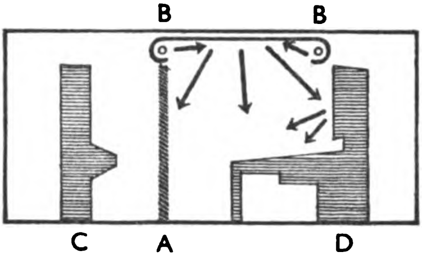

FIG. 4

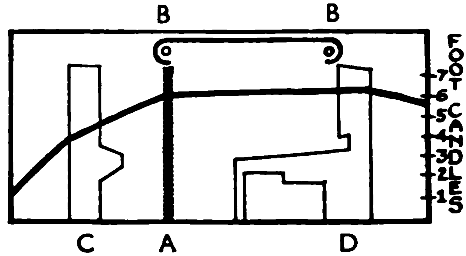

FIG. 5

FIGS. 4 and 5. Diagrams of operations room lighting utilising scroll-shaped reflectors.

the console; fluorescent tubes were placed in the scrolled edges. (*See* diagrams above.)

It was unfortunate in view of the efficiency of the system that the original decision, to put nothing which could interfere with the movements of the radar supervisor between the receiver and the console, had been either overlooked or not appreciated. In consequence of this and of the protracted delay in the experimental work, one station only was provided with this system of lighting.

The station conditions in the smaller operations rooms on C.H.L., Gee and Oboe stations were very similar, but their size prevented the development of any elaborate form of lighting. The lights were usually shielded, but the general level of illumination remained lower than that on the C.H. stations.

The Lighting of the Plotters' Map. This presented a different kind of problem entirely. The map was about three feet square, and the plotters required good illumination to work out and track the movements of aircraft by the grid references received from the tube operator. The surface of the map was covered with a sheet of perspex and the writing on it was done with coloured 'chinagraph' pencils. The map lay horizontally and was illuminated by shielded electric light bulbs. The perspex surface reflected the image of these bulbs; these reflections and the placing of the map on a flat instead of an inclined surface made the plotting difficult. The reflections were totally eliminated by lighting the map from behind with diffused light from four bulbs, but strip lighting was later used to give a more even illumination; a rheostat was added to the circuit so that individuals could adjust the lighting to suit themselves.

Two other types of plotters' map were tried out while the general experiments with the lighting were proceeding. One type was similar to the normal plotters' map, but was placed on a stand in a very inclined position; operators then found they became tired because they could not sit down during plotting operations. The other map was constructed on a different principle and consisted of a square of thick perspex strongly etched with grid lines; the light was provided by shaded strip light to transilluminate it. The map was clear and satisfactory but had one drawback in that operators who had mild astigmatism found the brightly lit grid lines irritating to the eyes.

It will be seen from this description that though all the difficulties were of minor individual importance, collectively they presented a serious problem which had not previously arisen in the Royal Air Force.

VENTILATION

Personnel using the complicated equipment in the technical buildings required good working conditions to maintain adequate standards; besides good food and regular hours of work and sleep a fresh atmosphere was essential to lessen the fatigue which resulted from unremitting concentration.

In 1937 and 1938 the technical buildings were made of wood and had ample air space. It was found that the double overlapping window shutters, used when blackout conditions were enforced, allowed a free passage of air. Numbers in one room at that time were small and no discomfort was felt. At all the C.H. stations and at a number of C.H.L. stations, transmitting and receiving were carried out in blast and gas proof technical blocks in which some form of forced feed ventilation was installed. The almost equally numerous wooden and Nissen huts, in which the technical equipment of other types of station was placed, were ventilated by induction motor-driven exhaust fans. The latter gave no sparks as they had no brushes and therefore did not interfere with the radar equipment. Fresh air was drawn in through slatted louvres at both ends of each building. The atmosphere of these buildings did at times become vitiated, but, in contrast to the technical blocks on C.H. stations, it was possible to open the doors and windows and let in fresh air when maintenance was in progress. Occasionally the existing exhaust fans were placed in the walls facing the prevailing wind; their efficiency was thereby seriously affected until the necessary changes in position could be made.

On C.H. stations, fresh air was supplied to the technical blocks by air ducts in a system which incorporated inlet and exhaust vents with horizontal adjustable slats in each room. In normal circumstances the circulation of air was assisted by an electrically driven exhaust fan, or, if the electric supply failed, by a small petrol motor. Air was drawn into the system directly from outside and not warmed or conditioned in any way, but if necessary it could be passed through a large anti-gas filter before entering the rooms, by an alteration of the position of two baffle plates in the system.

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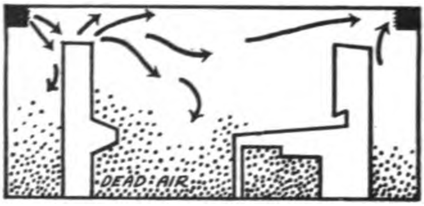

FIG. 6

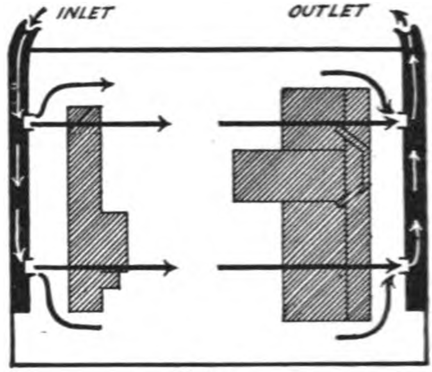

FIG. 7

FIGS. 6 and 7. Diagrams illustrating faults in ventilation in C.H. station operations room.

The inlet and exhaust ducts were placed on opposite sides of the room just below the ceiling, and the vent slats were so adjusted that the air was deflected downwards from the inlet vents and sucked upwards through the exhaust vents. The knowledge that hot air rises was not applied to any room to assist ventilation and the position of the equipment in relation to the ventilation system was not always satisfactory, for in some rooms the airflow was impeded and its direction altered by the receiver which was placed parallel and not at right angles to the air ducts. (*See* diagrams above and facing.)

Dead air spaces formed in rooms where the receivers were wrongly placed and the addition of extra equipment and personnel made such rooms very stuffy. A new form of cathode ray tube, the plan position indicator (P.P.I.) tube, which was introduced in July 1941, made matters worse because instructions were then issued that no light of any sort was to fall on the tube face for fear of causing serious deterioration of the tube, and blankets and other forms of screening were used to ensure complete darkness. Fortunately, however, it was proved in a very short time that the P.P.I. tube was unaffected by light and it was possible to order the removal of the various screens that had been erected.

It was generally agreed towards the end of 1943 that the ventilation in the operations rooms was still not satisfactory; the position was reviewed and extra ducting was proposed to carry the air inlet vents over the top of the receiver; it was hoped that this measure and the installation of more powerful electric fans would be successful in improving conditions.

Special arrangements had to be made in the transmitting rooms of Gee stations to dissipate heat generated by the transmitting equipment. An air-cooled ducting system was built into the transmitter,

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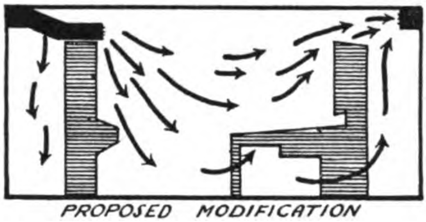

FIG. 8. Diagram showing modifications in ventilation layout in C.H. station operations room.

the hot air being collected and conducted from the back of the receiver straight up through the roof. The ventilation in the operations rooms on the newest Oboe type stations was carried out on a different principle. Two large circular vents ten inches in diameter were placed at floor level, one-third and two-thirds of the distance along one wall of the Nissen hut. The exhaust was effected by a large fan installed high up to one side of the door at the end of the hut. The air flow was adjustable by two regulators placed in the room, velocities up to twenty miles per hour being available if desired. (*See* diagram below.)

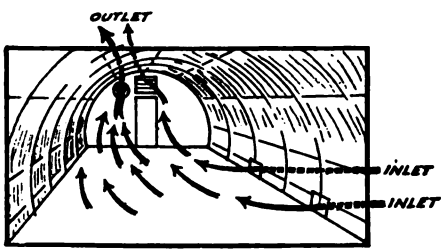

FIG. 9. Diagram showing ventilation in Nissen hut used to house Oboe equipment.

AIRWOMEN AND HOURS OF WORK

The trade of radar operator demanded patience, intelligence, alertness and appreciation of fine detail. The standard of girls attracted to this trade was high and a good type recruited, with the result that, generally, they were keener, more able to amuse themselves, maintained higher social and moral standards and had lower rates of venereal disease and illegitimate pregnancy than their contemporaries in other trades; the unmarried pregnancy discharge rate of radar operators based on 649 cases in 1942, was 0·14 per cent., the lowest in any trade. The supervision and administration of W.A.A.F. radar operators was made easier by their character and disposition. Unlike girls on airfields and larger units, the total number employed was seldom over 40 in a small C.H.L. station, or 75 on a C.H., Gee or Oboe station, unless several different stations were sited together, when numbers rose to as many as 150.

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Approximately 20 airwomen on a station with a strength of 40 were employed in operating the technical equipment; these 20 worked in three or four watches. There were between four and six airwomen on each watch and they formed their own communities whether billeted out or accommodated on domestic sites.

The number of airwomen in the Group in January 1941 was 1,070, of whom 730 were radar operators. Numbers gradually increased and by August 1942 there were 3,556 including 1,530 operators, and in December 1943 there were 7,444 including 3,074 operators. Comparative figures of airman radar operators would give an erroneous impression, for the total overseas requirements were drawn from the male personnel, but at home the proportions were approximately equal. In 1942, twelve airwomen qualified as radar mechanics and deserve mention because they were the only women radar mechanics in the Group.

Radar operators always tended to consider themselves exempt from all forms of work outside their trade and it was sometimes necessary to remind them that the cleanliness of their billets depended upon themselves. The routine adopted on all stations was that the watch next on duty was responsible for the cleaning and tidying of the barrack huts. Each girl had to keep one window clean, and the duty of lighting the fires in the huts was taken in rotation. At least one parade was held weekly and outdoor recreation encouraged.

WATCH SYSTEMS

There were enough radar operators, both airmen and airwomen, in the Group until February 1942 to use a system of four watches and four shifts in the operations rooms. The extra floating population of Group IV operators undergoing their final training, and those personnel awaiting overseas drafts, allowed the shift hours to be arranged so that everyone was able to take frequent days off and short leaves without interfering with operations.

In February 1942 it was evident, because of the shortage of male operators, who were required for service abroad, that work would have to be done on a three-watch and four-shift basis. Four changes of shift rather than three were adopted and as it was thought that the new system would not be popular, the proposed schemes were carefully considered beforehand.

Two schemes were finally evolved.* Scheme A was adopted at all stations except a few C.H.L. stations where local conditions made

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* *Scheme A*

2300–0800 hours	A C B A C B A
0800–1300 hours	B A C B A C B
1300–1800 hours	C B A C B A C
1800–2300 hours	A C B A C B A

Scheme B

2300–0800 hours	A B C A B C A
0800–1300 hours	B C A B C A B
1300–1800 hours	C A B C A B C
1800–2300 hours	A B C A B C A

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certain alterations necessary. The total number of hours of work per watch per week were:

A watch	62 hours
B watch	53 hours
C watch	53 hours

The extra hours done by A watch in one week were done by B and C watches in the second and third weeks respectively. Each watch had one long day of fourteen hours on duty in two periods; this allowed eight hours for sleep between the periods, but left very little time for anything else. The watch was then off duty again for nine hours after the second of these two periods and on duty for five hours; after that the personnel of the watch had a free period of twenty-four hours in which they had to do only their domestic duties in the morning of the following day. They went on duty again at the end of their twenty-four hours' rest, after which they had a further period of five hours for camp duties or rest before beginning their next long day.

Scheme B was applied to stations without domestic sites and where much time was needed to transport personnel to and from their billets. If Scheme A had been adopted in these circumstances sleeping time between shifts would not have been enough. Personnel obtained adequate sleep in Scheme B at the expense of the long periods off-duty which were arranged in Scheme A.

It will be seen that the hours of sleep were arranged for each watch at different times of the day. On one day in three, personnel had to sleep during the day and again the following night, but by the time they had had a meal and gone to bed only about six hours remained before the next shift. It was considered that this short period for rest and sleep was compensated for by the two long periods of sleep which had been arranged in the twenty-four hours of the previous day and by the long period off-duty which followed the end of the next shift. In Scheme B there was no difficulty over arranging the sleeping times.

Either Scheme A or Scheme B was put into force throughout the Group. There were a number of complaints, but these were expected, for no one liked leaving the relatively easy conditions of the four watch system. All personnel felt the limitation of their freedom considerably, and a proposal was put forward when the watch keeping system was under discussion to make one watch do night work for one week at a time; however, the suggestion was not welcomed by any branch or by the commanding officers of the stations, and the proposal was dropped on the grounds that it would complicate the station administration too much.

The airwomen reacted to the new system in various ways; most of them disliked the alteration of their hours of sleep and their meal-times from day to day. Some coming off night shift did not go to bed in

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the morning or afternoon because they said they could not sleep in the daytime. They would lie down and rest and report for duty on their next shift only partially refreshed. A few who could go to sleep were light sleepers and were continually being awakened by the noise made during the normal comings and goings on the sleeping sites. Attempts were made to sleep watches in separate huts, so that all the women in one room could be in their beds at the same hour; this was partially successful but postings, leave and courses upset the scheme.

The girls who had completed two shifts in twenty-four hours felt very tired if they had not had a good sleep before their first shift, and many, on leaving work, preferred to go straight to bed rather than eat their meal because they said they were too tired to eat; orders were issued for compulsory attendance at meals after night work to overcome this understandable disinclination.

Personnel who were not acclimatised to the new system grumbled and became irritable. The number of airwomen on sick parades increased and their complaints were of such a minor character that the increase was clearly not wholly due to physical illness, although there was a slight rise in the incidence of upper respiratory infection. Nearly all the complaints subsided after the first six to eight weeks, and no serious ill-effects were produced. The three-watch—four-shift system was maintained as long as there was a shortage of personnel, but some stations were soon able to revert to the four-watch—four-shift routine. In the meantime, investigations were proceeding into the watch keeping system as a whole, and in 1943 the Markham Committee published a report, with recommendations, on the conditions of work in the Services; points made are quoted here to explain the changes in watch keeping which followed the Markham publication.

In paragraph 132 of the Markham report it was stated that Service hours were not always comparable with industrial hours and it could not be decided on the basis of the latter what the optimum hours of work should be in the Fighting Services. It was considered that the usual Service hours were both regular and not excessive, and there was no question of fatigue, though there were some justifiable complaints of boredom and monotony. However, radar operators were included in the group of Service tradeswomen whose conditions of work were similar to those prevailing in factories and offices. It was stressed that their hours of work, rest and meals should not be irregular.

It was stated that from the health point of view, it was preferable to maintain the same watch keeping periods daily for a fortnight and to establish a regular rhythm. A fortnight was suggested as a better period than a week to allow a physiological rhythm of waking and sleeping to develop, but a month was thought by many to be too long. It was recommended that operators should only exceptionally work for more

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than eight hours a day, or more than forty-eight hours a week. It was realised that some increase of personnel would be needed to carry out the suggestions and that the reactions of many individuals would be adverse. The change would be unpopular for it would interfere with the recreation of the women, many of whom were young girls, in their off-duty hours. Many would rather have broken sleep and irregular hours than be tied to night duty for a fortnight. Nevertheless, it was thought that unless there were valid reasons to the contrary, these suggestions should be tried, and it was hoped that the expense of extra staff would be repaid by increased efficiency.

RECOMMENDATIONS ON WATCH KEEPING BY THE AIR COUNCIL COMMITTEE

Recommendations were examined by an Air Council Committee and accepted in principle, and, though it was not considered possible to lay down hard and fast rules for hours of work, the Council emphasised that peace-time standards must be wholly disregarded, and that the normal working week for men in the offices, in the workshops and elsewhere should not be less than sixty hours. Airwomen, on the other hand, should not generally be required to work for more than a forty-eight hour week, but the Council realised that, in many instances where airmen and airwomen were working side by side, adherence to this rule would not be possible.

The proposals put forward were finally promulgated in an Air Ministry Order in October 1943. Personnel were required to work to a system involving seven consecutive night shifts. A minimum of eight hours' sleep a day was enforced in a period arranged after duty. The night watch was served with light refreshments in the middle of the night, and with a full meal at the end of the shift. Personnel had to take part in parades and other off-watch duties, so that, though excessive organisation of off-duty times was avoided, it was understood that they were not exempt from Service routine. It was provisionally laid down that no airwoman was to be employed for more than one and a half years on watch keeping duties in underground rooms if it could be avoided. (*See* Appendix.)

CONCLUSION

This narrative has traced in some detail both the formation and medical problems of a Group which came into being during the Second World War and which had no counterpart or precedent on which to base its formation. The entire conception of the location of enemy aircraft and shipping by radar made rapid strides in the early years of the war, and in many instances development of the apparatus outstripped the facilities for its correct housing in relation to the comfort of the crews who were responsible for its operation.

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It has been shown that the relative crowding of personnel and the routine and arduous nature of interpreting the display on the radar tubes provided certain medical problems both technical and hygienic, and the steps taken to combat these hazards have been outlined. Despite the prediction of many authorities, radar personnel kept singularly fit and efficiency did not appreciably deteriorate even when it became necessary for longer hours to be worked when shortage of personnel in the later years of the war made its effects felt.

When information was received in 1943 that attacks by pilotless missiles were likely to be made on this country, plans were made to combat this danger. A balloon barrage in depth was placed south of London and bombing attacks were made on launching sites of the missiles in enemy-occupied territory. In these operations the services of No. 60 Group were particularly valuable in giving rapid and accurate pin-pointing of the sites. It was also possible to give considerable information, as to the tracks of the missiles while in flight, to fighter aircraft engaged in shooting them down in the area between the English coast and the balloon barrage.

Though these latter commitments put a considerable strain on the resources of No. 60 Group and much advancement was made in both the apparatus and the interpretation, no major medical problems were encountered in the later years of the war, indicating that the initial medical suggestions on lighting and ventilation were adequate to deal with the advances of the modified and new apparatus which was introduced.

No. 60 Group was, throughout the war years, an important and highly secret formation. It was also a very contented Group, this being largely due to the careful selection of personnel of both sexes, the obvious importance of their work and its far-reaching results, which were easily recognised when reflected in the successes of our aircraft both over this country and over enemy territory. Perhaps the final factor in ensuring the success of the Group was the splitting up of the units into what amounted to small teams, the members of which were acutely conscious of the team's responsibility to the Group as a whole and their own responsibility to the team itself, thus kindling a spirit which was likely to produce results of the highest order despite the difficulties or poor working conditions which unavoidably prevailed at certain periods during the war years.

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APPENDIX

The system of watch keeping below was proposed and was adopted by No. 60 Group, with a few minor modifications, at the end of 1943.

THREE WATCH ROSTER (MINIMUM CYCLE OF 7 DAYS)

	2359—0800	0800—1600	1600—2359
First week:			
Monday . .	A	B	C
Tuesday . .	A	B	C
Wednesday .	A	B	C
Thursday . .	A	C	B (24 hours off for B)
Friday . .	A	B	C
Saturday . .	A	B	C
Sunday . .	A	B	C
Second week:			
Monday . .	B	C	A (32 hours off for A)
Tuesday . .	B	C	A
Wednesday .	B	C	A
Thursday . .	B	A	C
Friday . . .	B	C	A
Saturday . .	B	C	A
Sunday . .	B	C	A
Third week:			
Monday . .	C	A	B
Tuesday . .	C	A	B
Wednesday .	C	A	B
Thursday . .	C	B	A
Friday . . .	C	A	B
Saturday . .	C	A	B
Sunday . .	C	A	B

Total hours of duty=56 hours each for A, B and C each week.

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CHAPTER 12

THE ROYAL AIR FORCE REGIMENT

THE Royal Air Force Regiment was formed on February 1, 1942; all Royal Air Force elements of ground defence were then absorbed into it. This account is concerned with the history of the ground defence organisation from 1939 until the end of January 1942, and of the Regiment from that date onwards; the narrative relates briefly the general history of the defence personnel during the period and the part played by the Medical Branch in the establishment of an efficient force for the defence of airfields and other R.A.F. formations.

GENERAL ACCOUNT

Light anti-aircraft guns were issued to Royal Air Force stations during the years immediately preceding the war; these guns were manned by airmen of the defence force specially trained in their use and were intended for defence against attack by low flying aircraft. A number of rifles was issued and stored on stations for use in an emergency, but also employed on ceremonial occasions and for guard duties. Matériel was supplied on a more ambitious scale and the defence organisation was more carefully planned at certain stations of the Royal Air Force overseas, for example at Aden and Iraq, where levies consisting of locally enlisted personnel were raised for this purpose soon after the R.A.F. took over, and exercises in co-operation with the Army took place from time to time.

On the outbreak of war, the defence of airfields at home was undertaken by the Army without prejudice to the retention of the few Royal Air Force personnel mentioned above who constituted the station defence force. It was thought in the autumn of 1939 that attacks on airfields might be made either by small numbers of paratroops dropped for the purpose of sabotage, or by large numbers of airborne troops in support of a landing in force at some place on the coast nearby. Such attacks were not then thought to be a serious threat, and it was considered that the station defence force would be able to deal with small numbers of paratroops, so that it would be necessary to call upon the Army only when it was known that large numbers of the enemy were to be engaged.

During the period between the outbreak of war and the invasion of the Low Countries by Germany the number of airmen employed on defence duties increased very slowly, mainly because of the apparent

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absence of any serious threat to the safety of airfields; certain elementary precautions were taken at a number of stations in the United Kingdom and extra rifles were issued, but the policy was that technical personnel of the Royal Air Force should not be diverted from their work to carry out anti-sabotage duties or training for defence and this policy was firmly adhered to.

No further Royal Air Force preparations had been made by May when Germany invaded the Low Countries, although the British General Staff had long considered such an invasion possible as a preliminary to attack upon this country. The contrast between what was regarded as probable and what actually happened showed not so much lack of imagination as failure to realise fully the scope of the attack and the success which was to attend it. The fall of France and the lessons this taught about the defence of airfields showed the imperative need for adequate numbers of men and quantities of war material at home for defence, unfortunately at a time when much that had already been prepared had been lost and little was available to make good the deficiency or prepare for the future. The Army was unable to undertake the defence of the rapidly increasing number of airfields at home,* mainly because of the disorganisation after the withdrawal from France, a lack of weapons, and the shortage of adequately trained second-line troops; it was therefore decided that Army troops should be supplemented by increasing the numbers of Royal Air Force station defence personnel, recruiting men for training as riflemen and machine gunners.

Accordingly, a senior Royal Air Force officer was appointed as Director of Ground Defence on May 28, 1940 to bring into being an organisation for this purpose. Recruits were mainly drawn from the civilian population although a small number of Royal Air Force personnel were transferred from other trades. After a hurried preliminary training, these men were established on airfields in units of various sizes according to the degree of priority given; approximately 29,000 men were brought into the Service from civil life for station defence duties and with those airmen previously enlisted to man anti-aircraft guns, a total of nearly 35,000 were employed on ground defence duties at home by October 1940.

The difficulties of a joint responsibility became apparent for the first time during the summer and autumn of that year. The airmen were controlled by Royal Air Force officers and were under the command of station commanders; Army troops of the various units, including the anti-aircraft and artillery, were commanded through corps, division and brigade commanders by the General Officer Commanding, Home Forces. An Army officer was appointed Inspector of Airfield Defence in

* A peak figure of over 600 airfields and landing grounds was reached at the end of 1944.

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January 1941 to advise on all matters of station defence affecting both the Army and the Royal Air Force; he agreed with the many other experienced officers that the situation was not satisfactory, and in the summer of 1941 the Defence Committee (Operations) ordered that an investigation should be made to determine whether such defence personnel should belong to the Army or to the Royal Air Force.

After full consideration of all the relevant facts the conclusion was arrived at that the proper solution was to create a Royal Air Force defence corps within the existing Royal Air Force organisation, under the control of its own officers, although ultimately responsible to the Army authorities.

The whole matter was taken into consideration at a meeting of the Chiefs of Staff Sub-Committee on November 21, 1941, and the report subsequently issued by the Sub-Committee urged the adoption of the majority of the proposals put forward. Three needs for airfield defence were detailed:

(*a*) Anti-aircraft defence, particularly against low flying aircraft.

(*b*) The holding of defended localities, a permanent defence works and fortified buildings, from which sites a considerable volume of fire power over the airfield should be possible.

(*c*) The provision of a highly mobile force for hunting, mopping up, and counter-attacking, with as great a volume of mobile and protective fire power as possible.

It was thought that these three needs could be met by the proposed Royal Air Force Defence Corps, and that the new organisation would allow the Royal Air Force to be responsible for local garrisons on its airfields in accordance with a policy to be formulated with the guidance of the Army, and for the control of defence preparations and arrangements through the Royal Air Force chain of command. The responsibility of the Army would remain that of ensuring the security of airfields as of other vital objectives against ground attack, reinforcement and relief and the forces required for them also being an Army responsibility, and Army commands having the right to satisfy themselves concerning the adequacy of local defence arrangements. The adoption of these recommendations resulted in the formation of the Royal Air Force Regiment.

TRAINING

AIRMEN

Twenty-nine thousand airmen were recruited in the trade of Aircrafthand General Duties for ground defence between the summer of 1940 and the spring of 1941.* They were posted to the Recruit Centre,

* There was considerable wastage from this force during the period because large numbers of the recruits were promised that they could re-muster to aircrew and other trades.

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Blackpool, in Technical Training Command, where they received the training of an ordinary recruit, each course lasting no more than three weeks in the summer of 1940.*

The subjects taught included foot drill, physical training, musketry, bayonet fighting, Service organisation, air-raid precautions (including anti-gas training and fire-fighting) and the care of equipment, while a few periods were set aside for lectures by the medical officer and the chaplain and for inspections and organised games. It was fully realised that this training period was much too short, but it was impossible to make any improvement until September 1940 when the course was extended by one week. The total number of instruction periods was then approximately 150; of these, 100 were spent in teaching drill, physical training, air-raid precautions, musketry and bayonet fighting, only 36 of these 100 periods being devoted to the last two important subjects. Efforts to lengthen the training period were continued throughout 1941; although it never fell below three weeks, it was not possible to increase it to the desirable ten weeks.

After this brief and variable period of training, the airmen were posted to stations for ground defence duties and during 1940 they were thereafter dependent for further training upon what their officers and non-commissioned officers could teach them. Courses of training in aircraft recognition, weapons, musketry and the passive defence of airfields were begun at various centres early in 1941, but this training was piecemeal and to some extent haphazard; men sent on the courses had not all attained the same standard of proficiency, and it was possible for some contingents to miss courses altogether. Recognition of the particular needs of ground defence personnel had been achieved by the autumn of 1941 and the airmen, who were then called ground gunners, received a more specialised training during a six weeks' course.

In September 1941, Nos. 20 and 22 Recruit Centres at Filey and Whitley Bay respectively were set aside for the training of ground defence personnel alone, the centres previously having been used for training recruits irrespective of trade. The course was of nine to ten weeks' duration, of which five or six weeks were spent on initial recruit training under Royal Air Force instructors, and four on more advanced training under Army instructors. Just over 13,000 gunners were trained

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* The period of training for recruits had previously been:
Fourteen weeks from 1919 to 1934.
Ten weeks in 1935.
Fourteen weeks from 1936 to 1938.
Ten weeks from 1938 to September, 1939.

The course had been reduced to six weeks in September 1939, and the further reduction was forced upon the authorities after the Campaigns in Norway, the Low Countries and France, when very large numbers of recruits were needed for the Royal Air Force.

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between September and the end of the year, when recruiting for ground defence temporarily ceased.

OFFICERS AND INSTRUCTORS

Officers of the defence force in 1940 were mostly those who had had experience in the Army during the War of 1914–18; the rest were young officers commissioned in the Royal Air Force after selection for ground defence duties. Many of the officers with Army experience were elderly, and although they possessed considerable experience of war and of Army organisation teaching, it was not thought that they would prove to be the most suitable to train and encourage young, enthusiastic airmen. The senior officers were, however, appointed to command the station defence forces, in the rank of flight lieutenant or squadron leader, and to assist station commanders in all matters relating to the defence of airfields. These officers continued to command defence contingents until the summer of 1941, and some of them remained with Ground Defence, and later the R.A.F. Regiment, after this date, but it was necessary to train new officers to replace those who had retired and to provide flight commanders for the growing forces of ground defence.

All existing sources of supply had been exhausted, with the exception of that of commissioning from the ranks under the terms of an Air Ministry Order which had been promulgated in 1940. Airmen selected under this Air Ministry Order, and direct entrants from civil life who had been accepted for commissions in the Royal Air Force for ground defence duties, were trained at No. 166 Officer Cadet Training Unit (O.C.T.U.) at Douglas, Isle of Man, which was lent to the Royal Air Force by the Army with a full complement of instructors and staff; liaison officers were supplied by the Royal Air Force and courses of twelve weeks' duration began on August 5, 1941. The trainees accepted for the first four courses were all commissioned and by the end of the first year 561 officers and 854 cadets had passed through the Unit.

In the early months of the war, there were no R.A.F. personnel fully qualified as instructors in defence duties and the training of airmen at the Recruit Centres was carried out by personnel who had themselves received only a limited amount of instruction; the position was a little better at stations where use could be made of the experience of officers and men who had fought in the previous war, or who had since served in the Army, and where assistance could be given by Army officers and others in the surrounding district. Some improvement was made as the ordinary instructors became more experienced in their dealings with airmen for ground defence, but no large-scale change was made until September 1941, when two recruit centres, as already mentioned, were reorganised for the training of defence personnel only and 532 experienced Army instructors were lent to the Royal Air Force.

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Similar difficulties were encountered in the training of the 'Backers Up' (ordinary airmen trained in defence duties), whose efficiency in defending airfields had always been an integral part of the whole scheme of defence; these personnel had received exactly the same preliminary training as other ground defence airmen before special courses were instituted for the latter, but for further training they were dependent upon what they might learn from their fellow airmen in the defence contingents and upon whatever instruction they might obtain from Army officers and others with some experience of active service.

WEAPONS AND ARMOURED FIGHTING VEHICLES

The only change in weapons suggested in 1939 was that a larger number of rifles should be issued to airfields for use by station defence personnel and other airmen who would be released from their normal duties for defence purposes in an emergency; it was recommended that a total of 250 rifles should be issued to each airfield in the Priority I category, and that 50 rifles should be held at other airfields. In the spring of 1940, rocket guns were set up in batteries at airfields considered to be particularly liable to enemy attack, and in the early summer a small number of armoured fighting vehicles, Armadillos Mark I, became available. The Armadillos each carried two protected Lewis guns and were intended for use as mobile pill-boxes whose occupants would be capable of dealing with aircraft carrying airborne troops and with paratroops before they had assembled. Another new weapon, the Smith gun, which as in production about nine months later, had been designed at short notice with a view to efficiency at limited ranges and great simplicity of construction and employment; it was intended for use by the 'Backers Up' rather than by whole-time defence personnel and was designed for action against light vehicles and concentrations of airborne troops on the ground. The gun was normally towed on a wheeled axle and when needed for firing was very easily set up by being turned on to one wheel, so that the axle became vertical instead of horizontal. A shortage of Service rifles and machine guns and ammunition became acute early in 1941. The armament needs of the recruit centres were considerable, and early in the year it was suggested that some of the weapons used at these centres should be replaced by wooden dummies; this scheme allowed the substitution of dummies for 50 per cent. of the real rifles, but the first consignment of 8,000 dummies was not available until August owing to supply and manufacturing difficulties. Shortages of all kinds were a serious embarrassment to training programmes during the spring and summer, but by the autumn, the situation was more satisfactory—at least as far as rifles, anti-aircraft machine guns and Smith guns were concerned;

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further supplies of Armadillos Marks II and III were ready, and a few Beaverettes Mark III had also been manufactured.

It was estimated at this time that more than 1,500 armoured fighting vehicles would be needed by ground defence personnel, apart from the requirements of the 'Backers Up' at low priority airfields; such quantities were not then available, and it appeared unlikely that they would be until the spring of 1942. The needs of artillery sections were reviewed at the same time and as it was already clear that heavier armament would be necessary, it was proposed that a two-gun section of 75 millimetre guns should be substituted for one of the three sections of Smith guns in the proposed establishment of standard squadrons; it was hoped that 100 such guns would be available by January 1, 1942, and another 60 by the spring.

THE FORMATION AND DEVELOPMENT OF THE REGIMENT

The interest taken in ground defence, particularly during the last half of 1941, greatly influenced the general attitude towards the creation of the R.A.F. Regiment. Much progress had already been achieved by the discussion and reports referred to in this narrative, for these had cleared away much of the confusion about the function of ground defence, and the success of the new Regiment was further assured by the inherent advantages of such a formation.

The Inspector of Airfield Defence was appointed Director-General of Ground Defence with effect from January 5, 1942, and assisted by a Director of Ground Defence (Planning) and a Deputy Director-General. The Directorate was divided into four branches, responsible for:

(*a*) the development of new weapons;
(*b*) organisation, administration and supply;
(*c*) liaison with the War Office;
(*d*) matters concerning personnel.

Many of the senior officers of the Directorate had had extensive experience of ground defence and the Director-General himself was an Army officer.

Command defence officers were appointed to the staffs of Commanders-in-Chief at home as advisers on Regiment matters and on the defence of airfields within each particular Command, while group defence officers were appointed in a similar advisory capacity to the staffs of Air Officers Commanding Royal Air Force Groups.

Programmes of recruiting and training commenced early in 1942, but were unfortunately hindered by the limitation of man-power and supply of weapons, as well as by defects which, although present since the beginning of the war, were only brought to light by the new programmes.

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In April 1942 it was estimated that approximately 40,000 men would be needed for the Regiment, and arrangements were made that these should be trained at the rate of 5,000 a month on courses lasting twelve weeks; accommodation for 15,000, including the necessary instructors and administrators, would be required for this training alone. The authorities at Technical Training Command suggested that the course should be divided into two parts: the first, lasting four weeks, to consist of close-order drill and elementary training at No. 9 Recruit Centre, Blackpool; the second occupying eight weeks and consisting of advanced training at Ronaldsway, Whitley Bay, Filey, Hocking or Hednesford. Recruiting for this training began in June 1942, and all the gunners completed either a ten or a twelve weeks' course; the training ended in December 1942, by which time 11,000 trained men had been posted into units of the Regiment, the greatly reduced number being due to man-power shortages.

Courses were also started for the training of officers and instructors. The first course for non-commissioned instructors of the Royal Air Force began in January 1942 at Filey and lasted six weeks; during the following months 3,700 non-commissioned officers completed this course, 1,250 of them being specially selected to attend further courses at No. 166 O.C.T.U. at Douglas, and at Whitley Bay and Filey; here they received such instruction as would enable them eventually to replace the Army non-commissioned officers who had been acting as instructors at Nos. 20 and 22 Recruit Centres since September of the previous year. The replacement was completed by the end of November 1942. Officers continued to be trained at No. 166 O.C.T.U. until September 16, when the course was transferred to the R.A.F. Regiment Officer Cadet Training Unit which opened at Sidmouth; nine instructors to supplement the Royal Air Force staff were lent by the Army, and 39 officers and 346 cadets passed through the unit during the succeeding eight months.

The training schemes which have been briefly outlined were essentially of a preparatory nature. The whole scheme of defence depended upon the efficient training of the personnel at stations and airfields who would in reality constitute the defence force; the greatest obstacle to this training had been the shortage of instructors and therefore, immediately the training of R.A.F. Regiment airman instructors and officers began in earnest, the selection and training of instructors for the large force of 'Backers Up' was started. The problem was tackled in many different ways; in January 1942 a flight of defence personnel from each Command was trained as a demonstration rifle flight and toured stations of the respective commands to assist in local station training; in June, 'Station Personnel Combined Instructors' Courses' of three weeks' duration began at Arbroath, Skegness, Eastchurch and Hereford,

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3,252 instructors being trained in the next ten months and a further 870 between April 1943 (when the courses were transferred to the R.A.F. Regiment Depot, Grantham) and July 1943.

The result of all this training and the better supply of weapons and ammunition was that by February 1, 1943 no fewer than 64,000 airmen and 6,000 officers of the Royal Air Force Regiment had completed officially recognised courses and 43 per cent. of all officers and 64 per cent. of all other ranks on the strength of Royal Air Force stations at home had completed at least one of the courses for 'Backers Up'.

From this date no major difficulties were encountered in training and the position improved in regard to both man-power and suitable weapons, so that in the final phases of the war the Regiment, from being a haphazard force of untrained, unskilled men, had grown into an organisation of highly trained and versatile troops, ready for immediate action in the defence of airfields and with a well-established position among the other branches of the Royal Air Force.

LIVING CONDITIONS

The defence contingents at stations and airfields shared the facilities available for airmen of other trades, so that the only differences in the life of defence personnel were those which arose from the nature of their work. No large scale changes were made until the beginning of 1941, when training centres (e.g. No. 1 School of Ground Defence) began to take airmen for courses; these courses, however, affected living conditions very little, for sleeping, messing and living accommodation were similar to that at the stations from which personnel were drawn. During the summer of 1941 certain defence personnel lived in tented camps under field conditions but this was nothing new to their fellows in other trades on stations where lack of accommodation had made tented camps necessary.

Circumstances began to change late in 1941, when Nos. 20 and 22 Recruit Centres were set aside for the training of recruits for ground defence only; facilities at these centres were essentially the same as those at any other recruit centre but there was some degree of overcrowding. Early in 1942, the R.A.F. Regiment Depot was formed at Filey, where it remained for only a short period before being moved to Grantham in May 1942. The premises taken over at Filey were those of a peace-time holiday camp which could accommodate approximately 1,500; there were some complaints about the accommodation and living conditions, for instance that the chalets were not suitable for the accommodation of troops in winter, and that the officers', sergeants' and airmen's messes and dining halls were bare and uncomfortable, but although these criticisms were probably justified, conditions were no worse than at many stations all over the country during the preceding two and a half years.

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Similar comments might be made about the tented or temporary camps which accommodated Regiment personnel and 'Backers Up' on courses held by the various authorities within the Regiment and within commands at home, but there was no evidence that defence personnel suffered more inconvenience or discomfort than did other personnel, nor that efforts to improve conditions were less on their behalf than for officers and airmen of other branches or trades.

MEDICAL ARRANGEMENTS

Defence personnel at airfields were covered by the unit medical arrangements for contingents who had no separate medical personnel or equipment. In the early days, there was little differentiation between defence and other personnel, and airmen were treated in the same way as those of any other trade; no special medical examinations were required and their accommodation and sick quarters, movement to hospital or visits to specialists were all matters of routine. Similarly, medical arrangements at recruit centres where ground defence recruits were trained, corresponded to those at all other recruit centres.

Some differentiation began to be shown in 1941 when the schools of ground defence were opened and local defence exercises were more frequent, for it then became apparent to certain medical officers that the specialised work of ground defence personnel exposed them to risks peculiar to their trade. Illness related to exposure or injuries sustained on exercises became more frequent among ground defence personnel, although at first such cases were not numerous. By the autumn of 1941 the differences had become quite clear to the medical officers associated with the training of personnel, particularly at the special recruit centres, but at stations where defence personnel were in the minority most of the medical officers were too occupied with other urgent duties to observe such differences. The separation of defence personnel from other airmen was completed by the formation of the Regiment and the medical difficulties which then arose are fully discussed in the following paragraphs.

MEDICAL STANDARDS: SEPTEMBER 1939 TO JANUARY 1942

The standard of fitness required of airmen selected for ground defence during the early months of the war was similar to that for entry into the Royal Air Force—i.e. any man who reached the standard of Grade I, Grade II, Grade IIa (Feet) or Grade II (Home Service Only) was accepted. The men who trained at Blackpool in 1940 were within these limits of fitness, and although a considerable proportion of these personnel were in the lower grades, the preliminary training received at Blackpool was neither sufficiently arduous nor specialised to prove a severe test of fitness in any respect, and it was not until the introduction

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of specialised training in 'toughening' and battle courses with special weapons, that minor physical defects began to be apparent. (*See* Plates LIII and LIV.) In February 1941 the Medical Directorate was informed by No. 1 Ground Defence Gunnery School that several men who had recently been sent for training had had a visual acuity of less than 6/60 in each eye; it was decided at Air Ministry that men to be employed on ground defence gunnery duties must have eyesight within visual standards I, II or III (the lowest standard permitted by this ruling being 6/60 unaided, correctible to either not less than 6/12 in each eye, or not less than 6/6 in the right and 6/36 in the left eye). At the same time instructions were issued that airmen selected for training should be tested by the unit medical officer, these instructions being incorporated in Air Ministry Orders in April.

In August, Air Ministry was informed by the same school that airmen selected as ground gunners and arriving for training were not medically fit for the duties which they were called upon to perform. Several airmen were found to be suffering from chronic bronchitis, asthma or defective hearing, and it was discovered that a few were drawn from the medical category Grade III. No change had been made in the standards required for ground defence personnel and the school was therefore instructed that any airman who was found medically unfit to carry out the duties of his trade should be dealt with under King's Regulations and Air Council Instructions.* This was the first instance brought to official notice of men whose disabilities remained undiscovered until they were subjected to a course of training more strenuous than the short, easy preliminary course at Blackpool.

The employment of personnel was not always understood at the stations to which they had been posted; in some instances they were regarded as interchangeable with aircrafthands and mis-employed on a great variety of duties throughout stations and camps; many defence personnel were properly employed on guard duties but some were engaged in duties which neither provided any test of their physical condition nor helped to improve stamina or fitness.

During 1941, further cases were discovered of men who were unfit for their duties and these were dealt with as described above. In October, a change of visual standard was made, when instructions were issued that the colour vision of recruits to ground defence and all candidates for defence courses should either have normal colour vision

* Paragraph 1446, clause 2(g) of King's Regulations and Air Council Instructions (2nd Ed.) stated that when an airman's fitness to perform the duties of his trade was called into question, the medical officer was to forward his Form 48 (medical history) with a report on Form 39 (medical report) to the commanding officer, who, if the medical officer thought the man unfit, was to refer the case to the Air or other Officer Commanding for decision.

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or be colour defective safe. No further changes in medical standards for defence personnel were made during 1941 and the first month of 1942.

MEDICAL STANDARDS: FEBRUARY 1942 TO OCTOBER 1943

The formation of the Regiment made necessary a thorough review of medical standards. Accordingly, at a meeting held at Air Ministry in February, 1942 it was decided that the following standards should be required in gunners and tradesmen accepted for the Regiment:

(*a*) Physical condition and hearing—Grade I, Grade II or Grade II (a) (Feet).
(*b*) Visual acuity—visual standards I, II or III.
(*c*) Colour vision—normal or colour defective safe.

This was the first time that a complete and separate standard had been laid down for defence personnel, and it was to be applied to all new recruits and to all those gunners and tradesmen who elected to be transferred into the new Regiment from Ground Defence. From the outset, difficulties were experienced in the application of this standard since all personnel coming into the Regiment from any source required examination. Very large numbers of men were being examined for their standard of fitness for the first time since their initial medical examination on joining the Royal Air Force.

FITNESS OF PERSONNEL FOR DUTY WITH THE ROYAL AIR FORCE REGIMENT

When the Regiment was formed, it was realised that a considerable number of the personnel transferred to it from Ground Defence were not up to the required standard of fitness; some of these men had been employed on Ground Defence since the summer of 1940, and apart from those who, on re-examination, were re-categorised to a lower standard, there were many who were rendered unfit by the newer and higher standards which had been introduced from time to time. It was obvious that these men would eventually have to be discharged from the Regiment on medical grounds, but it was decided to retain them for a time because the immediate withdrawal of such a large number of men would seriously affect the man-power position of the Regiment, for at that time replacements, even of untrained men, could not be obtained quickly. This unsatisfactory situation had to be accepted, but in order to simplify the eventual change, the men of the Regiment were divided into two classes, Gunners 'X' and Gunners 'Y'; Gunners 'X' were those who were fit for duty with the Regiment according to the new medical standards, and Gunners 'Y' were those who, although they had been trained as part of the Ground Defence forces, did not reach the required physical standard. Such a scheme allowed unfit personnel to be replaced gradually by new intakes of trained men.

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During the summer of 1942, standards of training were raised for both the newcomers to the Regiment and those formerly employed on Ground Defence. The courses became more rigorous and much additional instruction was given, and the greater effort on the part of the men which this entailed gave rise to a state of affairs not altogether unexpected by the Director-General of Ground Defence and his staff. It became apparent that some of the men previously assessed as fit for duties as Gunners 'X' were not in fact fit to do all that was expected of them in the new training courses: in addition, a number of the men newly recruited for the Regiment from civil life were being rejected on medical grounds both at the Depot and at the various Regiment training schools, the consequent discharges at No. 2 School having been as high as 5 per cent. on one intake. Discharges were made on the grounds of lack of stamina, or of development of physical conditions after recruits had been accepted and medically graded, but a number of the cases seemed to be due simply to failure to reach the required medical standard. It was decided at Air Ministry, by the branches concerned with the recruiting and training of R.A.F. Regiment personnel and with their medical standards, that a full investigation should be made. Accordingly, all relevant medical authorities were directed to forward separately all statistical returns dealing with the Regiment, and to submit a full statement on the case of every airman rejected for further service in the Royal Air Force Regiment on medical grounds. It was also pointed out that the reasons for the high later rejection rate of those accepted were not understood, because all trainees had previously been examined and passed as fit either by a Royal Air Force medical officer or by doctors at a Ministry of Labour and National Service Medical Board. Within a short time a total of 142 cases had been referred to Air Ministry; of these 95 were approved for re-mustering, 8 were not approved and 39 were returned for a further report. The chief causes for rejection were defective vision, functional nervous diseases, chest diseases or diseases of the ear, nose and throat. These cases were all trained Regiment personnel and therefore the discovery of physical defects did not reflect in any way upon medical officers or civilian doctors who had been examining recent recruits for the Regiment.

The views of the medical authorities, incorporated in their reply to the Air Ministry, were that the standards of training were possibly too high, or that the time allowed for the training was insufficient; that some of the officers responsible for local training had carried their enthusiasm further than had been intended, and that the men whose standard of fitness approximated very closely to that of personnel accepted for the Royal Artillery were unable to make the extra effort involved without the appearance of certain physical defects.

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The ensuing discussions between Air Ministry and medical authorities at units raised once more the problems of standard, in which all branches were interested from the point of view of the rejection rate at the training centres. In September 1942 those responsible for higher policy became increasingly anxious about the wastage rate of recruits for the Regiment in comparison with that of recruits for other trades and branches in the Royal Air Force, so that in addition to the information already called for, a fresh enquiry was instituted with the object of ascertaining how the health of the Royal Air Force Regiment personnel on stations compared with the health of other Royal Air Force ground personnel. The scope of the enquiry was to include reports on comparable percentages of personnel attending sick parade and comments on whether any particular ailments such as persistent colds or foot conditions were prevalent enough to cause a high rate of sickness; further, any evidence which suggested that men of the Royal Air Force Regiment reported sick with trivial complaints more frequently than other airmen was to be examined and comments submitted.

The results of the enquiry became available in October. Each of the Commands at home returned statistics dealing with personnel at six typical stations, except for Technical Training Command which assessed the permanent Regiment staff at three stations and Balloon Command where returns related to Royal Air Force Station, Cardington, the only 'typical' station from the point of view of the Regiment in the Command. The following table summarises the findings:

Percentages Reporting Sick Daily

Command	R.A.F. Regiment	Ground personnel	Approximate ratio of sickness
Army Co-operation	2·5	1·84	4 : 3
Balloon	4·0	1·0	4 : 1
Bomber	2·0	0·95	2 : 1
Coastal	1·76	0·7	2½ : 1
Fighter	5·7	2·7	2 : 1
Flying Training	1·5	0·97	1½ : 1
Maintenance	0·87	1·01	4 : 5
No. 44 Group	0·87	1·24	2 : 3
Technical Training	1·61	1·33	4 : 3
Average percentage reporting sick daily	2·31	1·30	2 : 1

Medical officers varied considerably in their interpretation of the instructions and particularly of the meaning of the word 'trivial'; consequently, there was much difference of opinion as to whether R.A.F. Regiment personnel did in fact report sick more readily than

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personnel in other branches. Many medical officers emphasised that large numbers of Regiment personnel reported sick with foot conditions such as blisters, mild sprains, ingrowing toenails, painful heels and painful first metatarsal-phalangeal joints, which although not serious disabilities, caused great pain and inconvenience and therefore affected marching.*

When, however, the more exacting conditions of service and the greater exposure were allowed for, it was not considered that the sickness rate was unduly high nor that any useful steps could be taken to reduce it.

MORALE

Airmen employed on ground defence duties before the outbreak of war enjoyed the high morale common to all personnel of the Royal Air Force, but a change began to be noticed especially in the United Kingdom and in France on the outbreak of war and became more marked as the war progressed; flying personnel, tradesmen and administrative staff all had a common and immediate aim in prosecuting the war against the enemy and it was not difficult for them to understand the way in which their own individual exertions assisted the total war effort. Defence personnel, on the other hand, were without this spur to endeavour; there were few in positions of authority who were willing to release, for ground defence duties, men who were mentally and physically capable of working as tradesmen, and consequently the least fit airmen eventually found their way into ground defence.

In June 1940, when the danger of enemy attack upon airfields at home had become very great and large numbers of men were recruited from civil life to form the defence force, a process of selection was still apparent; this selection was not carried out deliberately at the National Service Boards, but was rather the inevitable result of 'creaming off' those men fit for flying duties or suitable for the skilled technical trades essential in the Royal Air Force. It was natural that the first choice of keen, fit and patriotic young men should be the flying branch, with one of the more attractive trades as a second choice; consequently a large proportion of the unenthusiastic or unambitious who did not volunteer for these duties were drafted into ground defence, where they joined other men who had not succeeded in reaching the requisite physical standard for flying or other operational duties, or for whom there had been no vacancy in the trade of their choice.†

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* Further tables showing comparison of sickness incidence between the R.A.F. at Home and the R.A.F. Regiment are shown in the Appendix to this Chapter.

† *See* Chapter 9—'Functions of Technical Training Command in the War Years'.

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PLATE LIII: R.A.F. Regiment Trainee attempting an Obstacle on an Assault Course. It will be clearly seen that only the fittest Personnel could accomplish such Courses

[facing p. 688

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PLATE LIV: A Group of R.A.F. Regiment Trainees on an Assault Course. Numbers make for a Competitive Spirit. Note Battle Conditions being simulated by the exploding of Pyrotechnics

facing p. 689]

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The short training period available in the early days combined with the shortage of instructing staff and material rendered it impossible to produce a disciplined and well-knit body of men. This fact, while acceptable in respect of skilled tradesmen whose work was individual, produced difficulties where men might be exposed to the strain of active warfare.

All these difficulties which attended the creation of a defence force made the problems of organising, administering and training the force more formidable. Much of the energies of the authorities was devoted to creating the defence organisation and to meeting material needs, leaving little time or opportunity to put plans for training into effect; the efficiency of any unit of the defence force therefore depended largely on the efforts of the officers and men constituting the unit and consequently varied greatly from unit to unit, according to their drive, initiative and competence; it would have been surprising if a satisfactory general standard had been achieved in such circumstances. The appointment of an Inspector of Airfield Defence in January 1941 was a great step forward, for this officer, who had wide military experience, was able to compare units one with another and to assess the fighting value of the defence force. The courses which began later in the year slowly effected a great change for the better in the outlook of defence personnel in that the first of the younger and newly trained officers began to arrive at units, the new recruits received a much improved training, those who had been in ground defence from earlier days received proper instruction often for the first time, and the men's feeling of ineffectiveness was replaced by a sense of confidence in their fighting ability.

Medical interest in problems of morale was not aroused to any extent until the Regiment was formed. There were two important reasons for this: first, the exertions of the airmen of the defence force had not until the very end of 1941 been sufficient to reveal individual weaknesses of significance and, second, any such weaknesses were not associated in the minds of medical officers with the function of ground defence. Airmen of the defence force were no more remarkable than airmen in any other trade and although medical officers did interest themselves in diseases peculiar to trades, they did not usually draw a distinction between groups of airmen in different trades from the point of view of their morale, because the morale of the airmen on a station was viewed as a whole. When the Regiment was formed, however, it was regarded as a body of men whose title suggested definite functions and responsibilities and one of the changes made was the introduction of a separate sick parade for Regiment personnel; this arose from the irregular hours of work of the Regiment and the increased amount of medical attention which became necessary after the introduction of intensive methods of training.

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It has already been shown that the human material provided for the defence force was not always of the best, and among other problems brought to light by the formation of the Regiment was the fact that, despite all the great efforts made in 1941, a significant proportion of unsuitable men remained to be absorbed into the new formation. High standards were set by the Officer in Command and their importance was continually stressed by speakers in the Service and in public life.

During 1942, many reports were received from medical officers suggesting that a proportion of the personnel of the Regiment were not as energetic or enthusiastic as they might be. On consideration of these reports it was evident that the two main reasons for this were:

(*a*) A feeling that ground defence was really an Army commitment. This resulted in such service being unpopular with R.A.F. tradesmen.

(*b*) A sense of frustration arising from long-continued training for eventualities which never materialised.

These grievances were still apparent when the training schemes for 1942 had been put into effect because although the Officer Cadet Training Unit had by this time produced a number of young and enthusiastic officers whose ambitions for the Regiment were limitless, the new officers did not always realise that their enthusiasm was not shared by large numbers of the airmen under their control,* who had already spent a comparatively lengthy period in the defence force.

SPECIAL MEDICAL PROBLEMS

In the following pages some mention will be made of medical problems peculiar to the Regiment, for although the latter was in every way a R.A.F. formation, much of its work and essential function was closely allied to that of the Army, with the result that the medical problems were akin rather to those normally found in Army regiments than to those found in the R.A.F. as a whole.

FIELD HYGIENE

Sanitation. In war-time, R.A.F. formations tended to be based on a more permanent footing than the Army in regard to sanitation, for even when mobile R.A.F. formations began to operate in closer liaison with field regiments, the rank and file of the R.A.F. were rarely engaged in active fighting; it was to be expected, however, that personnel of the

* In this connexion, it is interesting to note the suggestion that some of the Regiment officers who had been posted to operational stations found that the continually related experiences of flying personnel spurred them on to greater efforts in the hope that they too would soon be able to recount the deeds of the Regiment under operational conditions.

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R.A.F. Regiment would come into closer contact with the enemy and that their location would be less permanent, and sanitation and allied problems were therefore dealt with on a strictly field basis.

In practice, members of the Regiment were normally able to share the sanitation facilities available to the R.A.F. in general, but as field sanitation might become necessary, it was important for officers and men alike to receive thorough instruction in all aspects of this subject. This knowledge was particularly necessary for Regiment personnel serving abroad.

Water Supplies. It was essential for personnel to be given considerable instruction on the problems of water purification and sterilisation. Normally water was procurable from station sources but when on the march or engaged in operations the Regiment had to be able to rely on its own resources. The standard Service water bottle was carried and where applicable water sterilising tablets were issued. Personnel were also taught the principles of husbanding water supplies when on the march, exercises and dummy attacks providing an opportunity for practising 'water drill'.

Sleeping. In the case of personnel who were liable to serve abroad, special attention was given in lectures to the proper handling and care of mosquito nets and the use of insect repellents.

Care of the Feet. Although the tedious method of moving troops by foot over long distances, which was such a feature of the First World War, had been largely replaced by mechanisation, Regiment personnel had to be prepared to carry out long forced marches and exercises which involved covering, in a comparatively short time, twenty or more miles of rough country.

Medical officers gave instruction to all ranks on the care of the feet under such conditions. Nevertheless foot complaints were one of the main causes of minor disability among Regiment personnel. Investigation showed two causes:

(*a*) The failure by young, fit and enthusiastic officers to realise the limitations of older airmen and to acclimatise them gradually.

(*b*) The fact that in many instances neither officers nor airmen appreciated the importance of the subject and failed to insist on or apply the simple precautions involved.

Clothing. Standard battle-dress with boots and anklets comprised the normal uniform and apart from tropical kit this remained the wear for the Regiment throughout the war period, camouflage capes and other items being issued as necessary. The uniform was found to be satisfactory and little complaint was received, although the anklets were considered by some to be constricting and to hinder ventilation from the top of the boots; anklets, however, were essential to prevent dust and mud from entering the boots when on exercises and in the tropics

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they had the added usefulness of preventing the access of such unwelcome visitors as leeches, ants and small scorpions.

First Aid. As fighting troops Regiment personnel had to be trained in the rudiments of first aid, for, as has already been mentioned, units of the Regiment might have to be self-supporting for some time when normal medical aid was not available. Special attention was given to instruction in the use of the 'first field dressing' (a large medicated pad stitched to a broad, six foot long bandage) which was carried by all personnel, and to elementary treatment for fractures and gunshot wounds, with particular reference to simple methods of warding off shock.

Commando Courses. The necessity for members of the R.A.F. Regiment to be trained in all methods of fighting resulted in a marked toughening in training methods, the most notable of which were the assault courses which included the surmounting of a series of obstacles, such as walls, ditches and hurdles, at the double, in full battle kit (Plates LIII and LIV). Apart from the considerable physical strain involved, such training resulted in a number of minor sprains, bruises and occasional fractures and it was largely through these courses that the older men were weeded out because of such defects as chronic bronchitis or varicose veins. These cases among men who on examination had been categorised as Grade I were only brought to light by the actual strain of training, and the position is well summed up in the words of a medical officer after he had inspected an assault course: 'In my opinion a young active man only is fit to undergo this training and to undertake the duties for which the training is preparing him. Consequently a man for these duties must be Grade I and it is suggested that consideration should be given by the executive to laying down a maximum age of 35 years. If it is intended to train some squadrons for defence duties only, who will not have to undergo such strenuous training, then Grade II(a) (feet) men could be used in these squadrons. Similarly Grade I men in the 'ack ack' squadrons who, although they have no physical disability necessitating the lowering of their medical category, are incapable of standing up to the severe training, could be transferred to such squadrons.'

VISUAL STANDARDS

In January 1943, investigation into the visual standards of recruits passing through the R.A.F. Regiment Depot at Grantham revealed a position which was far from satisfactory; men were being accepted with a visual standard of Grade III, which implied that, although corrected vision was either 6/12 in each eye or 6/6 and 6/36, the unaided vision was poor and instances of 6/60 acuity in both eyes were not uncommon.*

* *See also* Medical Standards: September 1939 to January 1942.

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Although this standard approximated to that adopted by the Army, it created a greater problem in the Regiment in that the number of men with defective vision was very much higher in relation to its size than the comparable figures for the Army.

The tasks that the Regiment was likely to undertake were singularly protean, ranging from anti-aircraft defence and the removal of land mines to acting as front line assault troops, and it was considered that a man with visual standard Grade III could carry out these duties efficiently only if wearing glasses and that in the event of their loss or damage he would be useless;* furthermore, mist and rain tended to cloud the spectacles and the wearer's ability in reconnoitring or attack would be dangerously curtailed.

In order to assess the extent of this problem an experiment was carried out on the range with men of poor visual capacity, the test comprising application shooting at 100, 200, 300, 400 and 500 yards on the standard Bisley target. The tests (without glasses) were undertaken in good weather and yielded the following information:

(*a*) The deterioration of shooting efficiency at ranges over 100 yards without spectacles was very marked in men with unaided visual acuity lower than 6/24, and quite considerable in those with lower than 6/12.

(*b*) Few men with vision lower than 6/18 could distinguish the markings in the target at over 200 yards. This implied that they fired at a vague object which they knew to be the target, but if they had been called upon to fire in action, it is doubtful whether they could have picked out their target unaided.

(*c*) The comparatively good scores obtained at 100 yards was of interest, as theoretically it would appear that the difficulties of shooting at 100 yards should be only slightly less than at greater ranges.

The conclusion drawn from this experiment was that a visual standard of Grade II would be acceptable, as men with 6/12 acuity or more were little handicapped without their glasses and this standard would eliminate men with unaided visual acuity of less than 6/12 in the right eye.

Unfortunately, however, desirable as these alterations may have appeared it was not possible to introduce the higher standard as the man-power shortage dictated the necessity for continuing to utilise personnel whose visual standard was only Grade III and the Regiment, in common with other formations, had to carry a proportion of men who ideally should have been eliminated.

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* A special mobile orthoptists' caravan was available on the Normandy beach-head for the repair and issue of spectacles.

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CONCLUSION

Much of the medical commentary would appear to be critical, but it should be remembered that the R.A.F. Regiment was formed during a period when the country was fighting for its very existence and that not only man-power but also the materials and weapons of war were in extremely short supply; it is therefore not surprising that difficulties were encountered. It is to the credit of all concerned that in almost every instance these difficulties were overcome.

The efforts made in 1942, supported by considerable encouragement from higher authority, together with the influx of younger officers and the issuing of distinctive shoulder flashes, produced a fine *esprit de corps*, which was further fostered by friendly rivalry between the Regiment and Army units and between the various units of the Regiment itself. At the same time the weeding out of the physically and mentally unfit resulted in a very great improvement in the calibre of those who comprised the Regiment in the later war years.

A detailed description of the achievements of the R.A.F. Regiment is not appropriate to this narrative, but it should be noted that units of the Regiment were in action in the Middle East as early as 1941 and that it was in fact men of this draft who took part in the heroic but ill-fated attack on the Island of Cos. To sum up, throughout the war years the Regiment played its part in all campaigns and actions where the R.A.F. was a participant and acquitted itself well in whatever demands were made upon its services.

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APPENDIX

Notifiable Diseases—1943

Comparison between the total R.A.F. at Home and the R.A.F. Regiment.

Disease	R.A.F. at Home		R.A.F. Regiment	
	Numbers of cases	Rate per 1,000	Numbers of cases	Rate per 1,000
Catarrhal jaundice	2,332	3·50	124	2·80
Cerebro-spinal fever	109	0·16	9	0·20
Chickenpox	575	0·78	18	0·41
Diphtheria	191	0·19	19	0·43
Dysentery	425	0·65	11	0·25
Malaria	484	0·74	30	0·68
Measles	812	1·24	32	0·72
Mumps	1,245	1·90	66	1·50
Pneumonia	1,412	2·16	68	1·54
Scarlatina	801	1·20	19	0·43
Tuberculosis	935	1·43	33	1·75
Venereal	5,846	9·00	312	7·10

Incidence of Total Sickness—1943

(Rate per 1,000 per annum)

Month	R.A.F. at Home	R.A.F. Regiment
January	644	815
February	552	718
March	517	608
April	437	509
May	411	434
June	383	370
July	368	426
August	380	443
September	410	413
October	453	432
November	751	943
December	632	618
Average	495	560

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