USAF HISTORICAL STUDY NO. 179

P.R.C.

PROBLEMS IN THE CONDUCT OF A DAY AND NIGHT DEFENSIVE AIR WAR

1 OCTOBER 1953

PREPARED BY THE USAF HISTORICAL DIVISION
THROUGH THE COOPERATION OF THE HISTORICAL DIVISION, HEADQUARTERS USAREUR

DEPARTMENT OF THE AIR FORCE

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By

JOSEF KAMMHUBER
General der Flieger, a.D.

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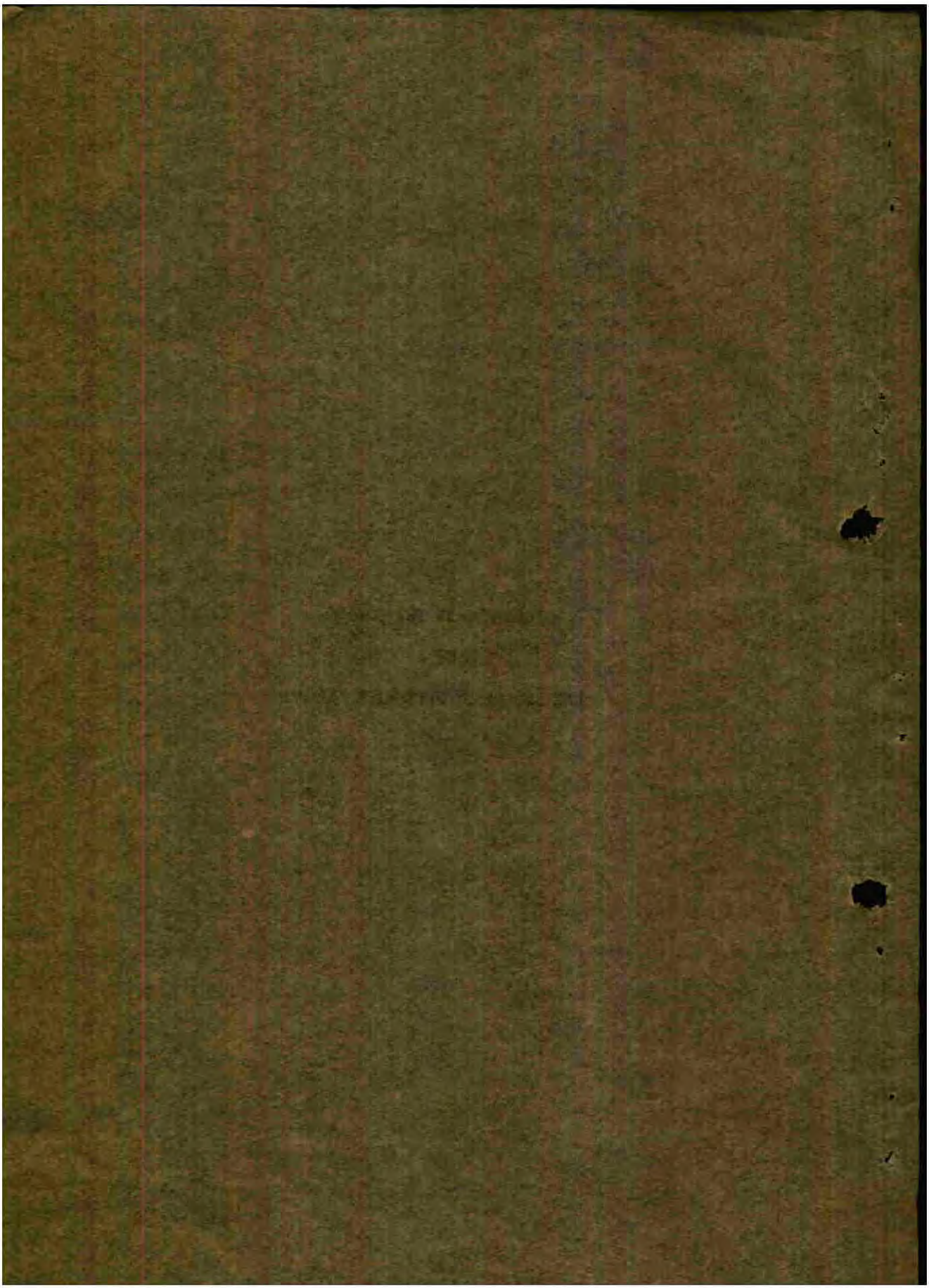

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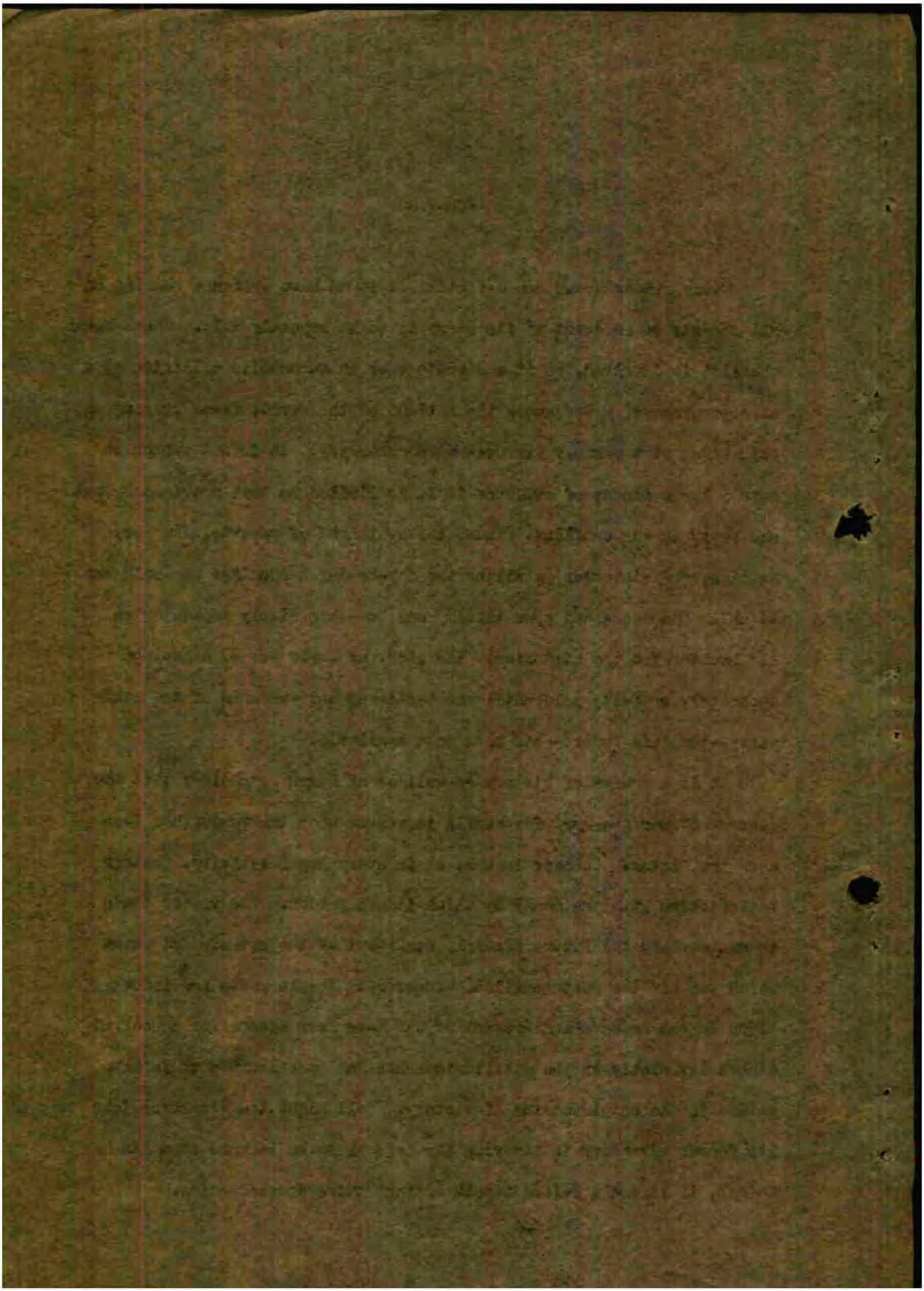
FOREWORD

Every reader knows how essential it is to have evidence bearing on all aspects of an event if its story is to be honestly told. Where human conflict is involved, be it a dispute over an automobile collision at a street corner or a war among the nations of the World, facts bearing on both sides of the story are even more necessary. It is not enough to have a large amount of evidence if it is limited to that provided by but one party to the conflict. Thus, the avalanche of reports, diaries, memoirs, and histories detailing the day-by-day happenings of World War II which has descended upon library and home has simply recreated an old problem for the historian. The story of World War II cannot be accurately or fully told until the testimony and evidence of the other party--the Axis Powers--has been made available.

It is a truism of history as well as of human psychology that the lessons of war are more forcefully impressed upon the vanquished than upon the victor. Success in war, as in every human activity, fosters satisfaction with the means by which it was gained. The victor tends to contemplate the future securely confident of the methods and means which won him the past conflict. Successful developments and innovations in the science and arsenal of war have been adopted or conceived almost invariably in the disillusionments and questionings of defeat, seldom in the complacencies of victory. Well might the Air Force join its former adversary in studying the lessons to be learned from his defeat, if it would defend itself against these complacencies.



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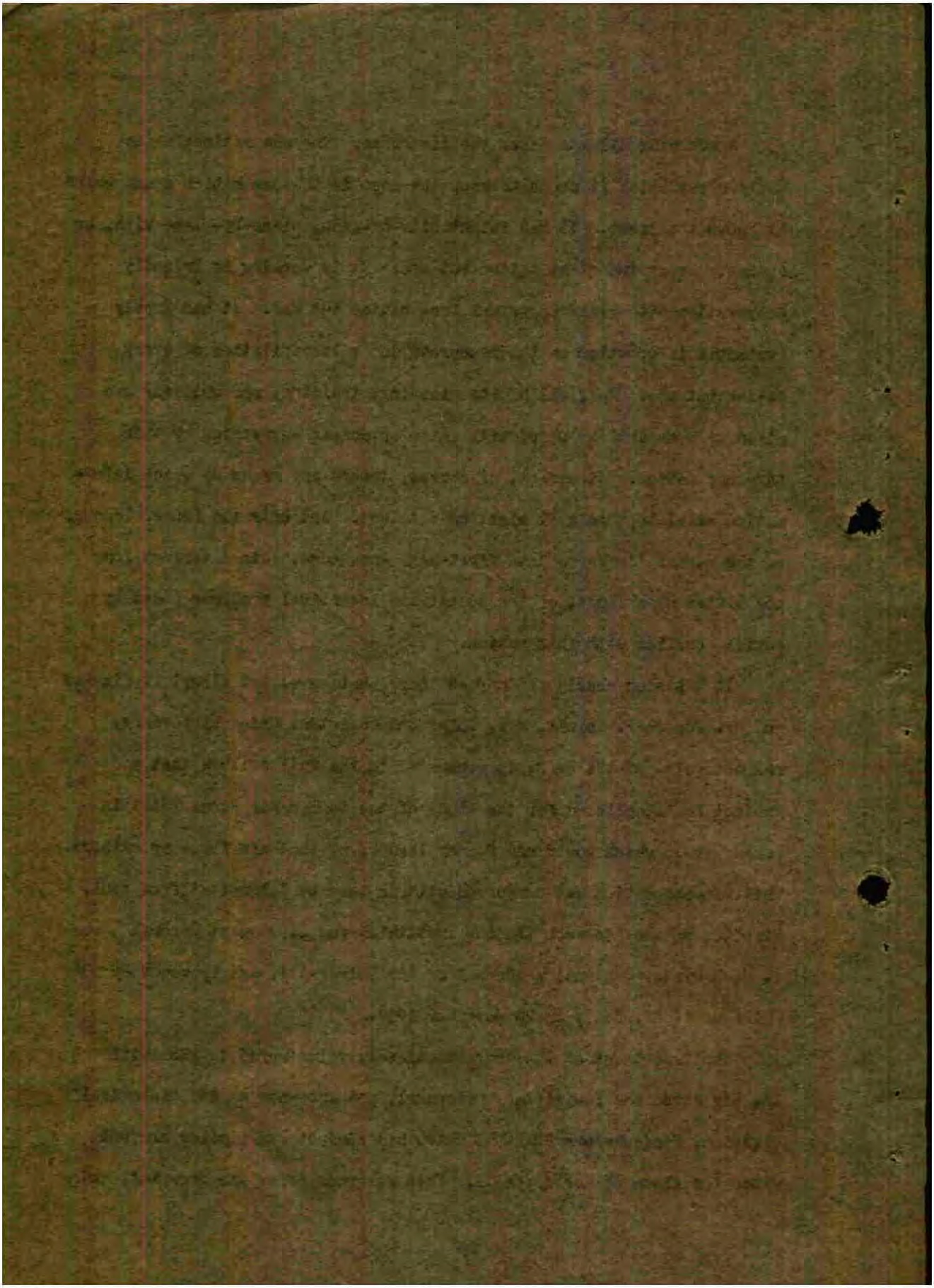
A sobering dilemma faces the Air Force. The one nation in the World about which it needs to know the most is the one nation about which it knows the least. It has fought side-by-side, plane-by-plane with, or against, every important nation but one. It is working in friendly cooperation with every important free nation but one. It has freely available information on the resources and vulnerabilities of every nation but one. Yet, all of its planning, training, and building are aimed at a capability which will deter or defeat aggression by this same one nation. It cannot, of course, ignore any means by which information vital to this goal might be obtained. And only the former leaders of the German Air Force have first-hand knowledge, gained through long and bitter experience, of the combat and logistical problems posed by aerial conflict with this nation.

It was such considerations as these that moved Dr. Albert F. Simpson and Mr. Joseph W. Angell, Jr., Chief and Assistant Chief Historians, respectively, of the USAF, to recommend in the fall of 1952 that a project be established for the study of the German Air Force (GAF) in World War II which would use former leaders of that air force as authors. This recommendation was concurred with in turn by Colonel Wilfred Paul, Director of the Research Studies Institute, and Lieutenant General I. D. Edwards, Commanding General of Air University, and approved by the Chief of Staff, USAF, on 26 November 1952.

The Department of the Army immediately volunteered to share with the Air Force the facilities, personnel, and know-how of its Historical Division, Headquarters USAREUR, which had conducted a similar project since the close of World War II. This generous offer was accepted, and



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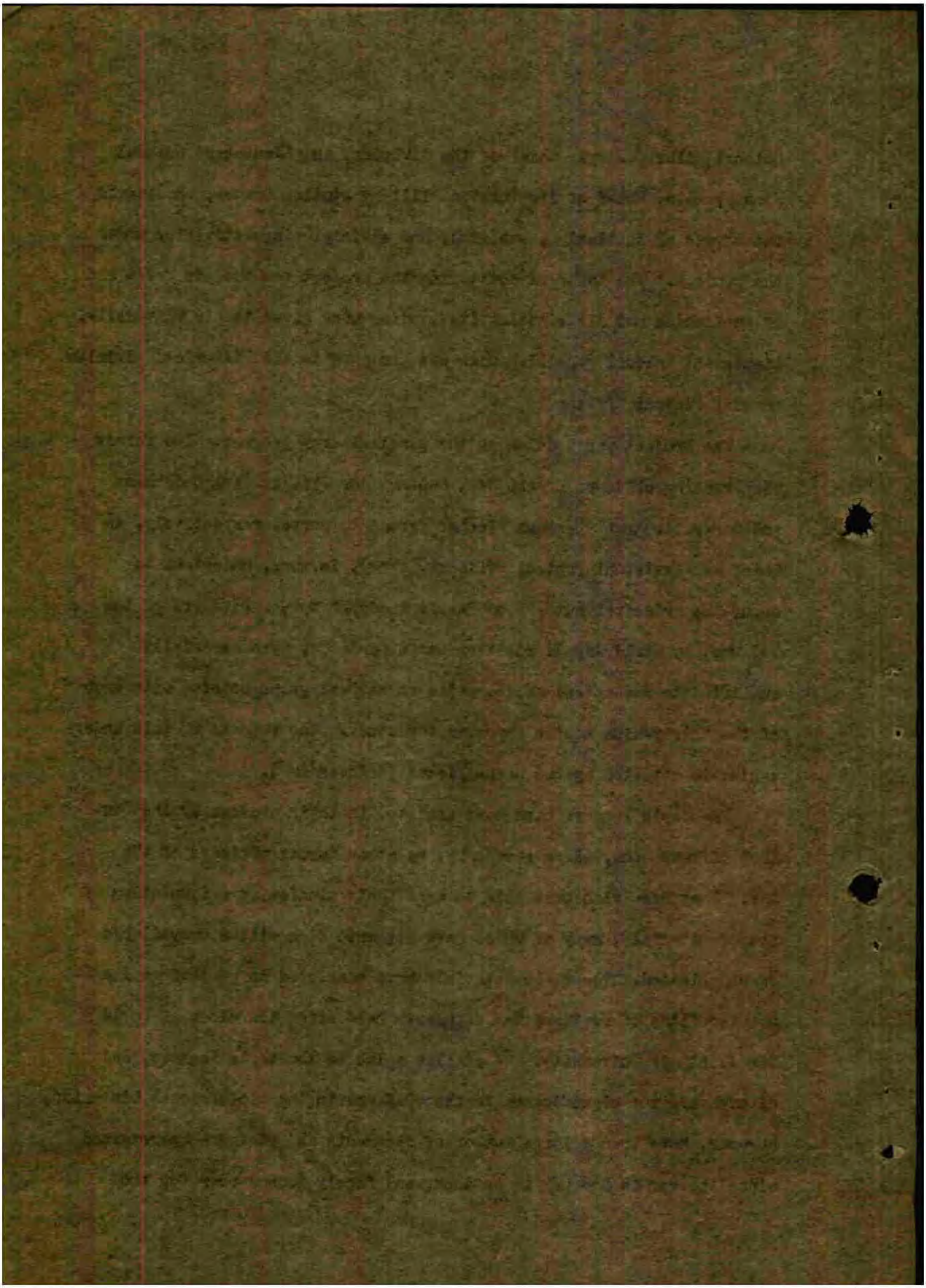
Colonel Wilbur S. Nye, Chief of the Division, and Lieutenant Colonel Hans M. Helm, Chief of its Foreign Military Studies Branch, shouldered the burden of initiating, staffing, and administering activities under the project. The tasks of monitoring the project for the Air Force and of publishing and distributing its studies were given to Air University. Lieutenant Colonel Wendell Hammer was assigned to the Historical Division as USAF Project Officer.

The Project was modeled on the parallel Army program. Two former high-ranking officers of the GAF, General der Flieger Paul Deichmann and Generalleutnant Hermann Plocher agreed to serve, respectively, as Chief and Assistant Control Officers. They, in turn, undertook to secure as principal authors or "topic leaders" former officers of the GAF who, by World War II position and experience, were especially qualified to understand and to write on happenings associated with each of the thirty-nine topics approved for study. The success of this undertaking is attested by the names listed in Appendix I.

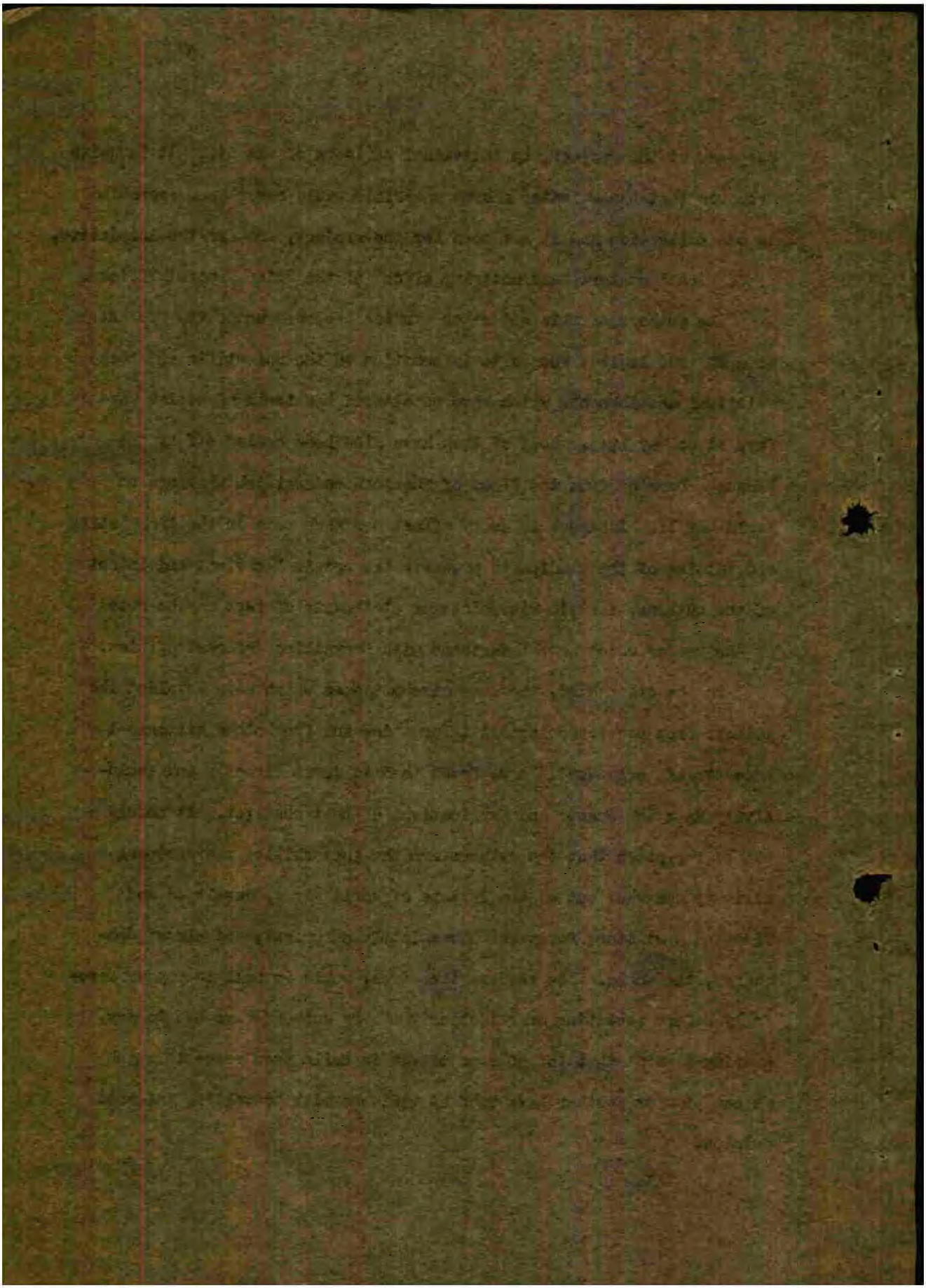
The topic leaders have been assisted in their studies by the Control Officers and, where necessary, by other former officers of the GAF. They have also been able to base their studies on a foundation of source materials, many of which have hitherto been either unavailable or unexploited. These new materials have consisted in part of copies or microfilms of captured GAF documents held since the close of World War II at Air University. Of similar value to the topic leaders, and of even greater significance to the USAF and to the professional historian, however, have been a large number of documents and photographs retained since the war in one way or another, and freely turned over for the



purposes of the Project, by individual officers of the GAF. It is quite probable that these latter source materials would never been assembled in one collection had it not been for the Project, and for the initiative, professional stature, and untiring effort of the Chief Control Officer.

The authors of this and other studies prepared under the Project have had but limited access to information on the scientific and technological developments which have so altered the tools of aerial warfare since May 1945. Most of them have also been sealed off by the language barrier from the flood of American and British writings on World War II. Inasmuch as every effort has been made in the translating and editing of the studies to preserve the original content and intent of the authors, certain viewpoints or statements of fact may be noted by the reader which are at variance with prevailing informed opinion.

On the other hand, the same circumstances which have shielded the authors from new technological information and from other historical accounts of World War II have freed them to focus directly and exclusively upon the events and implications of that conflict. It should not be forgotten that the authors are the same skilled professional military men who, out of the lessons of World War I, developed and directed a military force which completely surprised, and almost conquered, the World. The reader, therefore, would do well to ponder carefully before accepting or rejecting what the authors have had to say, bearing in mind that the science of war is built upon concepts which at one time or another have been at variance with prevailing informed opinion.



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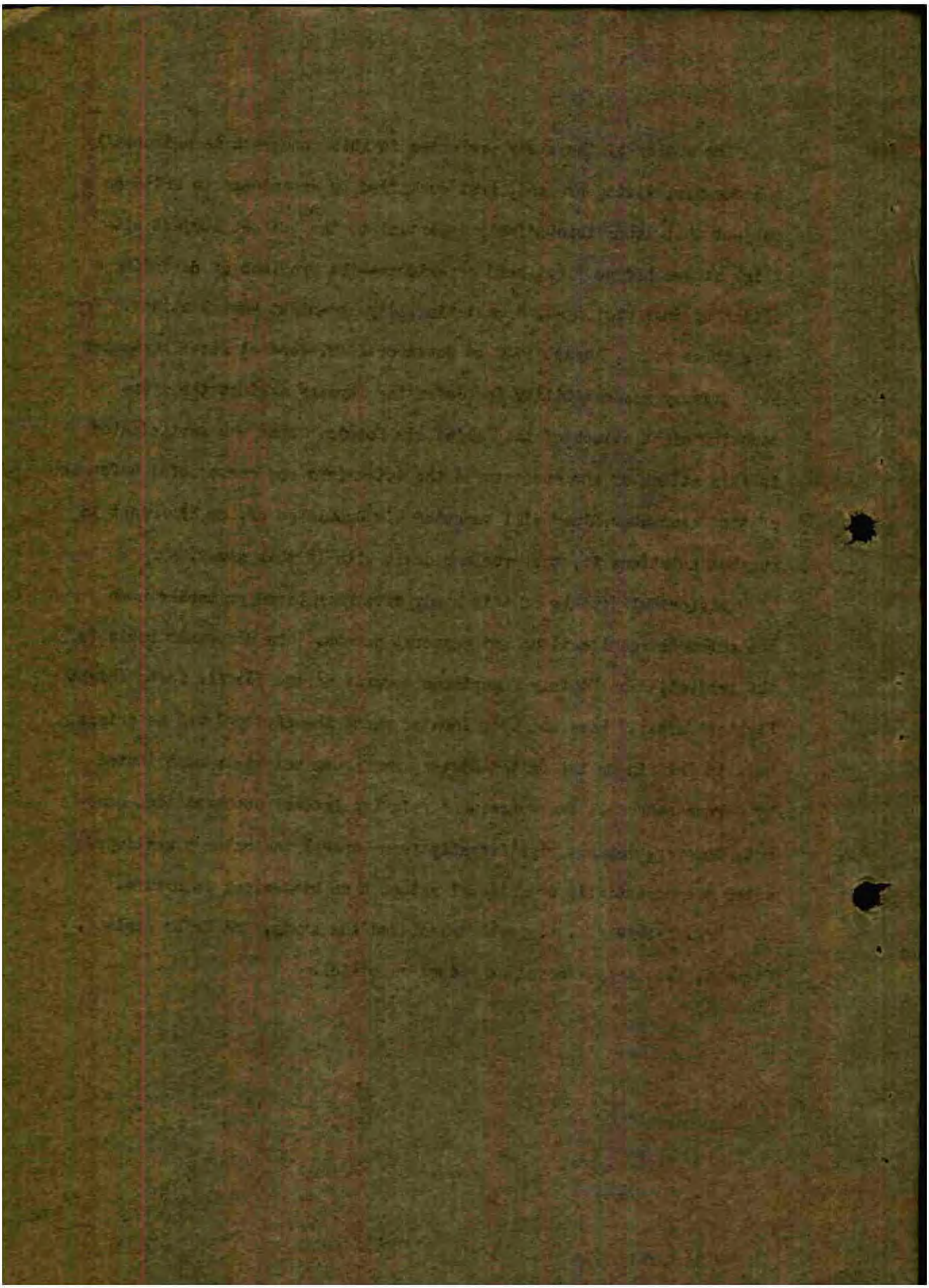
The author of the study presented in this monograph is undoubtedly the one man, living or dead, best qualified by experience to write on a subject that looms forebodingly important to the USAF—a subject with which it has had no first-hand experience—the problems of defending a nation against prolonged, devastating, day-and-night aerial attack. For over three years, August 1940 to November 1943, General Josef Kammhuber held primary responsibility for defending Germany against the ever-mounting night attack of the Allied air forces. None who participated in this attack or who encountered the determined and resourceful defenses of the "Kammhuber Line" will question his knowledge of, or his right to suggest solutions to, the problems dealt with in this study.

Historical aspects of this study have been based primarily upon the author's recollections and personal papers. The documents basic to the subject, "The Monthly Experience Reports of the XII Air Corps (Night Fighter Corps)," have not been located among the captured GAF materials held in Britain or the United States, nor among materials contributed by German sources. The consequent relative lack of documentation does not, however, detract significantly from General Kammhuber's writings, which are essentially operational rather than historical in nature.

Mrs. Patricia A. Klaserth translated the study, and Major Merle K. Stewart, U.S. Army, served as principal editor.



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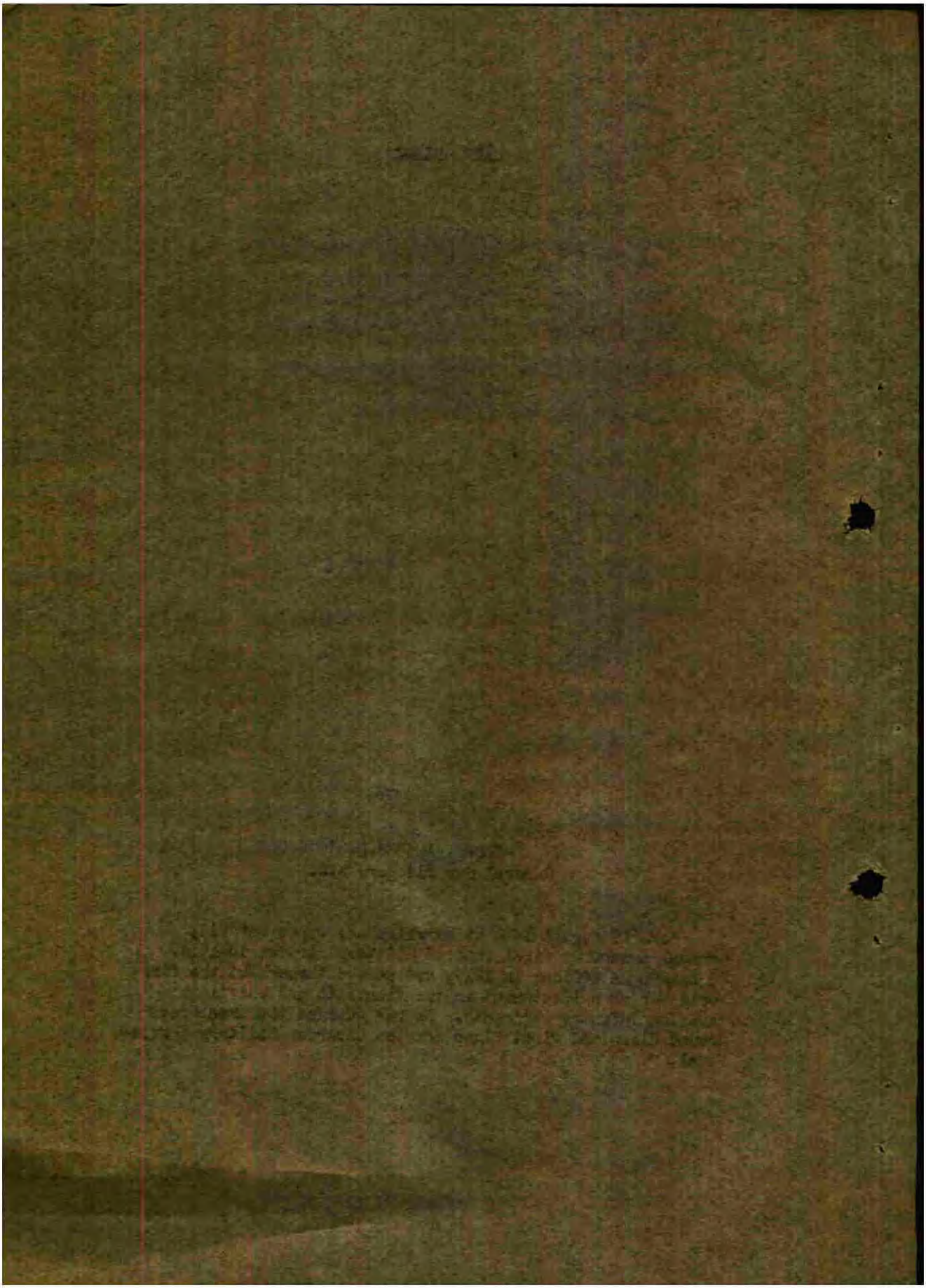
The Author

JOSEF KAMMHUBER
General der Flieger, a.D.

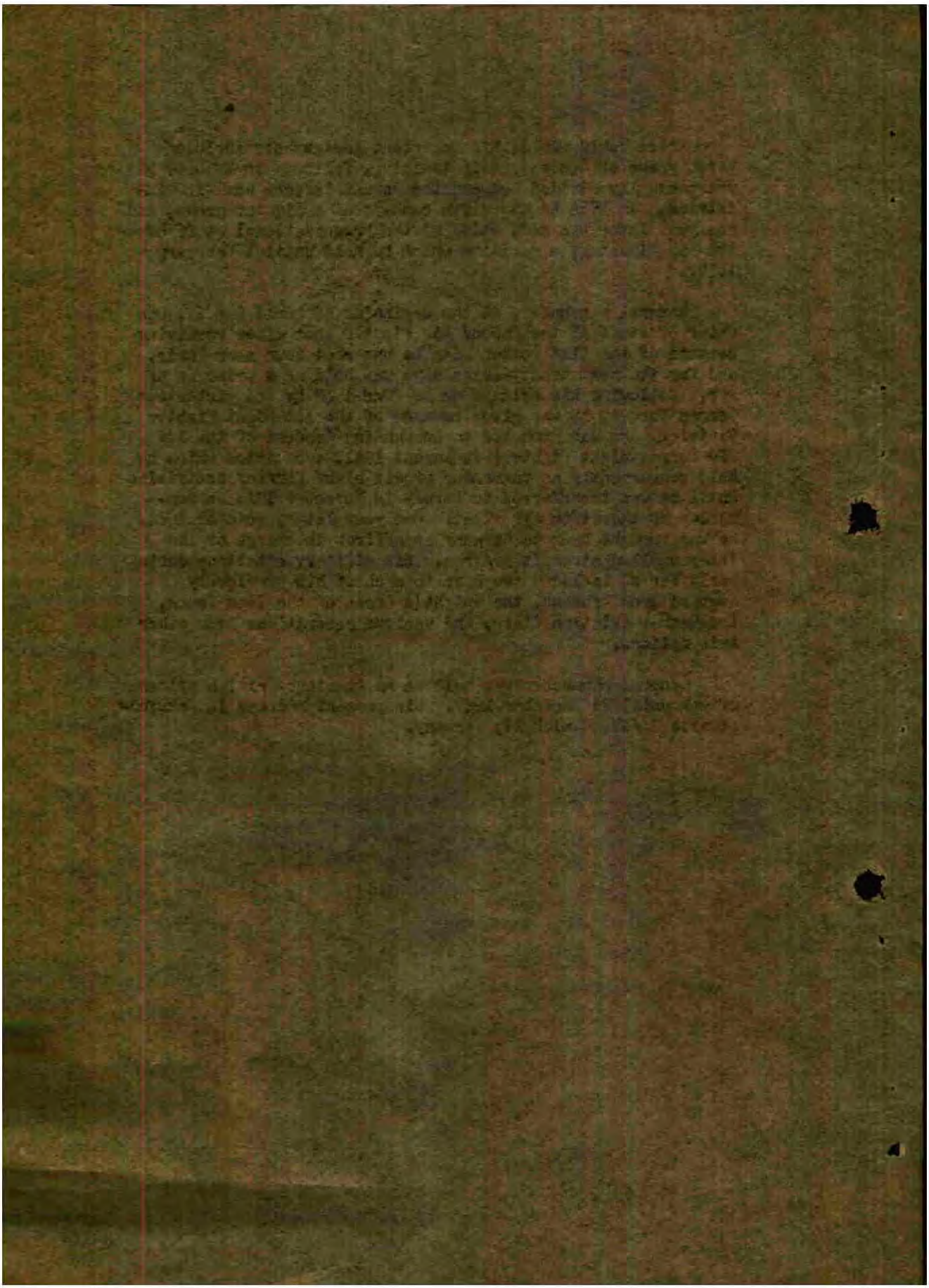
Born 19 August 1896 at Burghirchen, Upper Bavaria, General Kammhuber first entered military service in 1914. He became an officer in 1915, and served throughout the first World War as a lieutenant in the Twentieth and Thirtieth Bavarian Infantry Regiments. He was awarded the Iron Cross Second Class and First Class and the Bavarian Military Service Medal.



After World War I, his important assignments included three years of General Staff training, followed in 1930 by six years equally divided between the German Defense and Air Ministries. In 1936 he was given command of a fighter group, and one year later was made Chief of the Organizational Staff of the Air Ministry, a position which he held until 1 February 1939.

General Kammhuber, at the beginning of World War II, was Chief of Staff of the Second Air Fleet. Soon after receiving command of the 51st Bomber Wing he was shot down near Paris, and for the next twenty-seven days was held as a prisoner of war. Following his release on 30 June 1940 by the victorious German forces, he was given command of the 1st Night Fighter Division. He was promoted to Commanding General of the XII Air Corps (night fighter) in August 1941, a position which he held concurrently as commander of all night fighter activities until he was transferred to Norway in November 1943 as commander of the Fifth Air Fleet. One year later, October 1944, he was brought back to Germany as officer in charge of the jet-propelled aircraft program. His military citations during World War II included two bars to each of his previously awarded Iron Crosses, the Knight's Cross of the Iron Cross, the Combat Aviation Clasp, and various decorations from other Axis nations.

General Kammhuber was held as an American-British prisoner of war until 22 December 1947. His present address is Schwindstrasse 24/IV, Munich 13, Germany.



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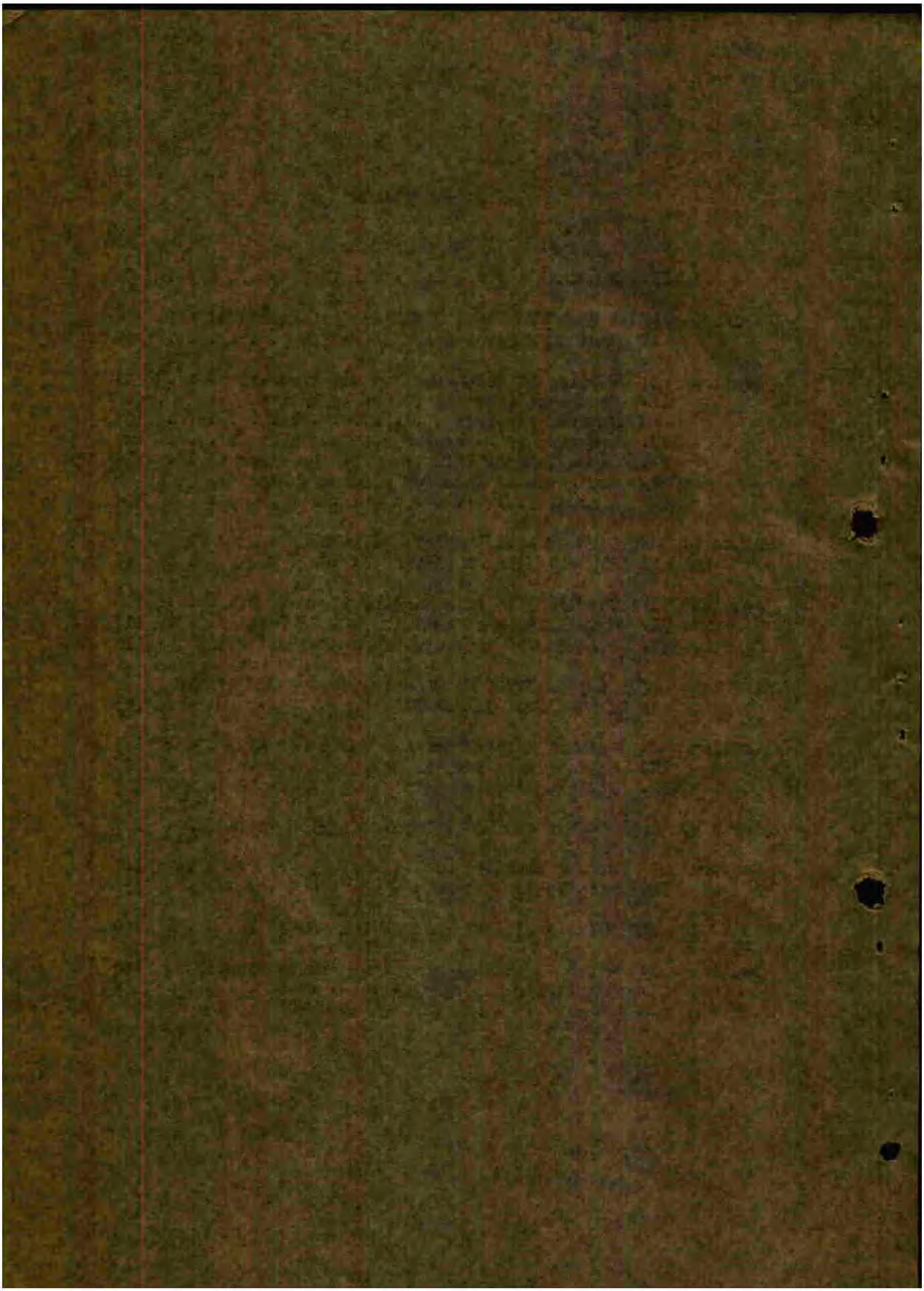

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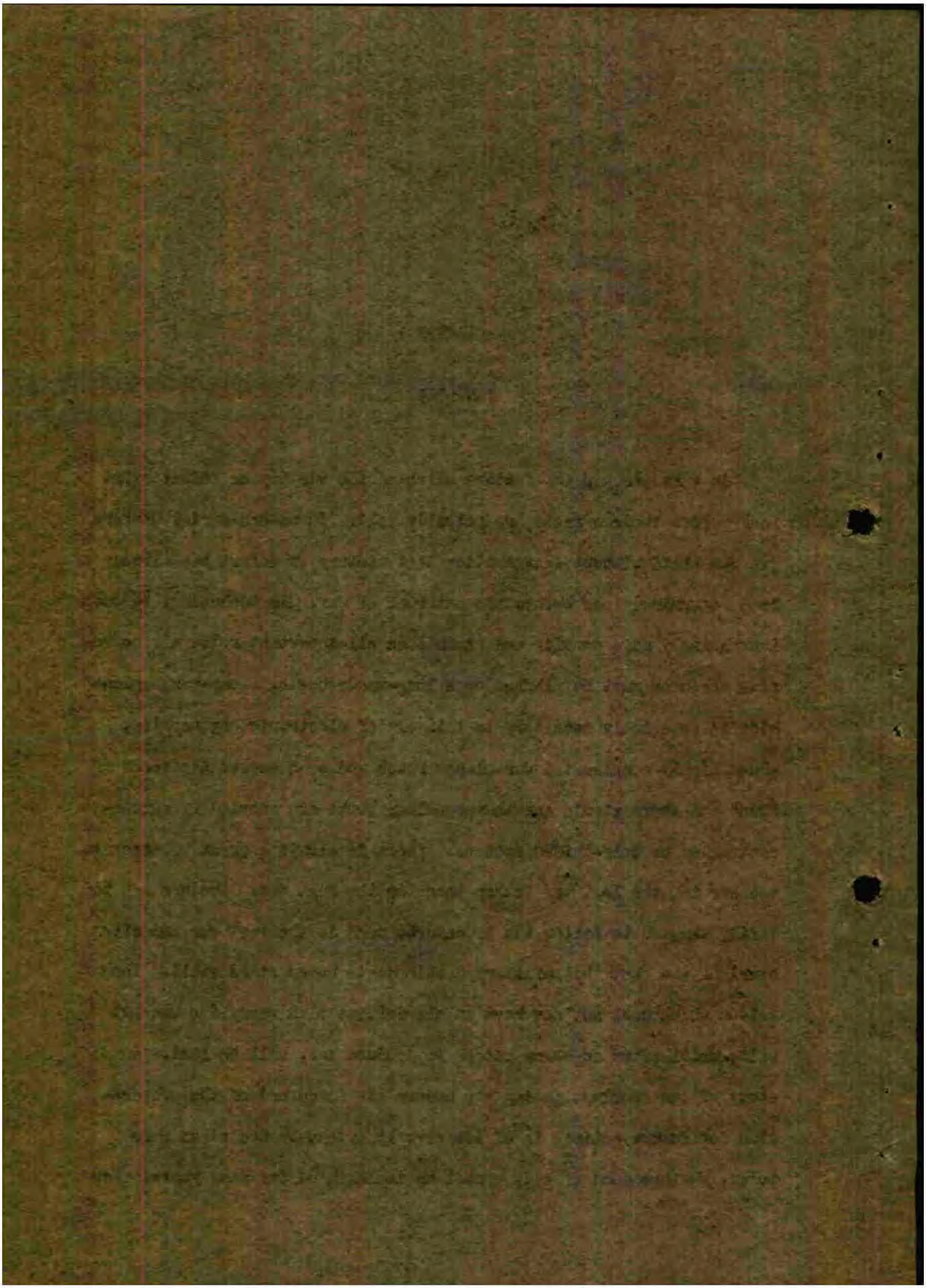
CHAPTER 1

INTRODUCTION

In a modern war the factors which decide victory or defeat exist long before their effects are actually felt. In modern aerial warfare one can state without exaggeration that victory or defeat has already been determined long before the outbreak of war. As technology becomes increasingly more complex and assumes an all-important role, air defensive measures must be planned on a long-range basis. Long-range planning is especially necessary in this era of electronic engineering, where highly complicated war planes reach and even exceed the speed of sound and where atomic and thermonuclear bombs are carried by remote-controlled or self-guided rockets. There is always a great tendency to prepare for the last war rather than for the next one. Leaders are too easily tempted to follow the procedures used in the last war and often overlook the fact that military developments never stand still. The nation which does not now have an air defense plan ready for use but waits until after an enemy attack to produce one, will be lost. A study of the problems facing the modern air force and of the preparation for future actions is of decisive importance. Decisions made today, whether good or bad, cannot be implemented for many years. New

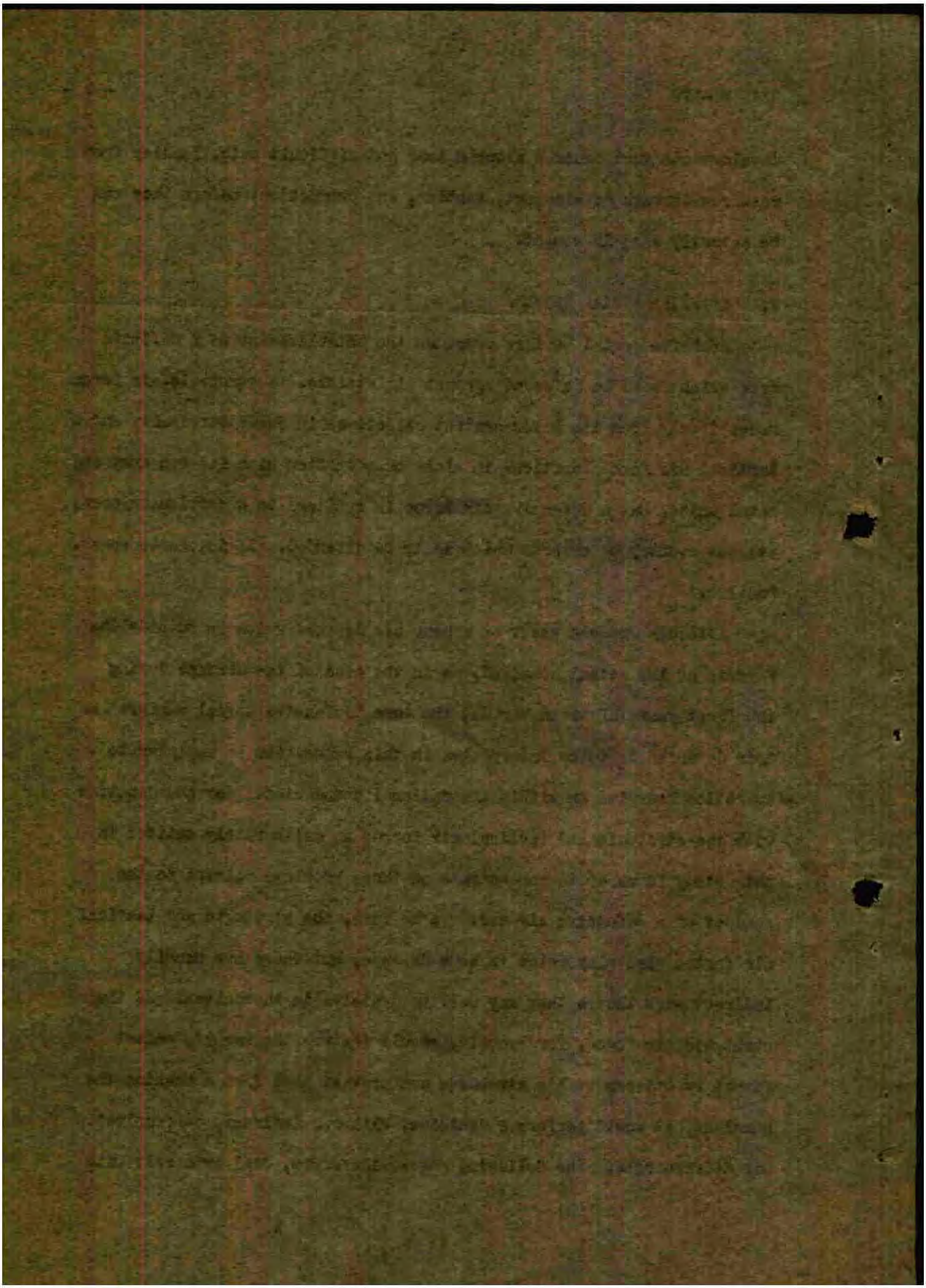


developments must proceed along a long and difficult path, leading from research through development, testing, and production, before they can be actually used in combat.

1. DEFENSIVE AERIAL WARFARE

Defensive aerial warfare presumes the establishment of a definite area which is to be defended against air attacks. A strategic air force moves freely from its bases against objectives in enemy territory, and a tactical air force functions in close coordination with its own army and naval units, but a defensive air force is confined to a particular area, its own country or an area which is to be defended. It is, so to speak, "native."

Although one can speak of a home air defense which is outside the borders of the actual homeland, as in the case of the Germans during the first years of World War II, the term "defensive aerial warfare" or "air defense" is to be interpreted in this exposition as applying to operations carried on within the national boundaries. Any coordination with the strategic and tactical air forces is deliberately omitted in this study in order to concentrate on those problems related to the conduct of a defensive air war. To be sure, the strategic and tactical air forces also play roles in home defense, but these are usually indirect even though they may well be decisive in themselves. If the strategic air force, for example, should destroy the enemy's combat forces by attacks on his air bases and prevent them from attacking the homeland, it would perform a decisive, although indirect, "offensive" air defense role. The following pages, therefore, deal primarily with



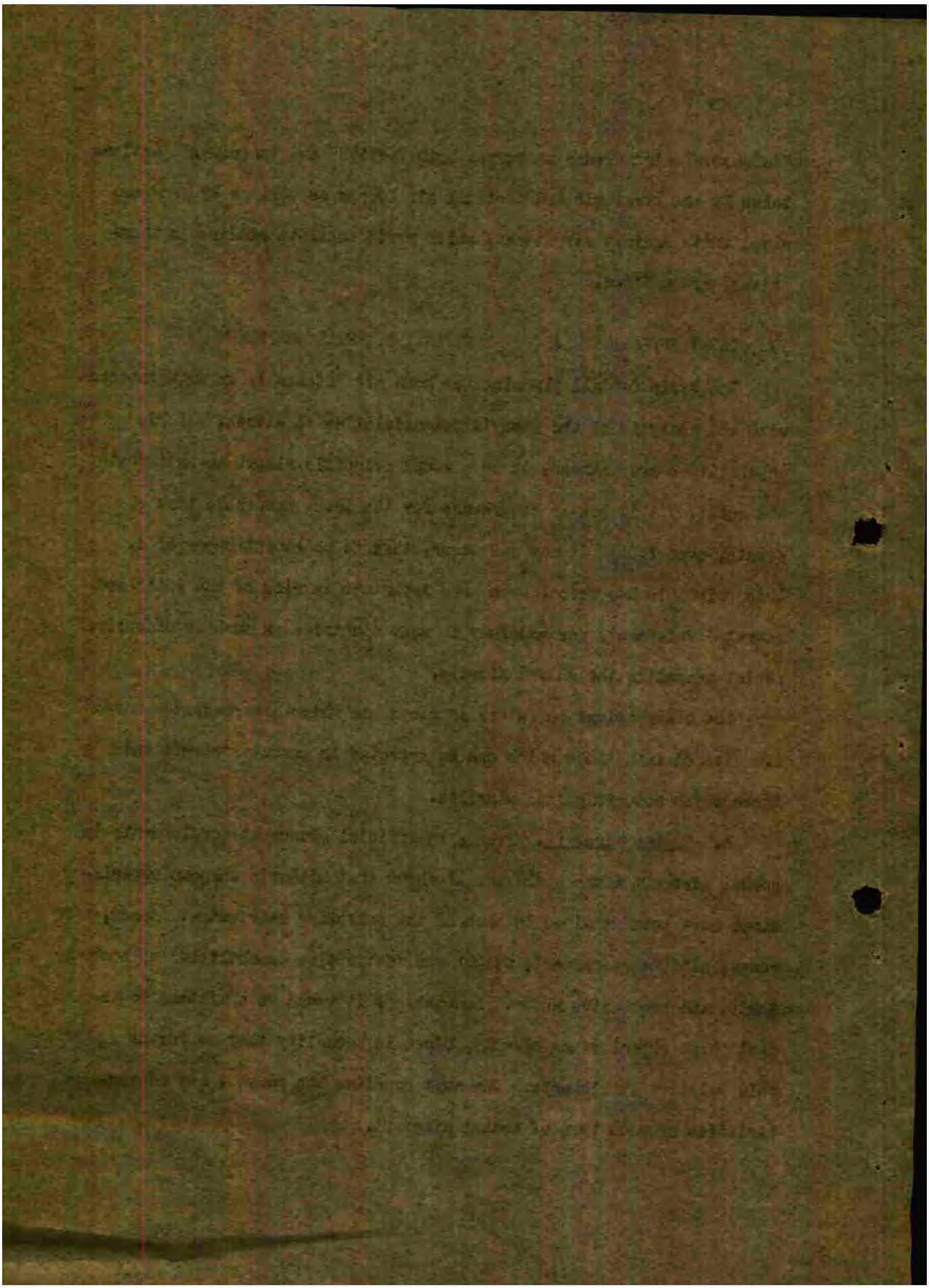
"defensive" air defense measures, both "active" and "passive." Actions taken by the strategic and tactical air forces as well as by army and naval units against air attack, which merit separate studies in themselves, are omitted.

II. ENEMY OFFENSIVE WEAPONS IN DEFENSIVE AERIAL WARFARE

The basis for all planning for home air defense is an acquaintance with and analysis of the enemy's potentialities to attack. If his capabilities are unknown, it is a sound principle always to anticipate the worst. It is better to prepare for the least favorable turn of events, even though it may not occur, than to be caught unprepared. This principle has become even more important in view of the rapid and secret developments now underway in many countries on such an offensive aerial weapon as the guided missile.

The observations on future developments which are presented here are divided into those which can be expected in combat aircraft and those which concern guided missiles.

1. Combat Aircraft. Even a superficial glance at developments in combat aircraft after World War II shows that hitherto unknown superlatives have been attained in each of the following attributes: speed, range, altitude, armament, weight and destructive capabilities of bomb loads, and protective armor. Nonetheless it would be a mistake to accept these superlatives blindly, since in actuality they represent only relative attainments. One must consider the purpose and characteristics of each type of combat aircraft.



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On the basis of such considerations, the following general classification might be set up to cover present-day combat aircraft:

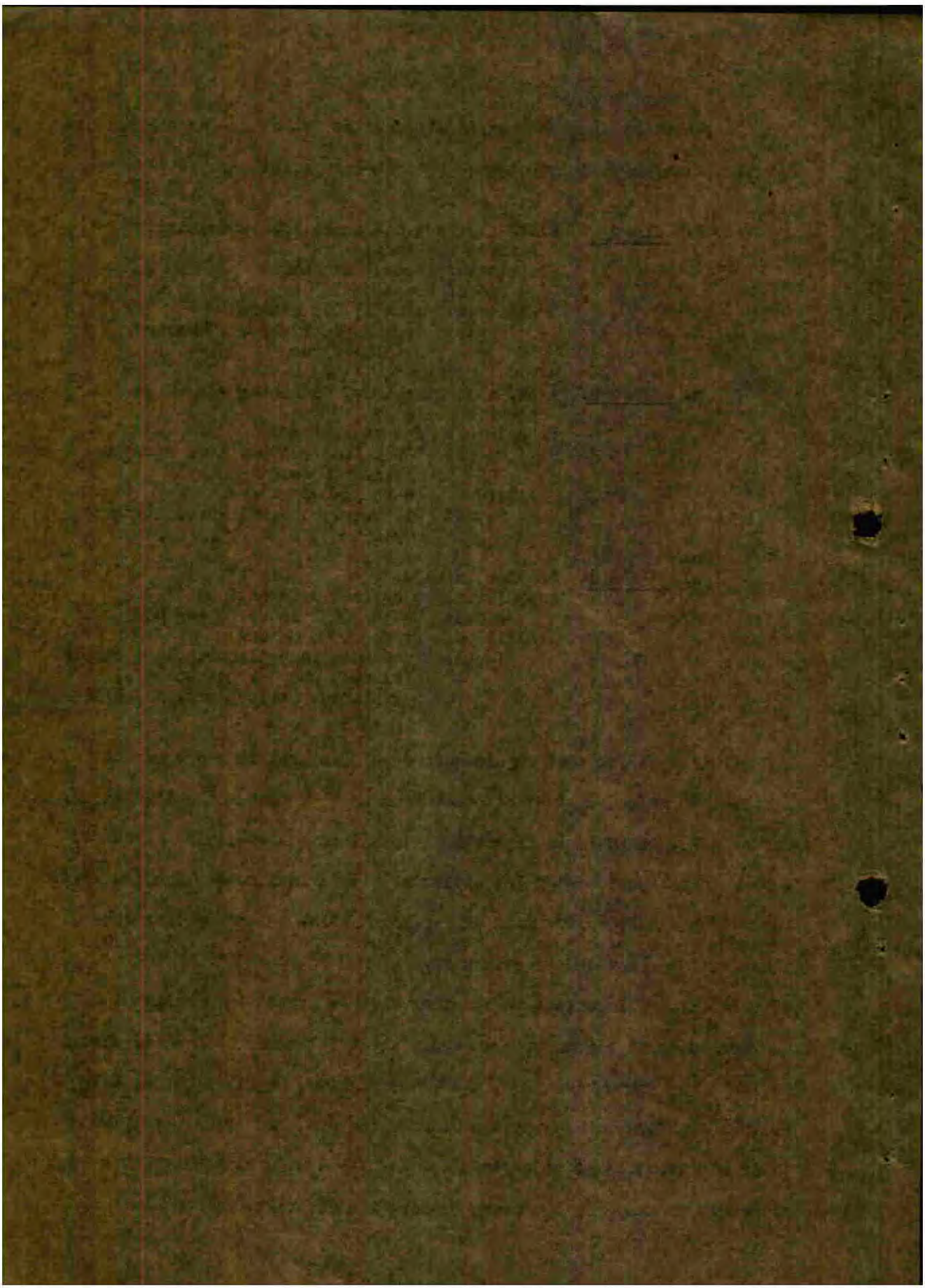
a. Class A. Extremely fast and capable of attaining maximum altitudes
Propulsion: Rocket mechanisms
Speed: Supersonic
Altitude: Over 15,000 meters
Types: Supersonic fighters, bombers, interceptors

b. Class B. Fast, also capable of attaining very high service ceilings
Propulsion: Jet mechanisms
Speed: 800 kilometers per hour up to the speed of sound
Altitude: Up to 15,000 meters
Types: Fighters, bombers, reconnaissance planes

c. Class C. Relatively slow
Propulsion: Propeller type engines
Speed: Up to 800 kilometers per hour
Altitude: Up to 8,000 meters
Types: Reconnaissance planes, close support planes, short-range bombers, trainers, helicopters, and liaison planes

It is apparent that an air defense system must be prepared and equipped to defend against aircraft from each of these classifications. For example, it would be impractical to attack a slow-flying aircraft, such as a helicopter at a low altitude, with a supersonic fighter. Yet, because this helicopter plays an important role, an appropriate type of plane must be provided to attack it.

It is also important to consider what to expect in the way of numbers of enemy aircraft, not merely the total number but their distribution among reconnaissance planes, day fighter, night fighters, all-weather fighters, close support planes, bombers, and transports, and their distribution as to supersonic, fast, and slow classes. It is necessary to know how the enemy employs its aircraft, such as in



formation or single-approach flight, in day or night attack, with or without fighter escort, and tactics of the fighter escort. Knowledge of whether or not the enemy is expected to use atomic or hydrogen bombs is of vital importance. These, along with guided missiles, will be decisive.

2. Guided Missiles. Because of security restrictions no exact knowledge is available of what to expect in the field of guided missiles; however, certain capabilities can be assumed:

a. Range: Up to and beyond 700 kilometers.

b. Altitude: Up to and beyond 400 kilometers.

c. Striking velocity: Up to and beyond 2,700 meters per second.

d. Weight of Warhead: One ton.

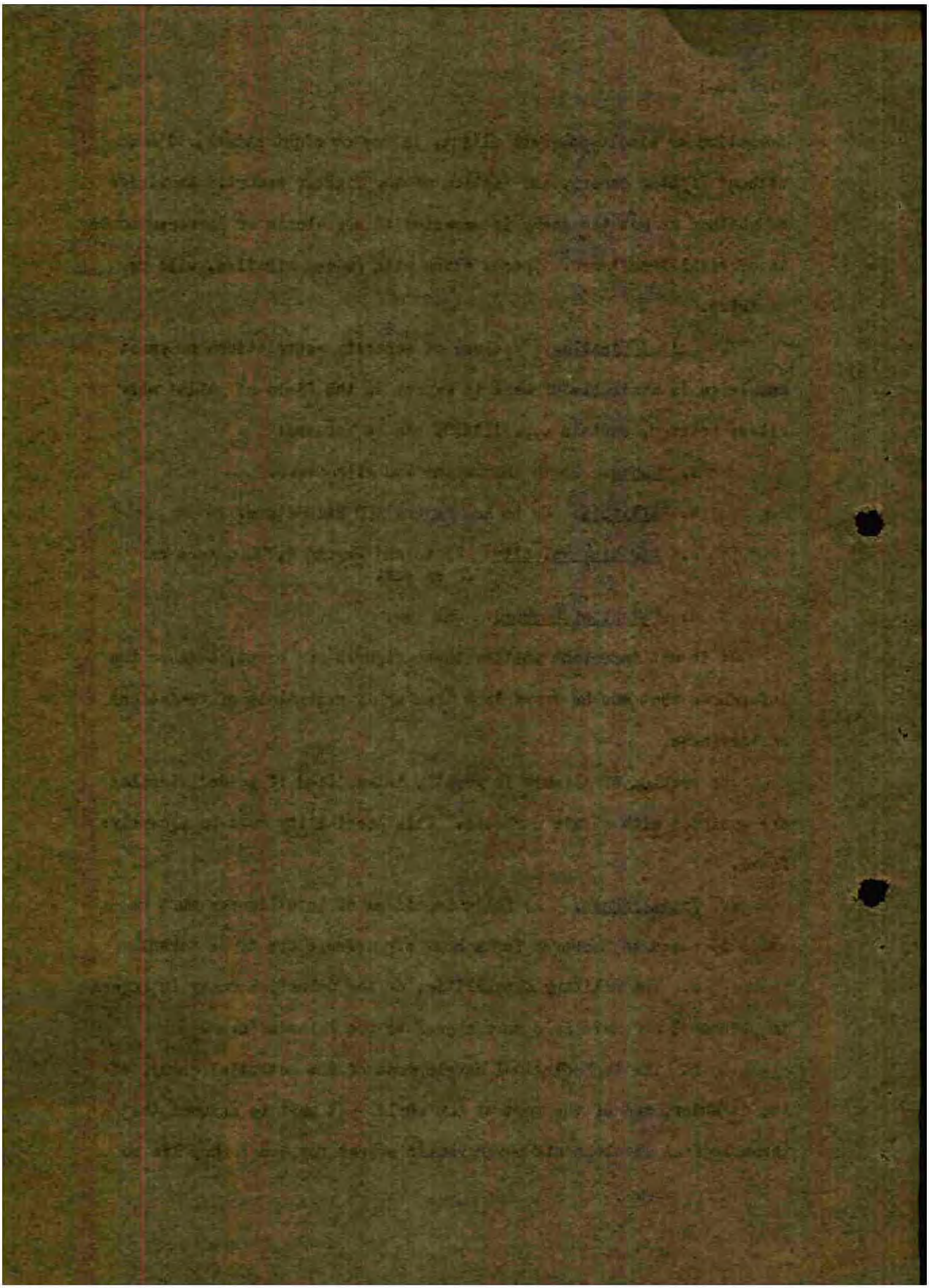
It is not important whether these figures are exact, because the inferences that can be drawn from them apply regardless of variations or increases.

The problem of defense is greatly intensified if guided missiles are equipped with atomic warheads. This possibility must be squarely faced.

3. Intelligence. The following items of intelligence must be known if adequate measures for a home air defense are to be taken:

a. The military capabilities of the potential enemy in regard to personnel and materials as compared to the defender's.

b. The technological development of the potential enemy, of the defender, and of the rest of the world. It must be assumed that technological developments never remain secret for long; they lie so



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to speak "in the air" and sooner or later become common property. But it is precisely this sooner or later--the time factor--which is important; what matters is the advantage in time which the defender may have over the potential enemy. Utilization of this advantage may well be decisive.

c. An evaluation of the size and geographical location of the territory to be defended with reference to the enemy's position; to the number, type, and location of first priority objectives to be defended; and to the nature and extent of the area in front of these objectives, such as water or land, mountains, desert or fallow land, and industrial or agricultural land.

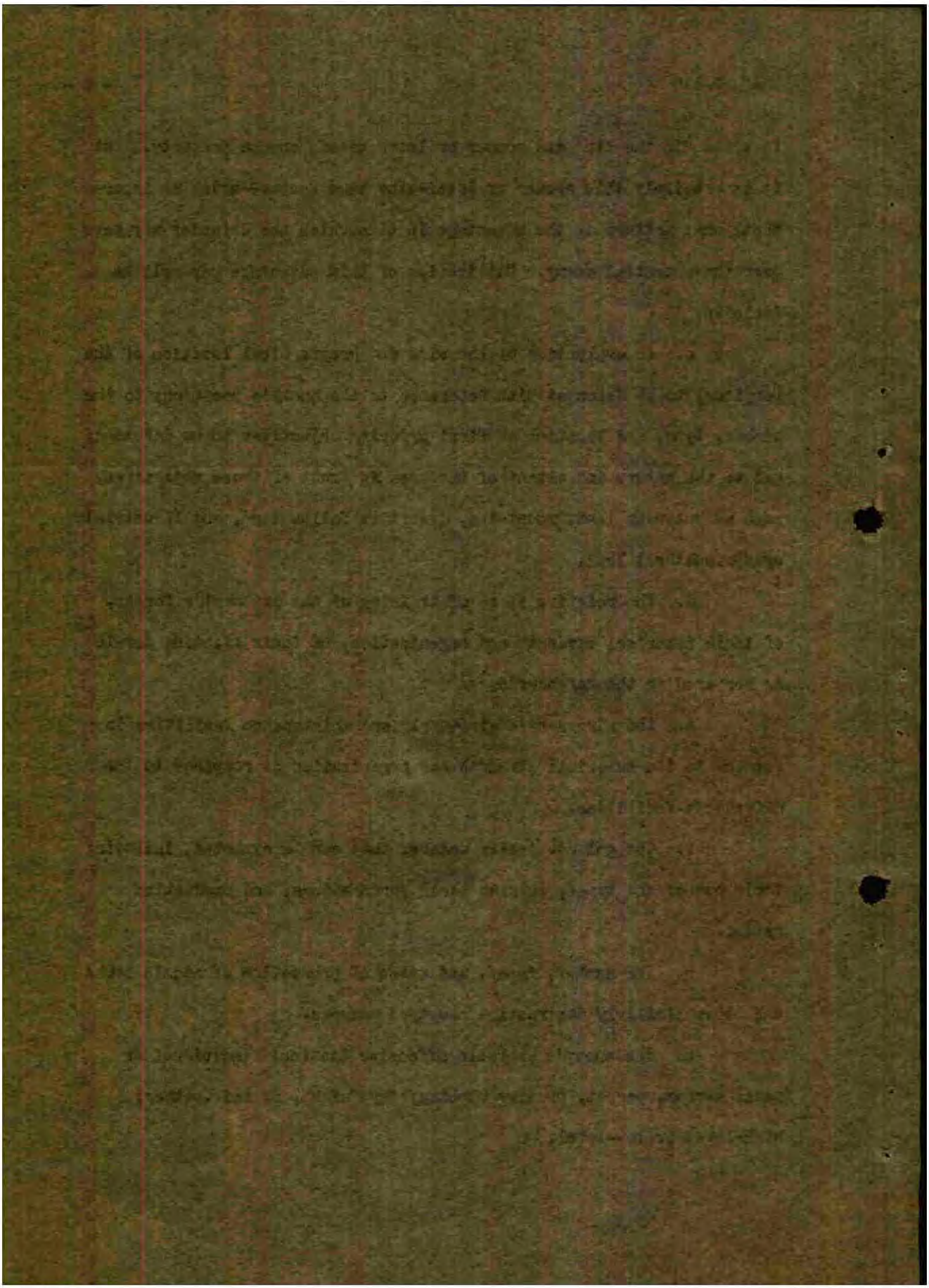
d. The relative stage of training of the opponent's forces, of their numerical strength and organization, of their fighting morale as compared to the defender's.

e. The adversary's air supply and maintenance facilities in respect to its numerical strength and organization as compared to the defender's facilities.

f. The guided-missile weapons that can be expected, including their number and types, data on their performances, and production rates.

g. The number, types, and rates of production of atomic bombs and other similarly destructive new-type weapons.

h. The enemy's probable offensive tactics: individual or mass; stream, carpet, or dive bombing; day, night, or bad weather; high-level or low-level.



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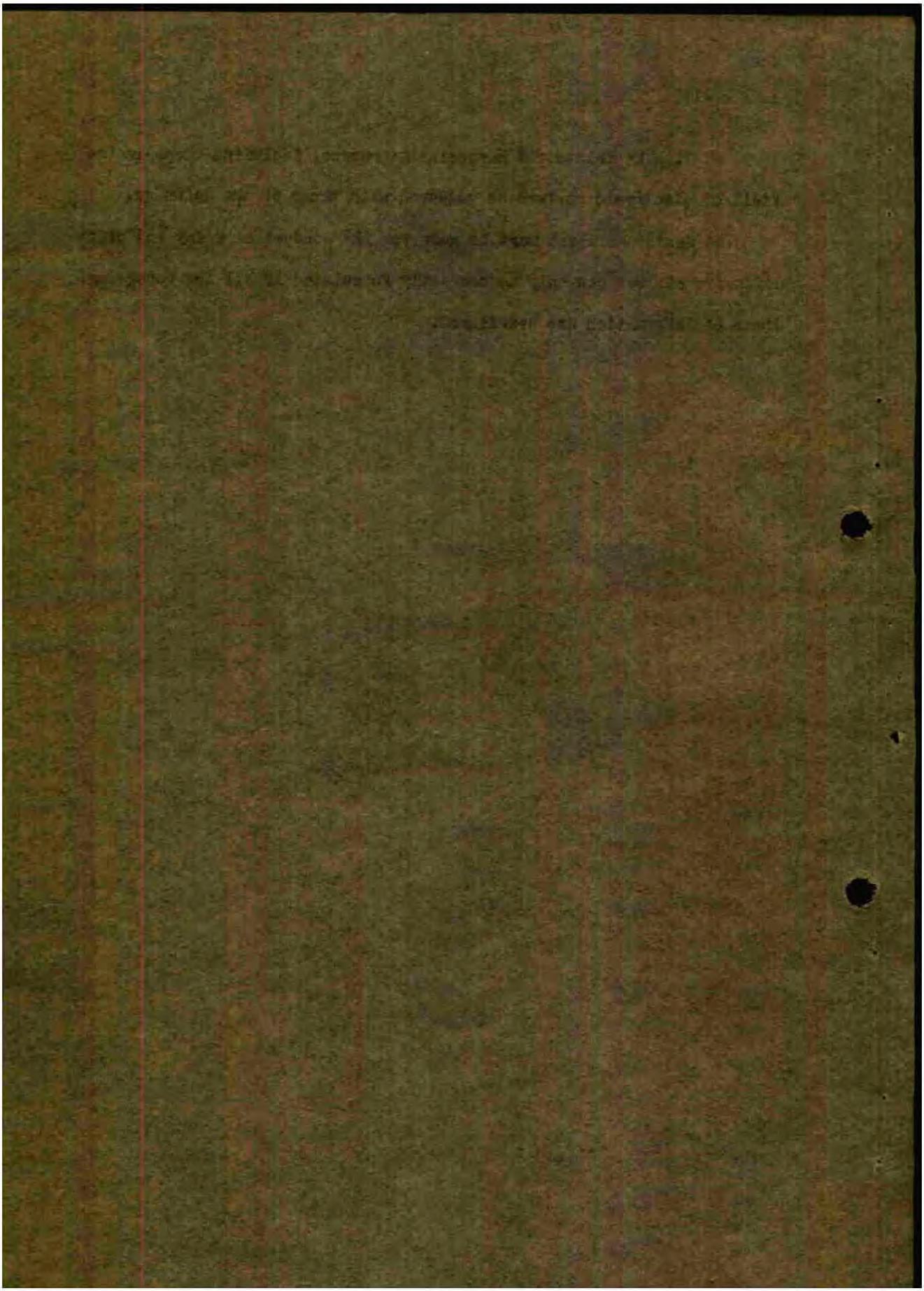
1. The feints and harassing maneuvers, including those in the field of electronic warfare as compared with those of the defender.

The decisions which must be made for the conduct of a day and night defensive air war can only be correctly formulated if all the foregoing items of information are considered.



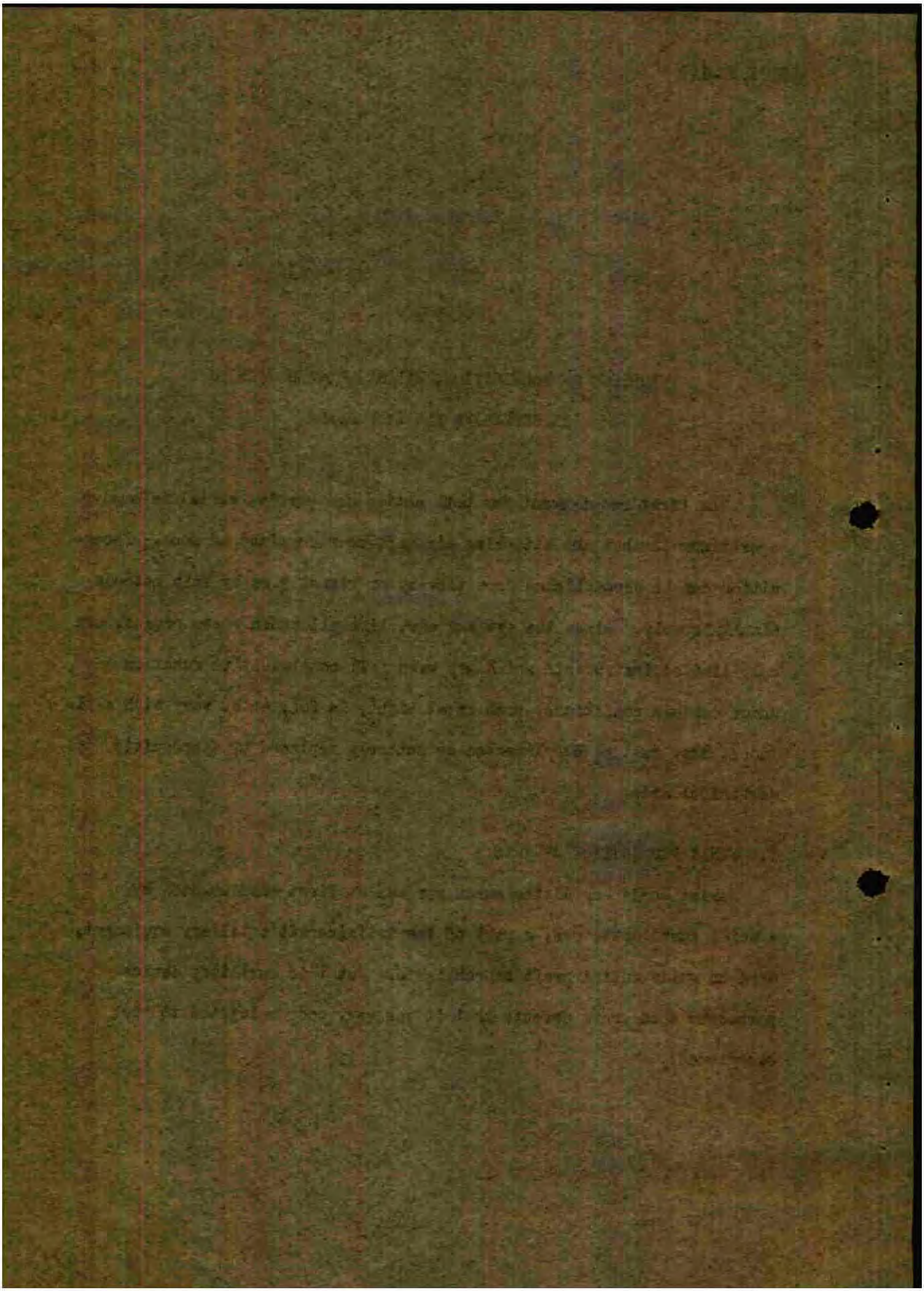
CHAPTER 2

PROBLEMS OF RECOGNITION, REPORTING, AND WARNING IN DEFENSIVE AERIAL WARFARE

The first requirement for both active and passive aerial defensive operations is that the attacking aircraft be recognized as such. Recognition can be accomplished acoustically or visually or by both methods simultaneously. Since the eye and ear, like all human sense organs, are only limited instruments which may even fail completely to function under certain conditions, such as at night, in fog, or at very high altitudes, they must be supplemented or entirely replaced by appropriate mechanical aids.

I. EARLY RECOGNITION DEVICES

During World War II the human ear was at first supplemented by special sound detectors, a part of the antiaircraft artillery equipment, used to guide antiaircraft searchlights. But this auxiliary device possessed such grave defects that it was very soon relegated to the background.



The human eye, however, was given unexpected help in the form of electronic position indicators--so-called radar--which were developed to an ever-increasing degree of efficiency during the war. Such equipment was limited in its usefulness only by its own tendency of self-tracking and by its vulnerability to enemy jamming.

It was precisely these two factors which forced the German aerial defense during World War II to retain an accoustical aircraft reporting system in addition to radar. For the same reasons it will probably be advisable to continue a simple aircraft observer and listener service on a standby basis to supplement radar systems. If all instruments fail, man must manage to get along on his own senses. If technical equipment can no longer be relied on, simple measures are the only alternative. Therefore, they must be prepared; they cannot be worked out after it is already too late.

II. RECOGNITION EQUIPMENT CAPABILITIES

The tactical and technical requirements which radar must provide for an aircraft warning service include the following: landscape scanner[1]; greatest possible accuracy in determining the angle of traverse, distance, and altitude; farthest possible range; positive identification, both friend and enemy; highest possible degree of operational reliability and freedom from interference.

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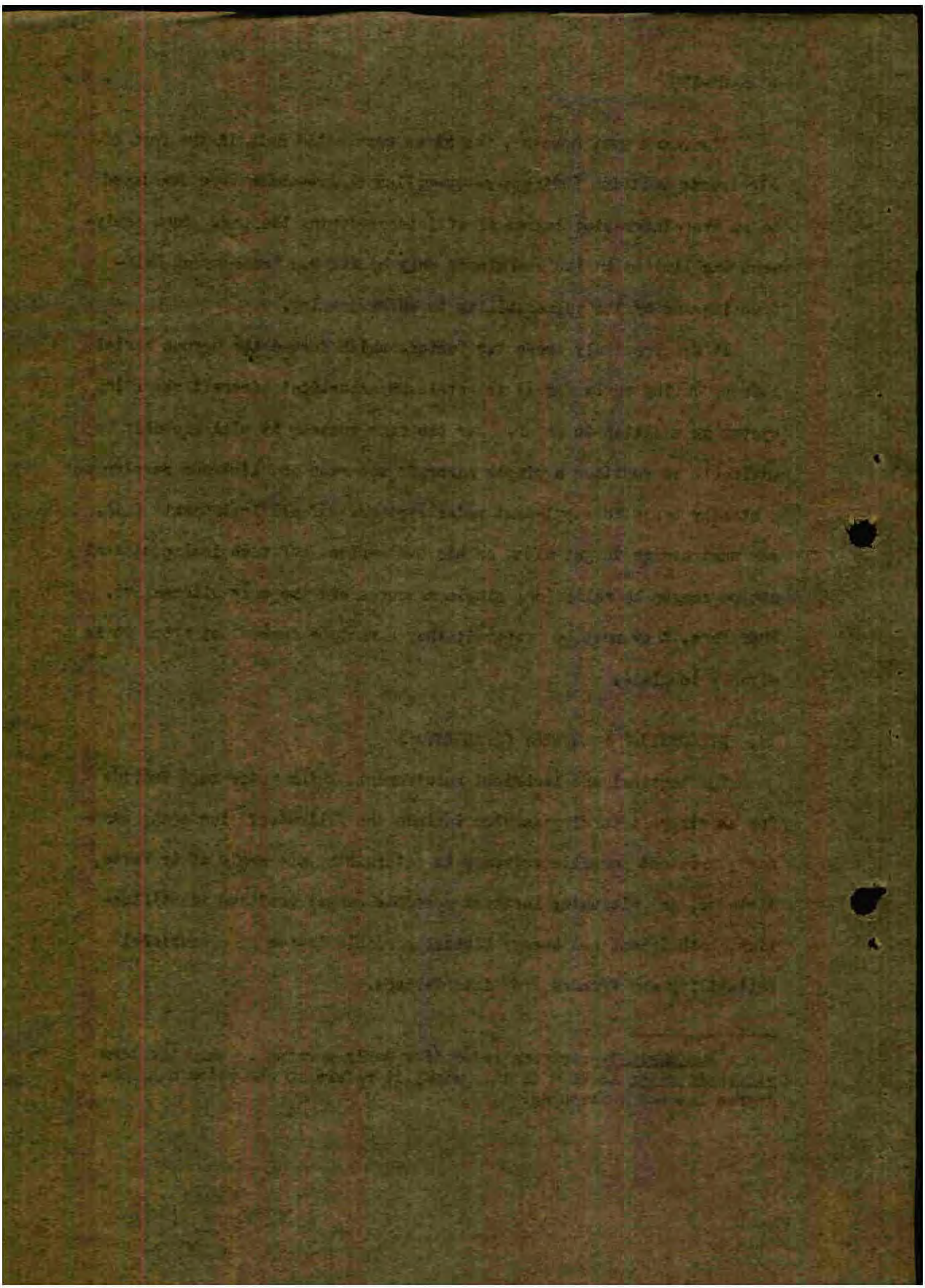
[1] Rundumsicht--panorama radar (for early warning). When the term panoramic radar is used in this study it refers to one which has 360-degree landscape scanning.



Radar without a landscape scanner is unthinkable. The panorama radar was perfected during the last war by both sides, in England as early as the end of 1940, and in Germany much later, in 1944. The problem of obtaining a satisfactory landscape scanner is not impossible of solution.

The requirement of having the greatest possible degree of accuracy in determining the angle of traverse, distance, and altitude of the air targets to be plotted is needed not so much for the purpose of an aircraft-reporting[2] service but as a guide for one's own fighter planes, as is described in detail later in the study.

The requirement of having the greatest possible range is, however, definitely a critical one for an aircraft-reporting service. Ideally, radar should be able to pick up enemy planes from the moment they take off and follow them continuously to and from the target. The need for an extremely long-range radar becomes all the more vital when enemy planes are capable of great speeds and the distance from the enemy air base to the defender's first-priority defense objectives is short.

In view of the great expense of the equipment capable of meeting these requirements, two radar sets can be used: (1) one large set with panoramic scanner and greatest possible range, ideally 500 kilometers but at least 300 kilometers; (2) one small set with panoramic scanner and a range up to 150 kilometers. A positive identification of friendly and enemy planes is of course not only essential for an

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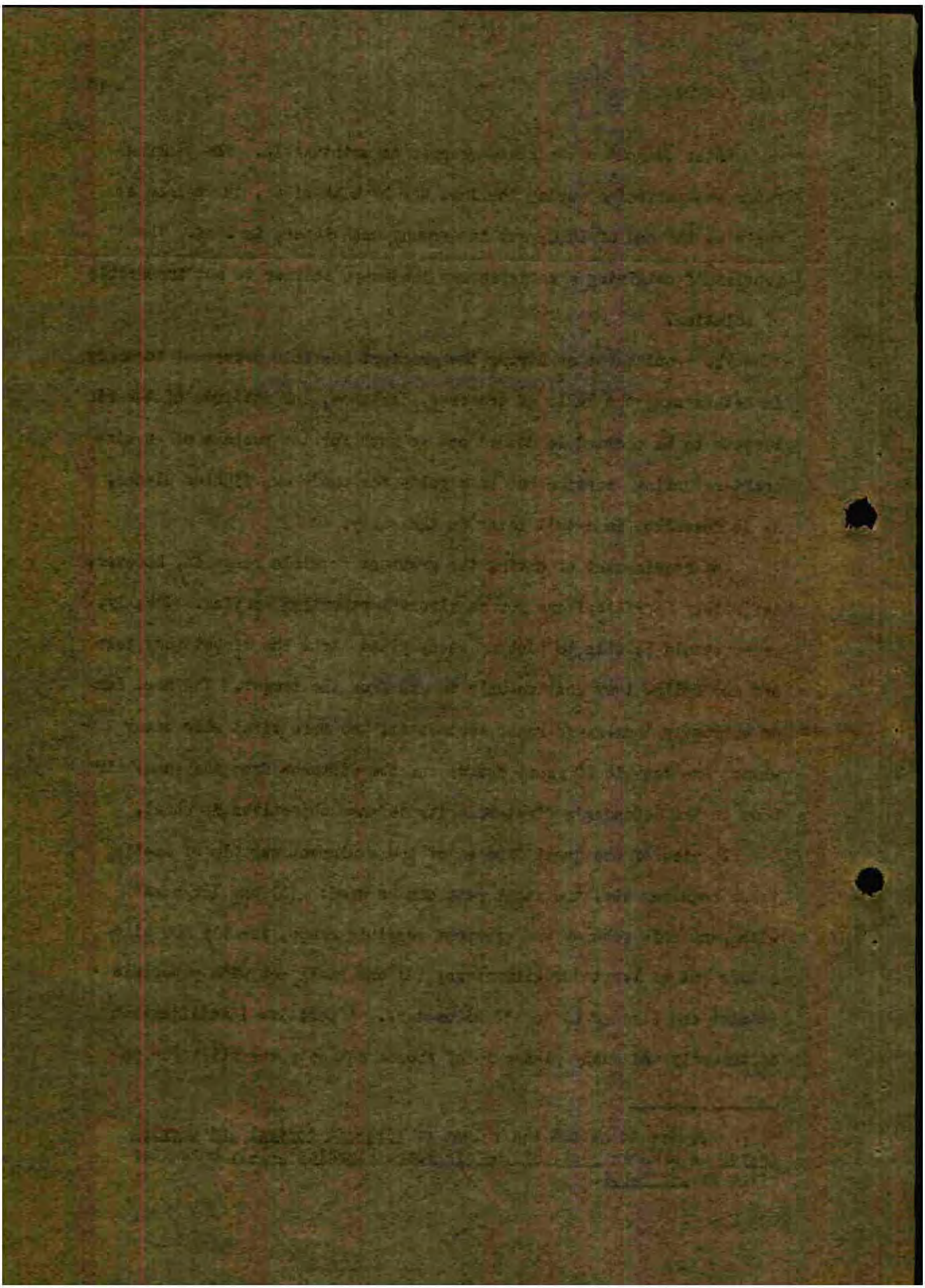
[2] Appears to be the equivalent of aircraft control and warning system as used in Dept. of the Air Force Pamphlet 5-1-1, hereafter cited as AFP 5-1-1.



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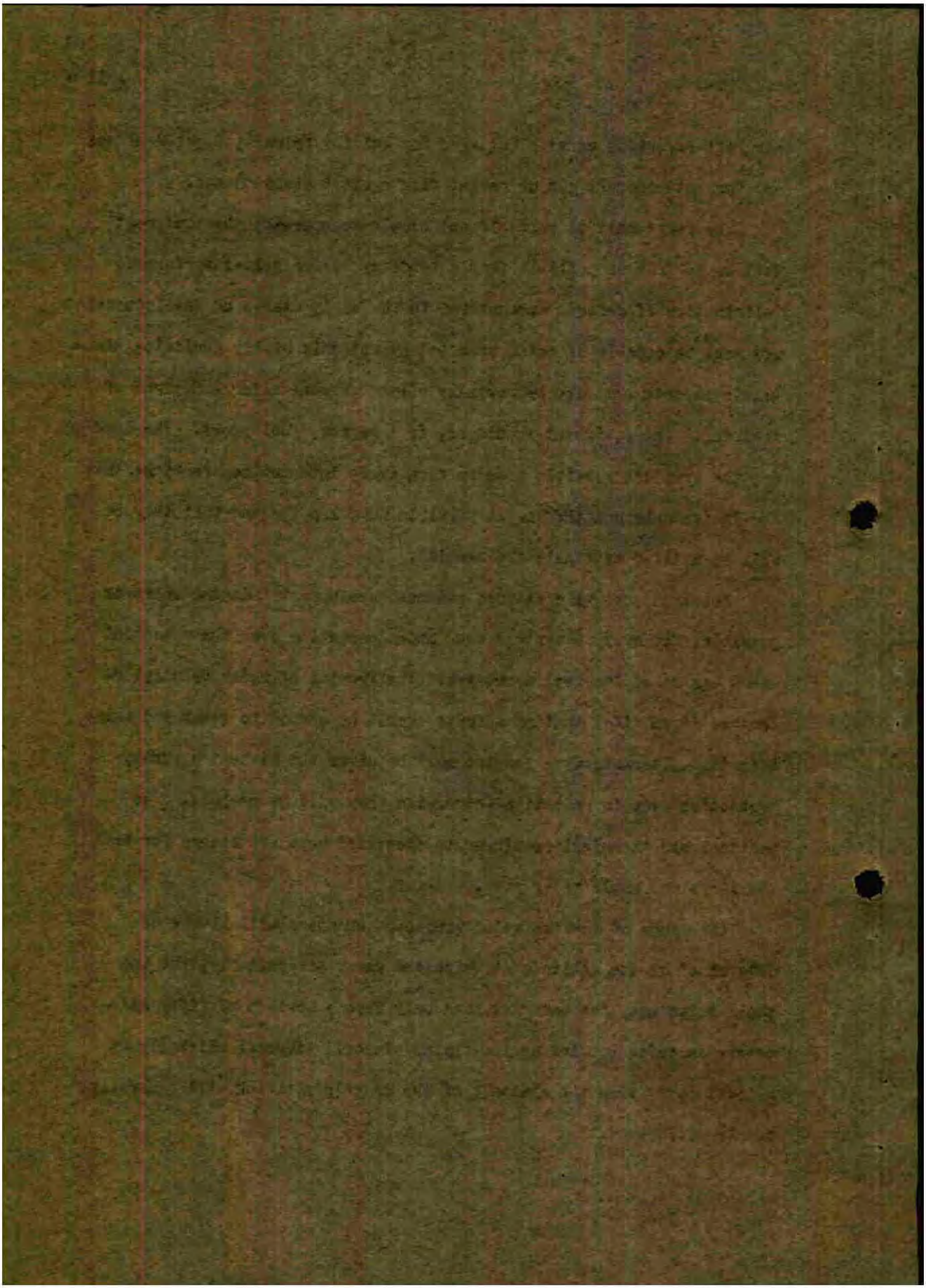
aircraft-reporting service but also for guiding friendly fighter planes and for antiaircraft gun or rocket fire against enemy planes.

The radar must be reliable and simple to operate; the equipment must be as free as possible from a tendency toward self-interference (elimination of defects encountered in the early stages of development) and must be capable of being operated by not only highly qualified electronic experts but also by normally gifted persons after a minimum of training. The equipment should be, to a degree, fool-proof. The need for the greatest possible freedom from enemy interruption requires that the instruments use the lowest possible wave lengths and that they be able to utilize alternate frequencies.

Research must be continued and new developments adopted wherever possible, for every advantage won during peacetime over the potential enemy can be of immense importance. The freeing of radar from interference is so vital that no efforts should be spared to reach and maintain it. Alternate wave lengths must be given the highest security protection even in peacetime--otherwise they will be useless. The tactical and technical requirements discussed here are needed for both the large and small radar sets.

The range of devices using landscape scanners will always be determined by the altitude at which the enemy aircraft fly, but the small radar set, for example, need only have a horizon of fifty kilometers in order to pick up low-flying planes. Aircraft which fly at a level lower than the altitude of the radar's position will generally not be discovered.

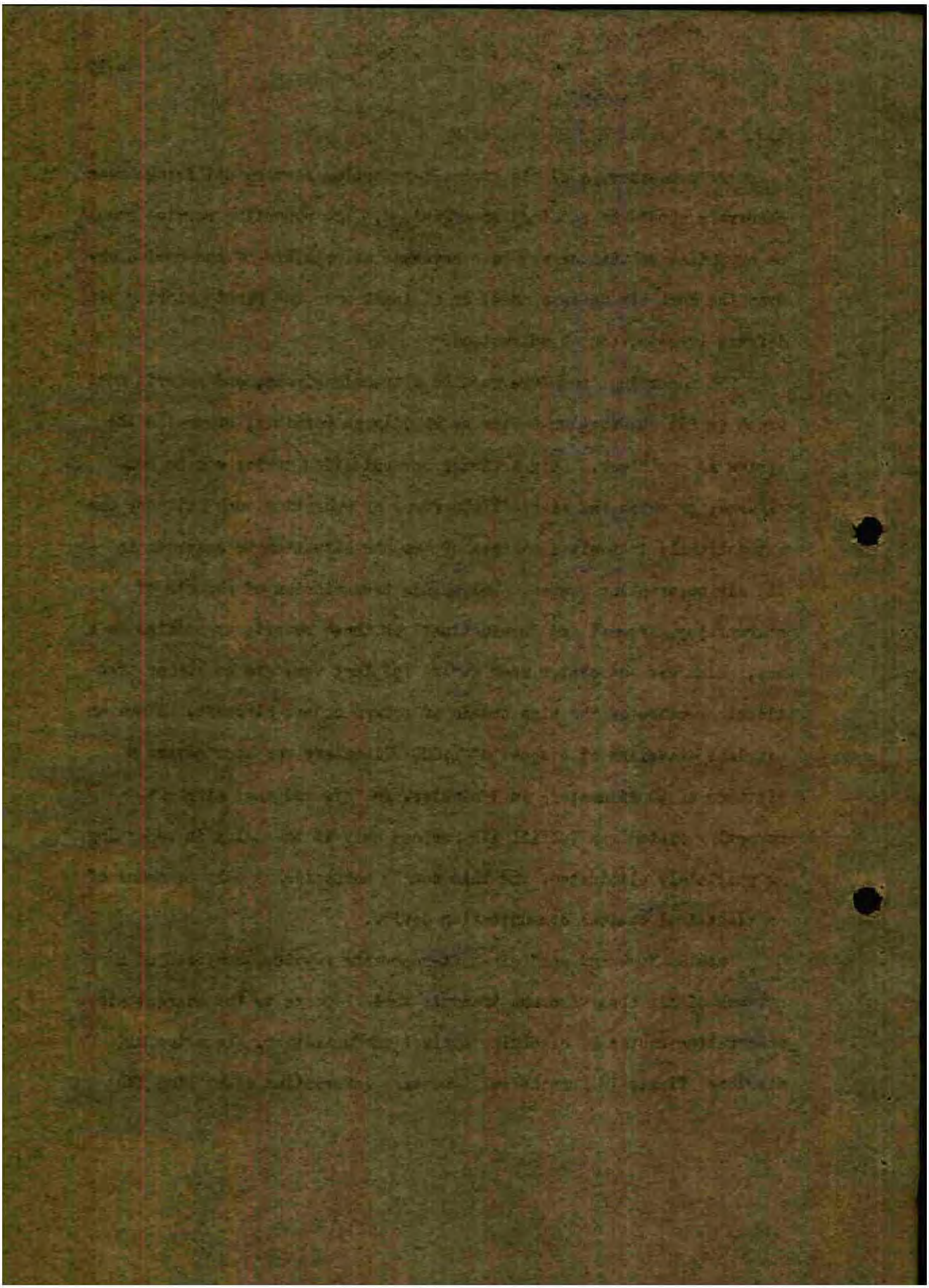


III. AIR DEFENSE REPORTING SYSTEMS

If necessary, a simple aircraft-reporting service utilizing human observers should be retained or organized. The reporting service should be organized so that as complete coverage as possible of the entire sky over the home air defense area, or at least over the first-priority air defense targets, can be guaranteed.

The reporting procedure must be extremely simple, and reports must reach an air observation center as rapidly as possible; otherwise the system is worthless. Only a visual communication device can be considered, by which the aircraft observer, by operating push buttons, can automatically transmit a picture of the air situation to a screen in the air observation center. Telephonic transmission of reports of approaching aircraft and "evaluations" of these reports by entries on a map, which was the system used during the last war, are no longer practicable because of the high speeds of modern combat aircraft. Since an airplane traveling at a speed of 1,000 kilometers per hour covers a distance of 50 kilometers in 3 minutes, an "eye and ear" aircraft-reporting system can fulfill its purpose only if the delay in reporting is completely eliminated, and this can be accomplished only by means of an electrical optical communication device.

Such an "eye and ear" aircraft-reporting service, composed of a network of air observers who transmit their reports to the nearest air observation center by electric, optical communication, has a twofold mission: first, to furnish supplementary information concerning the



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air situation, and second, to act as a substitute in case radar is unable to function, either because of self-tracking effects, enemy jamming, or planes flying too low to be picked up.

Radar, however, constitutes the nucleus of a modern air observation post. An air observation center gathers: (1) reports of approaching aircraft transmitted over electric devices by the "eye and ear" observers; (2) data received on the oscilloscopes transmitted from radar sets located in each observer station, usually the small radars with a range of 150 kilometers; (3) reports from neighboring air observation centers and from the higher-level aircraft observation commands[3] or from long-range observation services, which serve as advance warnings and supplement or complete the picture of the air situation; and (4) reports from higher headquarters concerning the movements of friendly air forces.

An air observation station, equipped and operating as described above, would be able to present a clear picture of the air situation.

IV. UTILIZATION OF REPORT DATA

Who should make use of this picture of the air situation, that is, whose interests are served by the preparation of such a picture? The answer to this question has a decisive influence on the further organization and structure of the aircraft-reporting system. A reporting service is a means to an end rather than an end in itself and it is not

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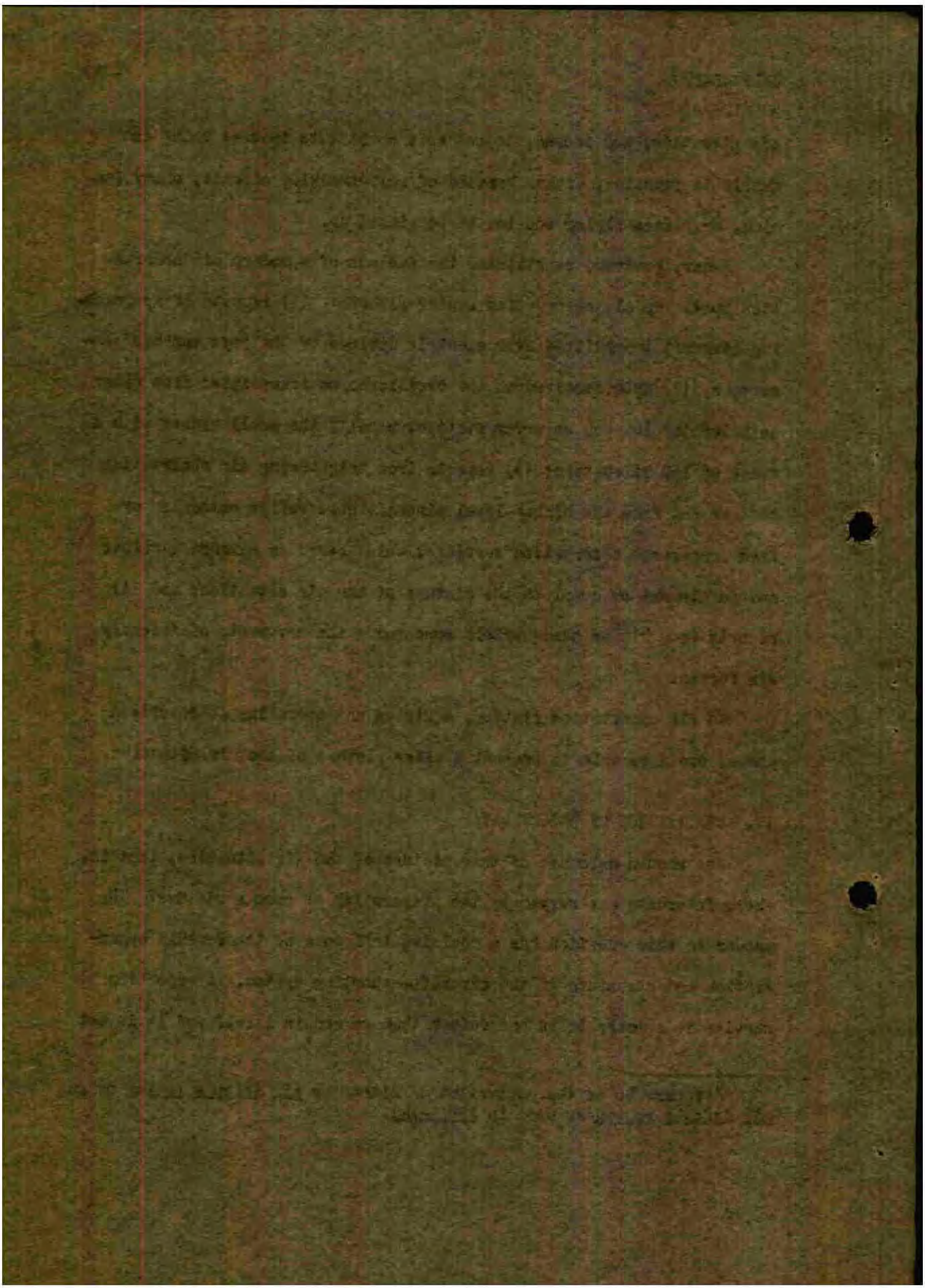
[3]Appears to be the equivalent of either an air defense sector or an air defense region as used in AFF 5-1-1.



set up in order to satisfy idle curiosity or merely for statistical purposes but rather to supply vitally important information upon which to base the conduct of a day and night air defense of the homeland.

The agencies chiefly interested in an aircraft-reporting service are the aircraft warning service[4], the headquarters[5] which directs all-weather interception and combat, and home antiaircraft artillery and antiaircraft rocket units.

All three agencies alike make use of and rely upon an efficiently operating aircraft reporting system. While the aircraft warning service is limited to passive utilization of the air picture, the headquarters directing interceptor units and antiaircraft artillery or rocket units must make active use of the air picture.

Another possibility which might be considered is that of linking the aircraft-reporting service with the aircraft warning service alone, and equipping all fighter commands and antiaircraft units with their own radar and letting them supply their own air picture. Such a plan would, however, require three times as much equipment and personnel and would inevitably entail an extremely confusing, parallel organizational structure. Higher headquarters for home air defense, moreover, would find itself confronted with problems nearly impossible of solution if each subordinate unit prepared its own air picture.

The function of command can be performed with prospect of success only where a single uniform language is spoken—a graphic one; in other words, only where all the subordinate units use the same air picture as

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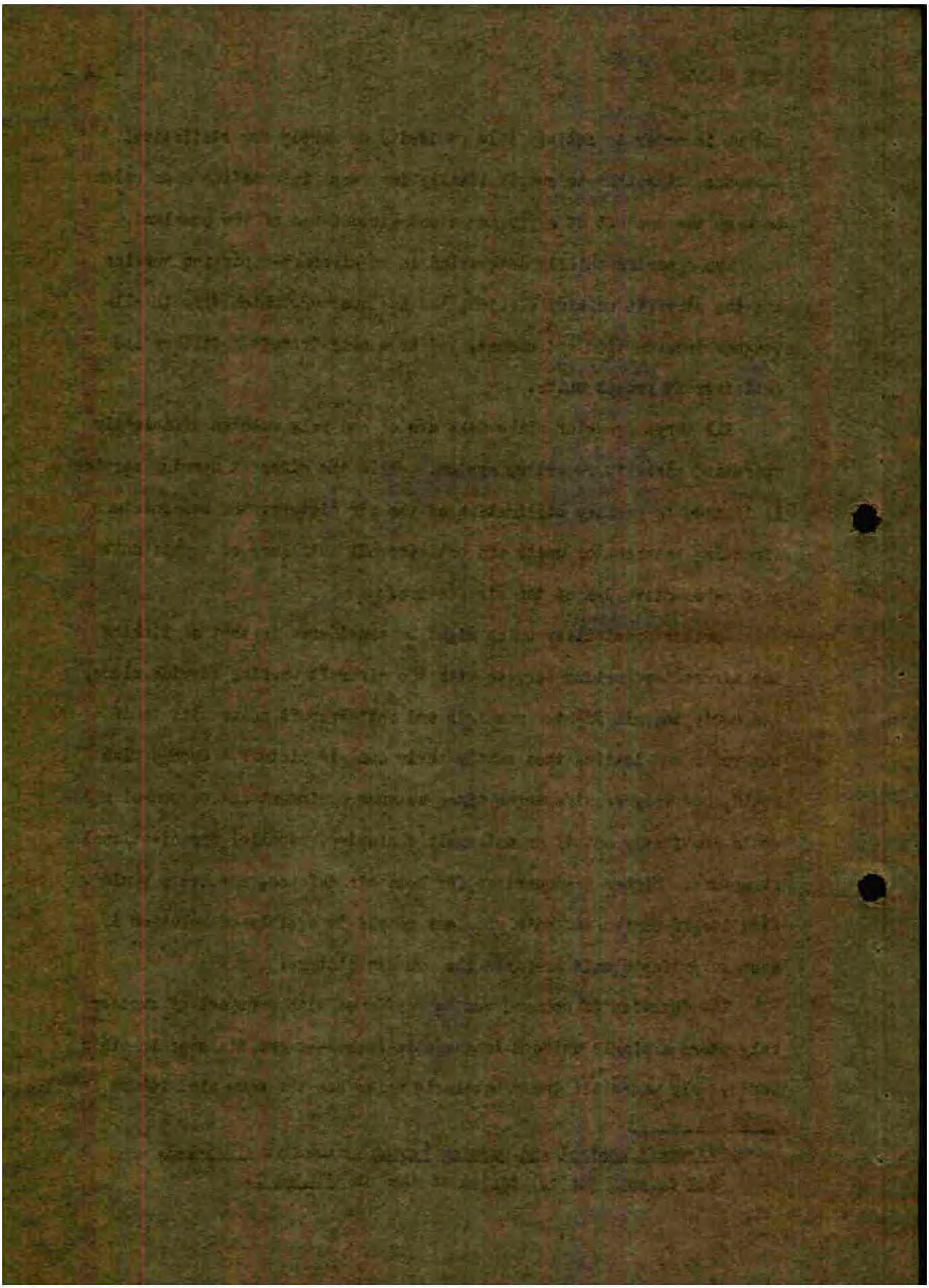
[4] Aircraft control and warning system as used in AFP 5-1-1.
[5] Air defense control center as used in AFP 5-1-1.



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a basis for their tactical operations. Planes and antiaircraft must work together so closely in home air defense that they must under all circumstances be placed under the same command and not be permitted to function independently of one another, much less in opposition to one another.

V. ORGANIZATION OF THE RECOGNITION AND REPORTING SYSTEM[6]

For this reason it appears to be not only desirable but also absolutely necessary to organize the aircraft reporting service in such a way that it can furnish data for the preparation of a single, composite air situation report to all agencies. This can be efficiently accomplished without any particular difficulty.

In order to insure the accomplishment of this task, the aircraft-reporting service must adapt itself to the requirements of everyone concerned. Such adaptations, of course, make certain actions necessary. These apply equally to the number and type of observation stations and commands to be set up and to the organization and internal structure of an air defense headquarters, whose major function is the preparation of a complete picture of air operations.

The number of observation posts to be established, that is, the density of the reporting network, must be adjusted to the participant which requires the greatest coverage. For reasons which will be discussed in detail later, this would be the observation network of the antiaircraft rocket batteries. The observation stations should be so

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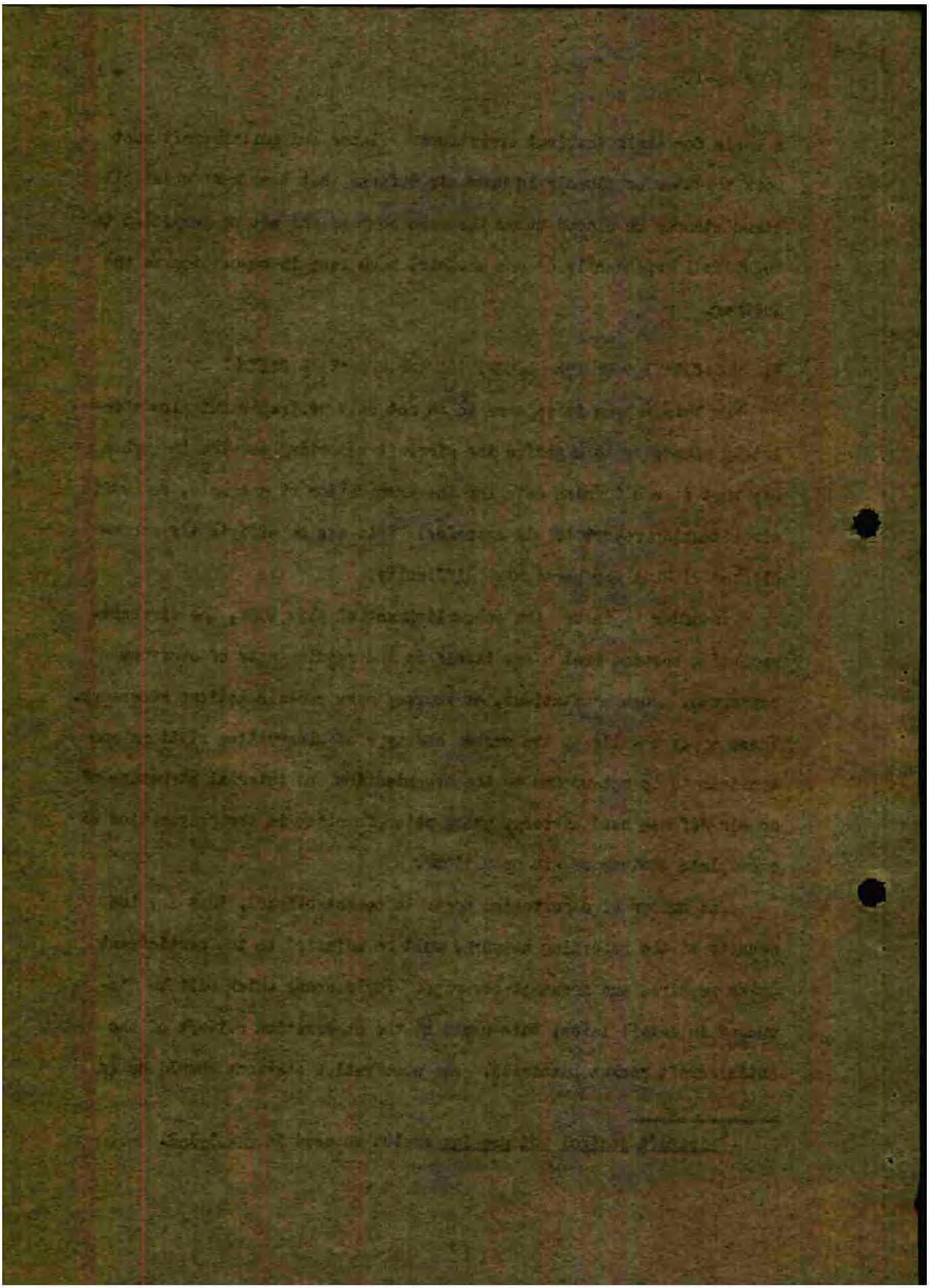
[6] Aircraft control and warning system as used in AFF 5-1-1.



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established that they are scattered over the home air defense area in a checkerboard pattern at an average distance apart of approximately fifteen kilometers. The reasons for selection of this particular distance will be explained in Chapter 7.

At first glance it may seem an unwarranted expenditure to equip all observation stations, although only fifteen kilometers apart, with small panoramic radars with a range of 150 kilometers. But each antiaircraft rocket battery for technical reasons needs a panoramic radar with a range of 150 kilometers. It would be a waste of funds to equip the individual observation stations with a smaller radar with a shorter range of perhaps only 50 kilometers, simply because they are located at a distance of only 15 kilometers apart.

The problem, then, is to establish a ground network of air observation stations whose focal point, the air observation center, will correspond to the description just presented. This network must correspond to the ground network of the antiaircraft rocket batteries in order for the one communications net to suffice for both installations—an incalculable advantage, not to mention the savings in material and personnel.

It is also most desirable to coordinate the organization of the aircraft reporting service with the organization of the antiaircraft rocket batteries. In the latter case, nine batteries frequently comprise one battalion. For this reason it is best to combine nine air observation stations into one air observation command[7]. The headquarters of the antiaircraft rocket battalion and the air observation command

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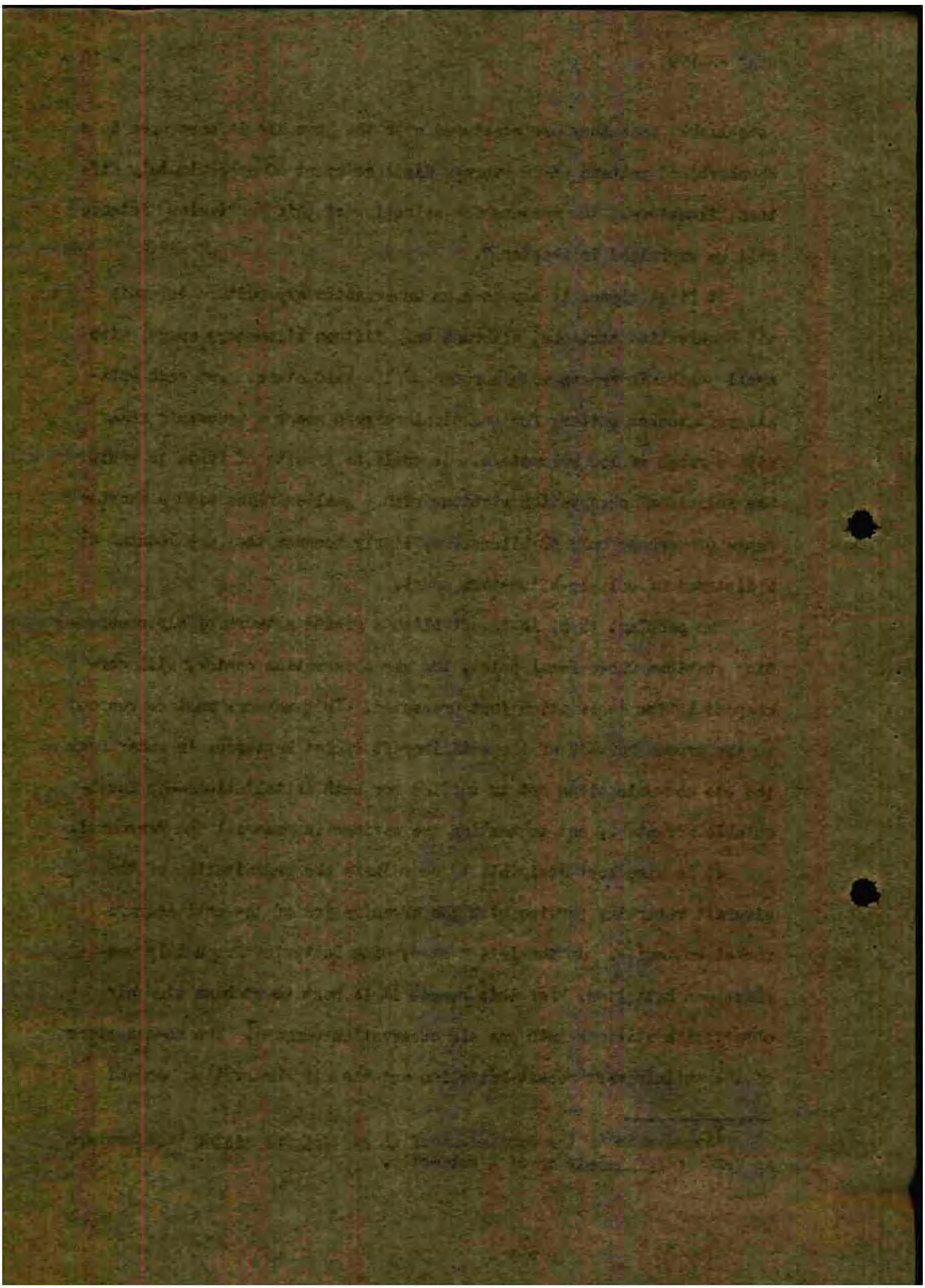
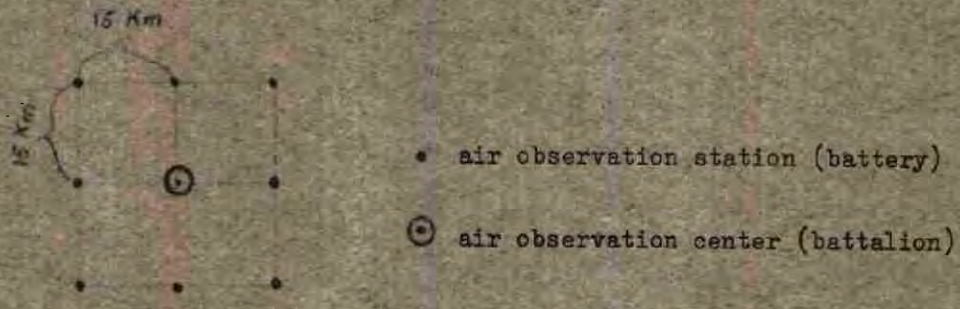
[7]Appears to be the equivalent of an air defense sector headquarters as used in AFF 5-1-1, or of a subsector.

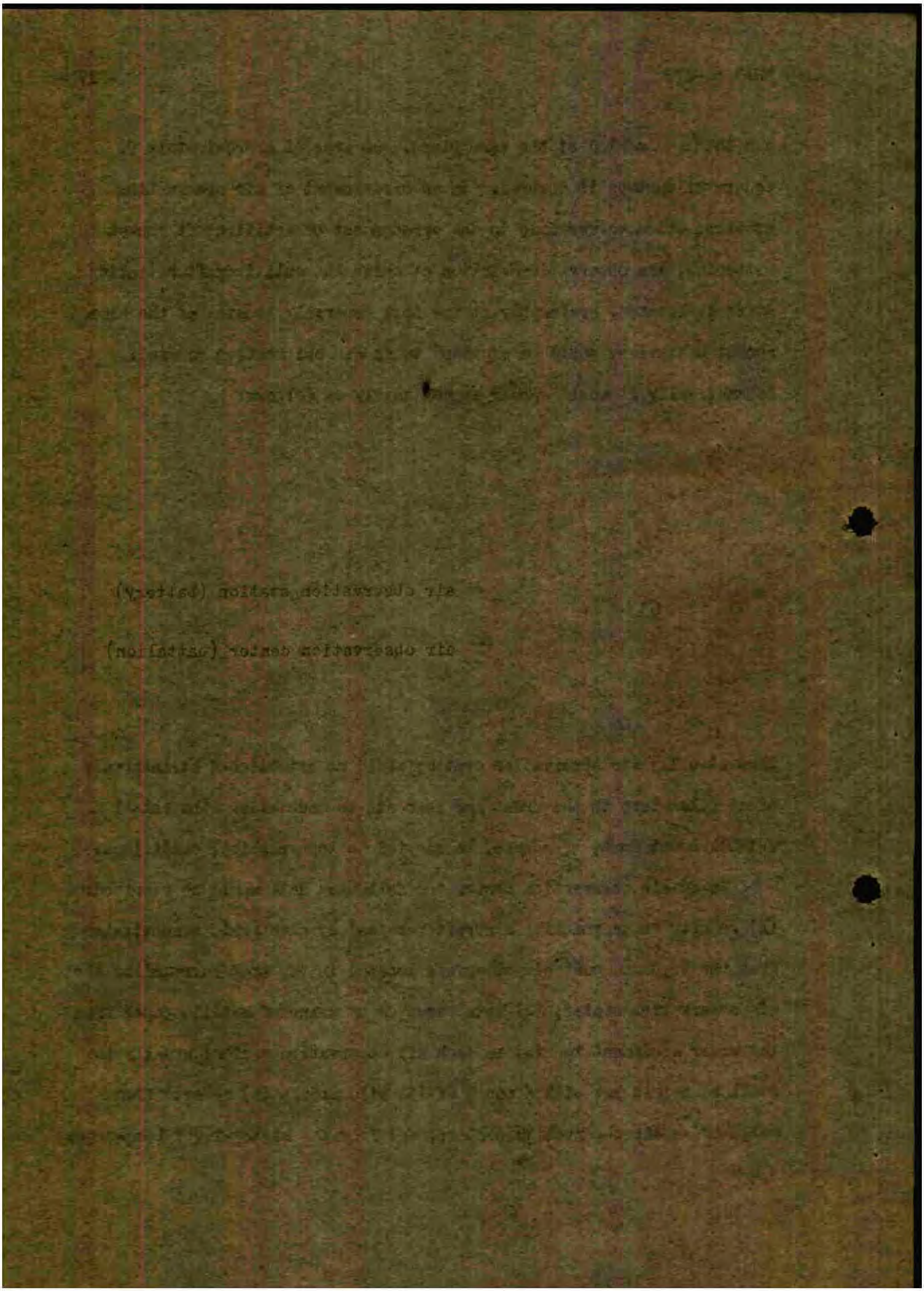


can then be located at the same place. An area of approximately 90 square kilometers is covered. In an arrangement of air observation stations which corresponds to the arrangement of antiaircraft rocket batteries, the observation station at which the antiaircraft battalion staff is located, preferably at the most centrally located of the nine rocket batteries, could be expanded to an air observation command. Schematically it would appear approximately as follows:



Theoretically air observation centers would be established at intervals of 45 kilometers to the front and rear and to each side. The actual establishment must, of course, be adapted to topographical conditions.

In an air observation center the following data would be received: (1) reports of approaching aircraft received by electronic transmission from the "eye and ear" air observers located in the area surrounding the air observation center; (2) data received by means of oscilloscopes from the radar equipment located in each air observation center, usually the small panoramic set with a range of 150 kilometers; (3) reports from neighboring air observation centers, and from the higher-level long-range



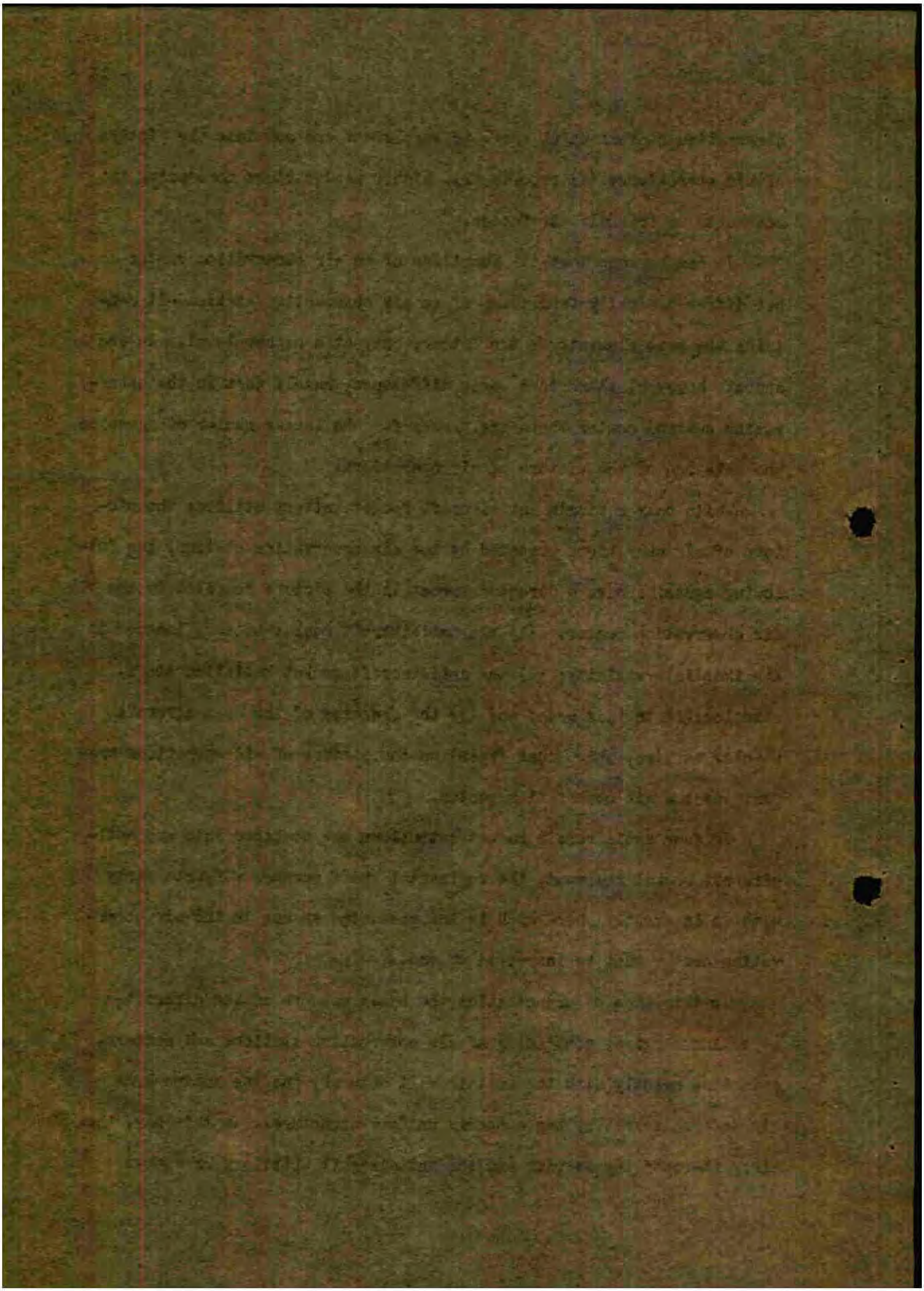
observation centers which serve to supplement and complete the picture of air operations; (4) reports from higher headquarters concerning the movements of friendly air forces.

It can be seen that the functions of an air observation center do not differ basically from those of an air observation station--it contains the same elements as the latter, only at a higher level. In one aspect, however, there is a basic difference, namely that in the observation command center there are places for the larger number of agencies who make use of the picture of air operations.

While only a single antiaircraft rocket battery utilizes the picture of air operations prepared by the air observation station, the following agencies have a direct interest in the picture compiled by the air observation center: (1) the antiaircraft rocket battery located in the immediate vicinity; (2) the antiaircraft rocket battalion staff, also located in this area; and (3) the agencies of the area aircraft warning service, which must depend on the picture of air operations prepared by the air observation center.

If four antiaircraft rocket battalions are combined into one antiaircraft rocket regiment, the regimental staff becomes a fourth party with an interest. Where such is the case, the spaces in the air observation center must be increased by one.

In this type of organization the basic network of the aircraft-reporting service, consisting of air observation stations and centers, coincides exactly with the antiaircraft network, and the entire home air defense territory has a nearly uniform structure. In this way, the aircraft-reporting service and the antiaircraft artillery or rocket



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units can be supplied with a complete air picture up to regimental staff level. A second chief user of the aircraft-reporting service is the air-raid warning service which gives immediate local air-raid alarms in cities and industrial plants. The warning of larger areas can be accomplished only by aircraft-reporting centers larger than the ones heretofore described.

VI. ORGANIZATION OF THE DEFENSIVE CONTROL SYSTEM

The warning of larger areas and the control of defensive fighter planes requires more extensive installations, such as a special headquarters,[8] which can furnish a more complete over-all picture of air operations than that which can be provided by an air observation station or center.

The air picture prepared in a larger headquarters would be based on the following information: (1) data received on oscilloscopes from one or more large panoramic radars operating at maximum ranges, ideally 500 kilometers, but at least 300 kilometers; (2) reports received from air interception[9] service; (3) reports received from subordinate air observation centers; and (4) reports and/or bearings received from units in the air.

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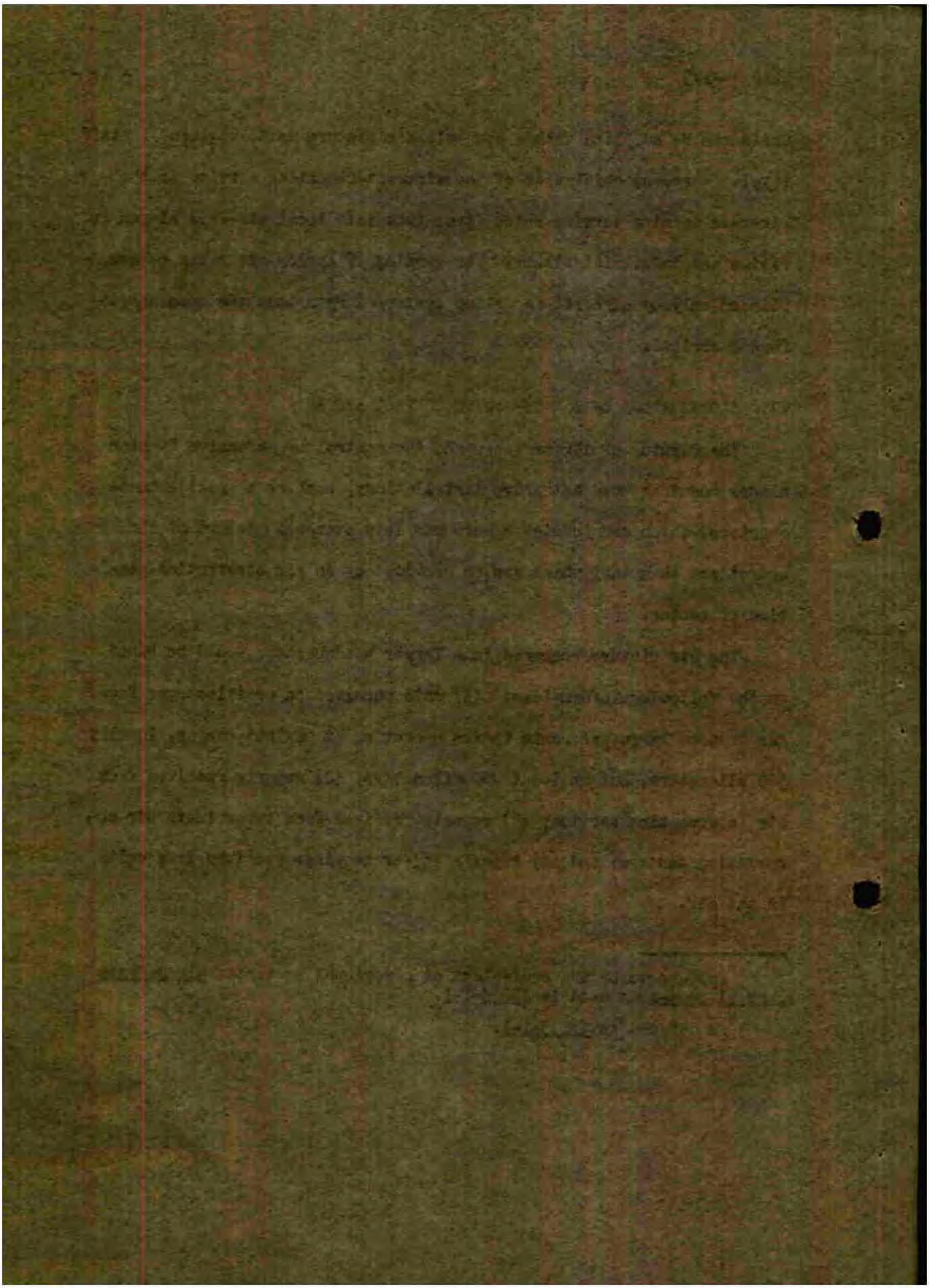
[8] Appears to be the equivalent of a regional or sector air defense control center as used in AFF 5-1-1.

[9] As defined in AFF 5-1-1.



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These headquarters actually become long-range air observation centers, since they prepare the air situation map of an extensive territory. Neighboring long-range observation headquarters, naturally, are in continuous communication.

Service would be provided to all three of the principal users, even though their degree of interest varies. The aircraft warning service would use it to provide warnings for larger areas. The command group of this headquarters, which assumes the active direction of day, night, and all-weather aerial combat, would use the information in carrying out its chief mission. The division staffs of the antiaircraft artillery and rocket units would use the information to gain an over-all picture of all air operations in their area and to maintain coordination between the operations of the air units and the antiaircraft artillery and rocket groups.

The arrangement and internal organization of these air defense control headquarters must be such as to enable them to fulfill their obligations.

Depending upon the extent of the air area to be defended, several additional, regional headquarters may be required for top-level command[10] of home air defense. These resemble in structure and internal equipment, as discussed in detail in Chapter 8, the division[11] headquarters. There is, however, the difference that in each, the several large panoramic radars, overlapping in their coverage of the area to be defended, must be linked together for transmission of data by oscilloscope, so that a

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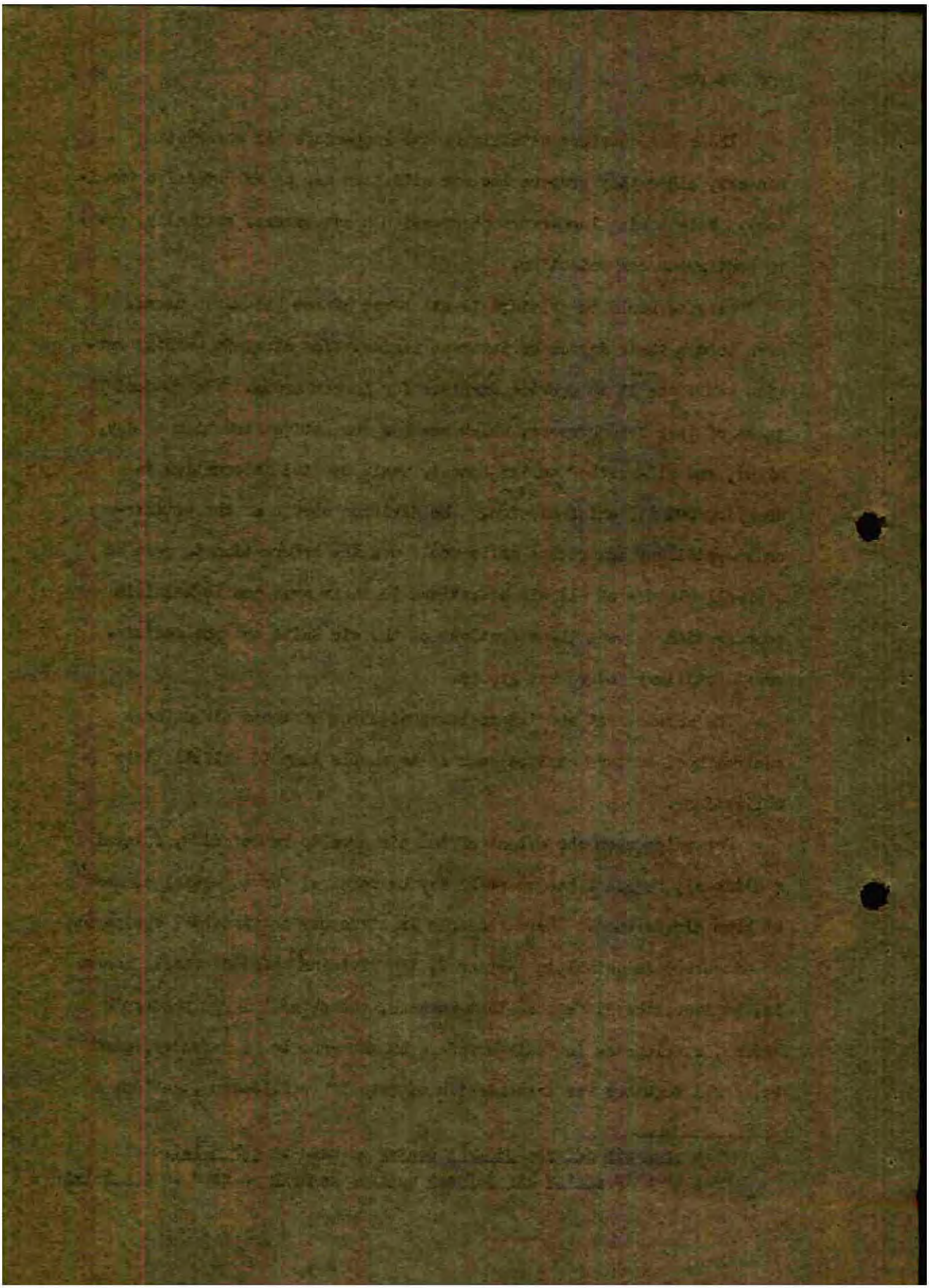
[10] An area air defense control center as used in AFF 5-1-1.

[11] Apparently sector air defense control centers as used in AFF 5-1-1.



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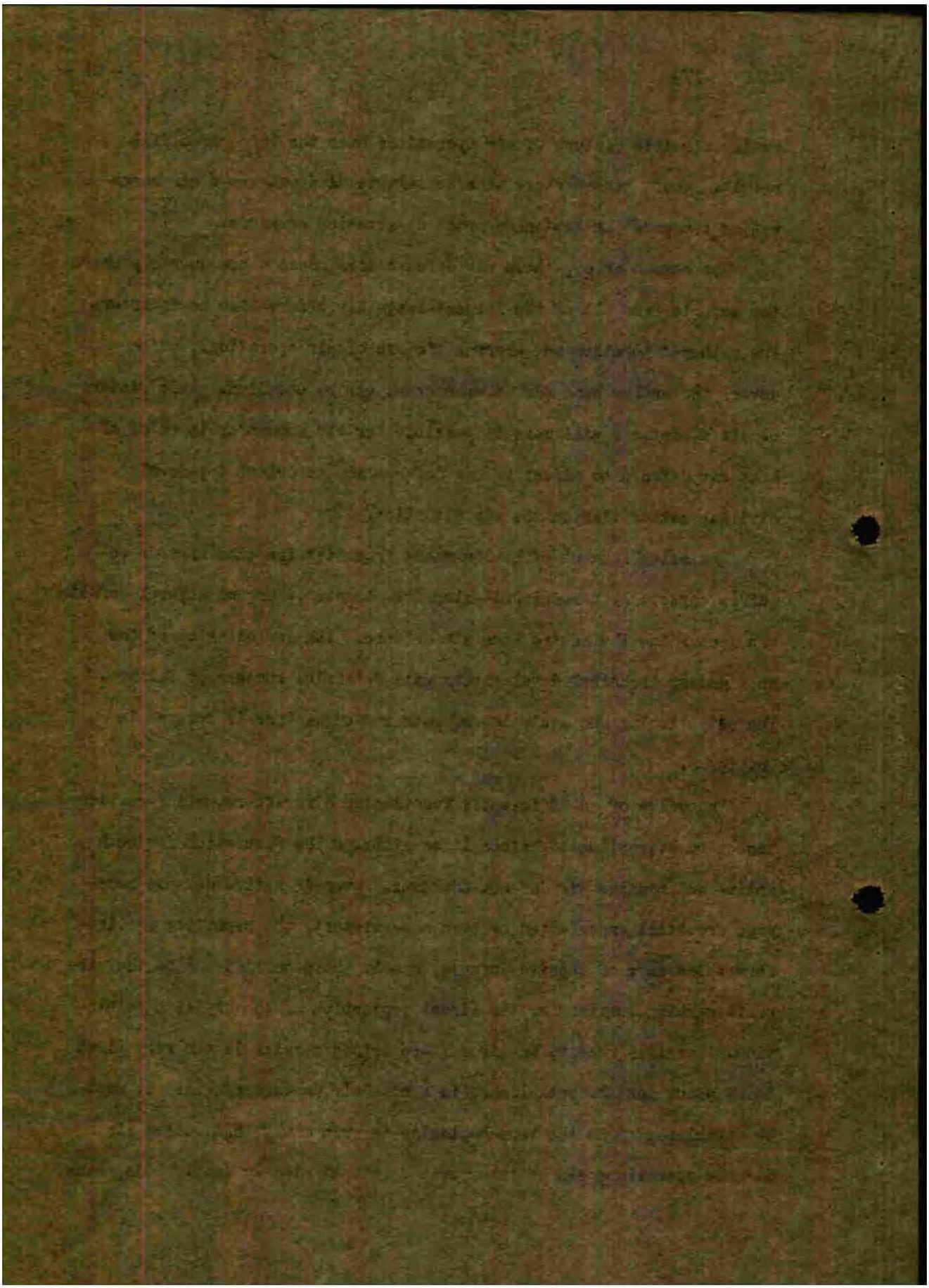
really complete picture of air operations over the large area will result. These headquarters thus constitute "longest-range air observation commands" or "extended area" observation commands.

The commander of a home air defense area needs a headquarters where the reports from all of the longest-range air observation headquarters are gathered together and where a picture of air operations, which covers the entire home air defense area, can be compiled. This picture of air operations will make it possible for the commander in chief of home air defense to direct an air defense and to orient top-level civilian authorities on the air situation.

The establishment of headquarters from division size upwards requires especially careful and extensive planning. Organizational defects can jeopardize the entire home air defense. The exploitation of the most modern technical developments will determine success or failure. The establishing and equipping of such a headquarters is covered in Chapter 8.

The value of an efficiently functioning aircraft-reporting service cannot be overestimated, since it constitutes the foundation for both active and passive air defense measures. Even if active defense measures are still unperfected or even non-existent, the reporting service serves the ends of passive defense, namely those carried out by the aircraft warning service for the direct protection of the civilian population. For this reason, an aircraft-reporting service is the very first thing which must be established in a home air defense system. It must be established from the very beginning in such a way that active air defense operations can be incorporated into it step by step. This means



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that the basic network of the reporting service must be adjusted to that agency which will be most dependent upon it in the future, the antiaircraft rocket units. Air observation stations and air observation centers must be set up at those locations where antiaircraft rocket batteries and their staffs will be stationed later. Time, material, and personnel can be saved by the establishment of common communication and command channels.

Independently of the basic network, which for purely technical reasons is inevitably somewhat schematic, but in close association with it, observation installations can be established at locations determined by tactical necessity. The long-range air observation centers should be set up in the division headquarters, and the "longest-range" or "extended area" observation centers, in the sector[12] headquarters commands, or in the headquarters of the commander of the air defense area.

The radio intercept service is extremely useful in locating the position of the enemy. By monitoring Allied radio communications—ground to ground, ground to air, and air to air—a great many day and night approach flights during World War II were spotted as they took off from their bases. Sometimes it was even possible to guess correctly the direction of attack from seemingly quite insignificant details. Violations of radio discipline, which can never be entirely eliminated, can give an intercepting service valuable hints. Unintentional violations may also occur.

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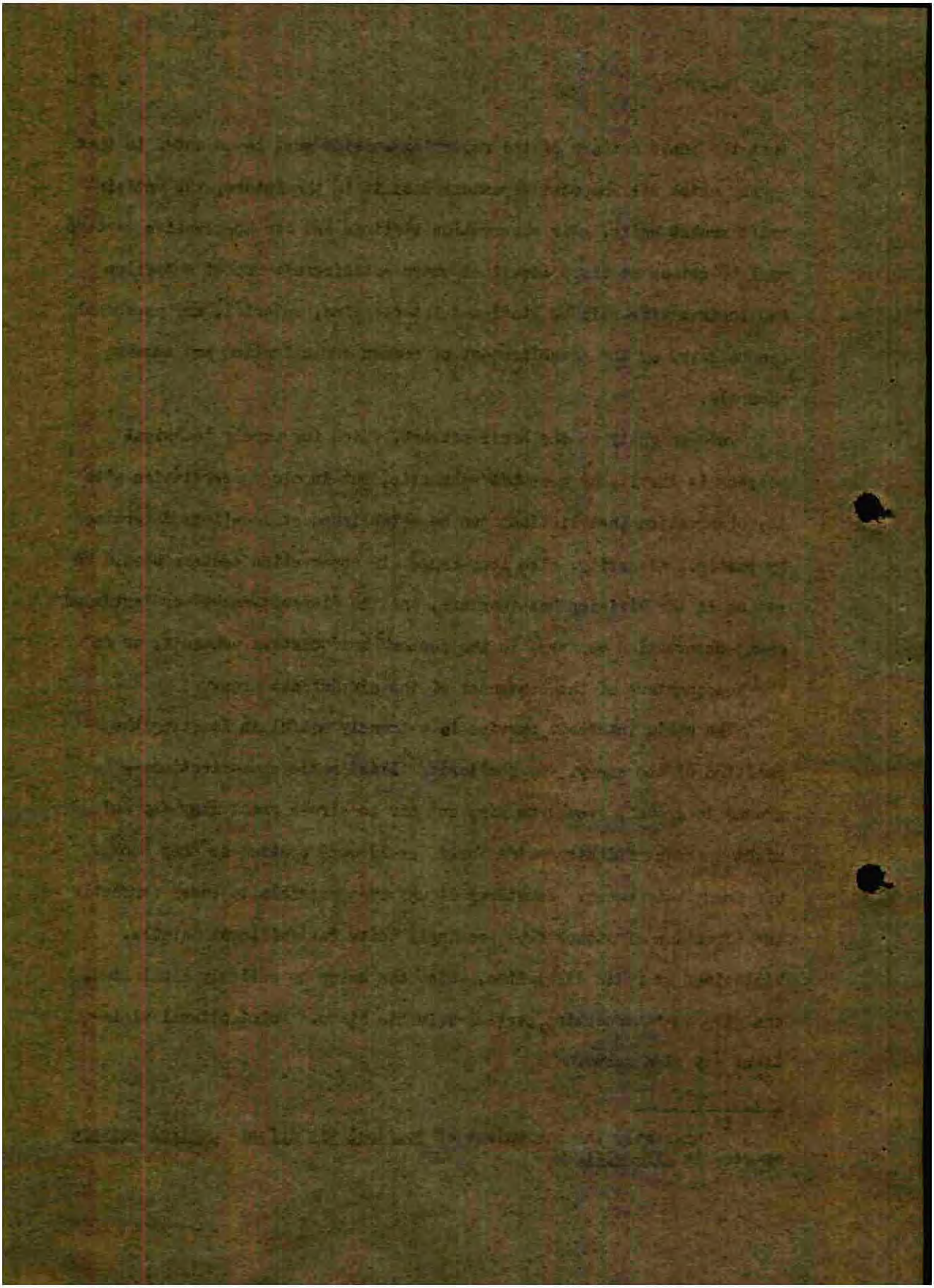
[12] Apparently the equivalent of regional air defense control centers as used in AFP 5-1-1.



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In this way, even when the radar equipment was disturbed by interference, it was possible for a long time during World War II to obtain a most comprehensive, overall picture of Allied air operations because of the fact that the Rotterdam[13] special receiving equipment was tuned in before the planes took off and was left tuned in during the entire approach flight and withdrawal. Because the special receiving sets (Korfu)[14] of the radio intercept service could pick up the radiations from the Rotterdam equipment, the enemy aircraft, in effect, was flying over the area in full illumination. As soon as the Allies realized what a great favor they were doing the radio intercept service by this practice, the Rotterdam instruments were not tuned in until shortly before the aircraft reached the targets.[15]

The development of a far-reaching electronic intercept service and the establishment of an electronic countermeasure service are equally important measures in home air defense.

VII. AIR-RAID WARNING SERVICE

An air-raid warning service is a passive activity of home air defense. As its name implies, its purpose is to provide the civilian population with direct warning of enemy air attacks. This alone

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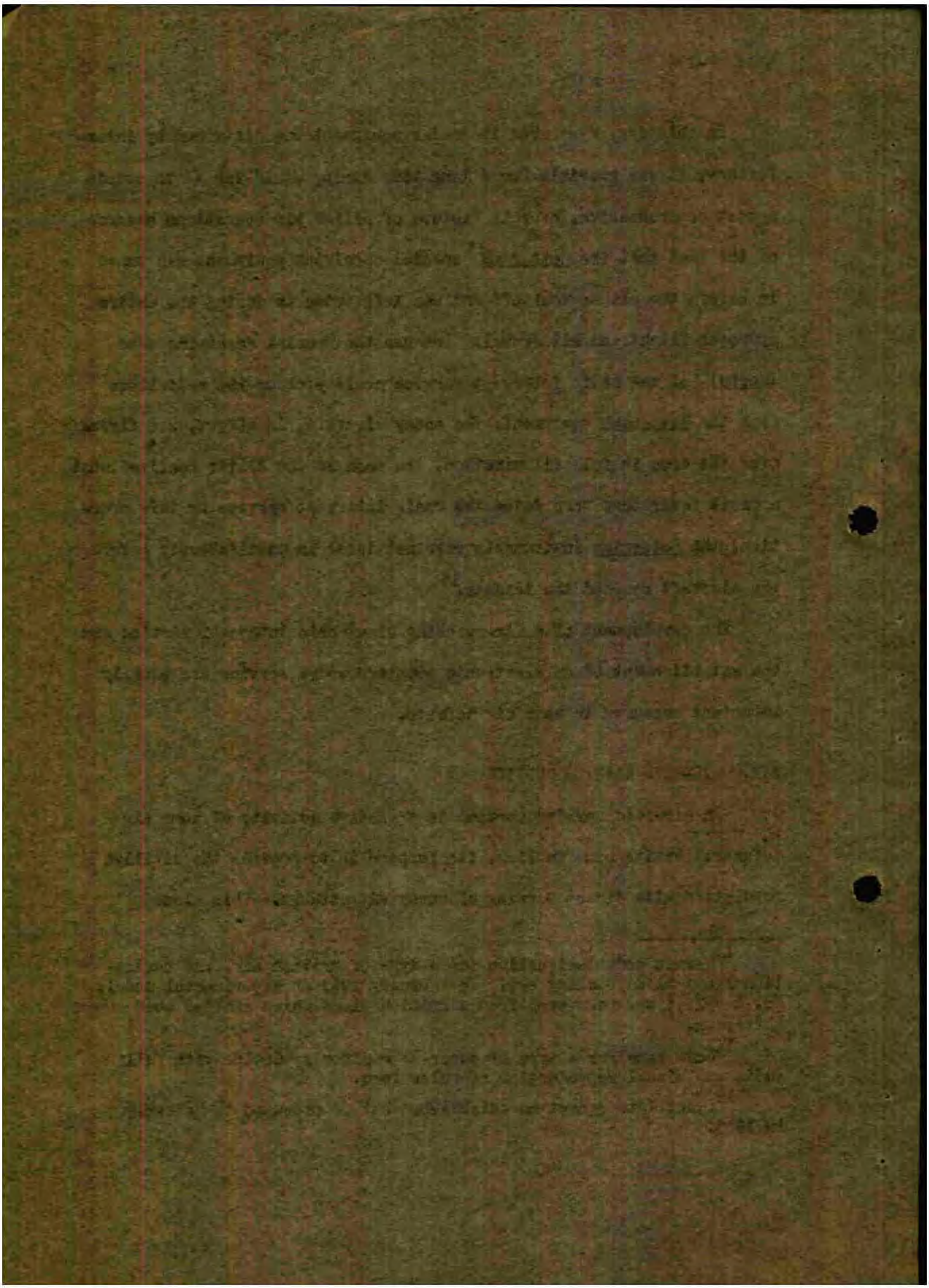
[13] German code designation for a type of British airborne navigational and blind bombing set. In February 1943 an experimental model, No. 6 "H2S," was recovered from a British plane which crashed near Rotterdam.

[14] Code name for a type of super-HF monitoring device with full audio and visual reproduction of pulse form.

[15] Exact date cannot be established but is presumed to be early in 1943.



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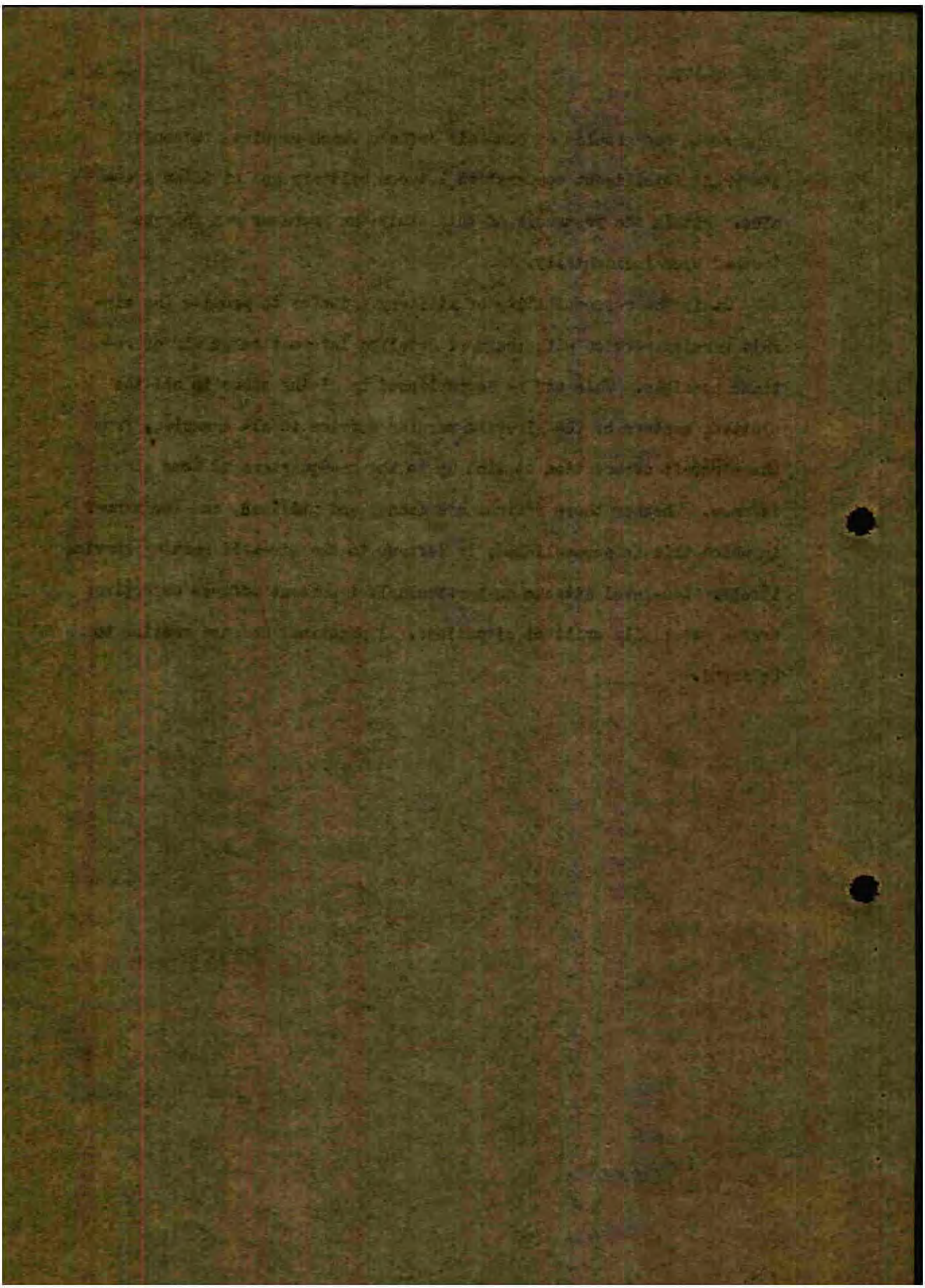
represents one problem of home air defense which requires thorough study and intelligent cooperation between military and civilian agencies. Within the framework of this study the problems can only be touched upon incidentally.

It is the responsibility of military agencies to provide the air-raid warning service with the most detailed information on air operations possible. This can be accomplished by giving space in all the plotting centers of the aircraft warning service to all agencies, from the aircraft observation station up to the headquarters of home air defense. Whether these offices are manned and utilized, and the manner in which this is accomplished, is left up to the air-raid warning service itself. Low-level attacks on particularly important defense objectives create especially critical situations. A practical defense remains to be found.



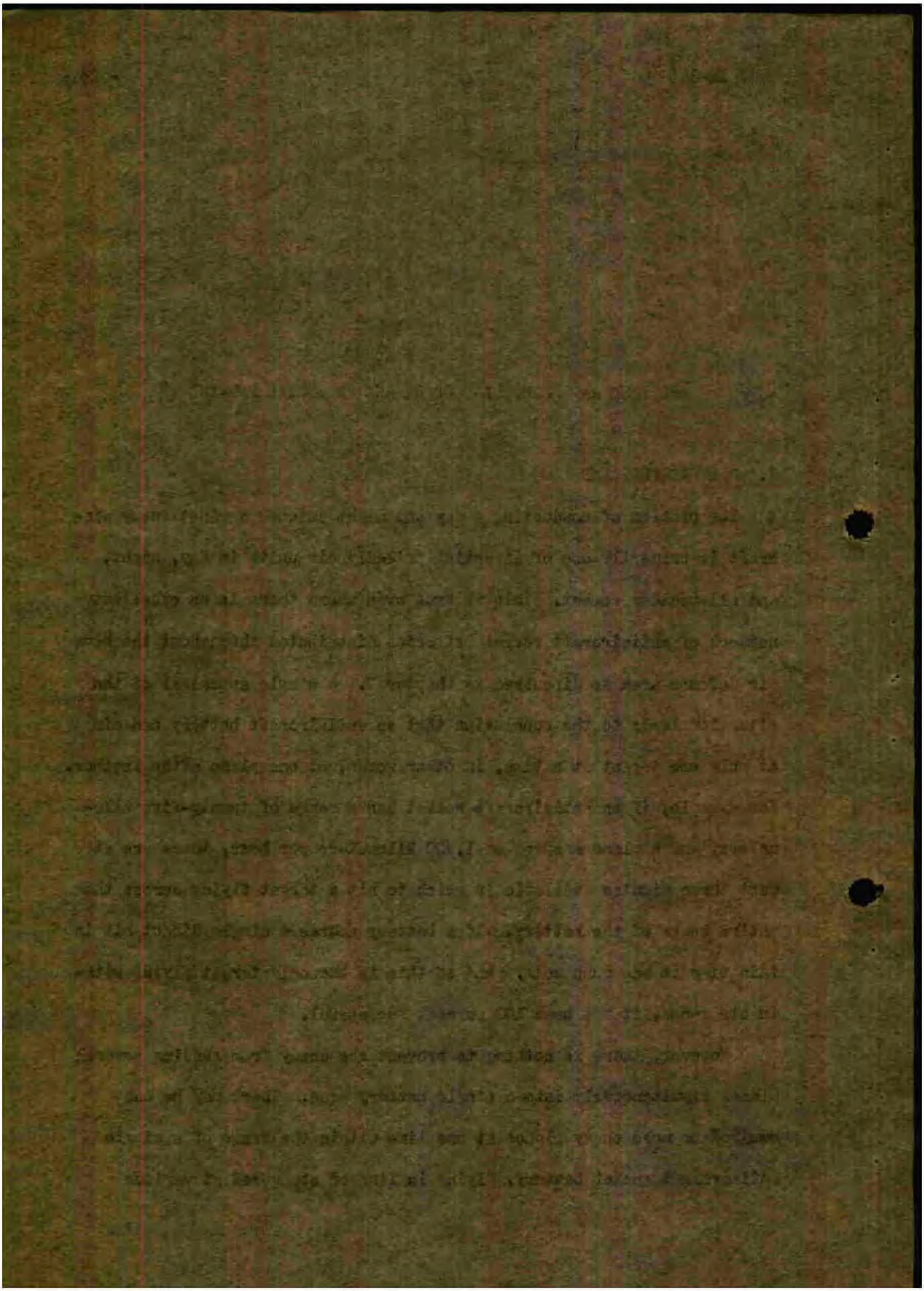
CHAPTER 3

PROBLEMS AND PRINCIPLES OF DEFENSIVE AERIAL WARFARE

1. GENERAL PROBLEMS

The problem of conducting a day and night defense against enemy aircraft is primarily one of directing friendly air units in day, night, and all-weather combat. This is true even where there is an excellent network of antiaircraft rocket batteries distributed throughout the home air defense area as discussed in Chapter 7. A simple appraisal of the situation leads to the conclusion that an antiaircraft battery can aim at only one target at a time, in other words, at one plane after another. For example, if an antiaircraft rocket has a range of twenty-five kilometers, and a plane a speed of 1,000 kilometers per hour, there are at most three minutes available in which to hit a target flying across the entire range of the battery. If a battery scores a single direct hit in this time it has done well. And if this is the only target flying within its range, it has been 100 percent successful.

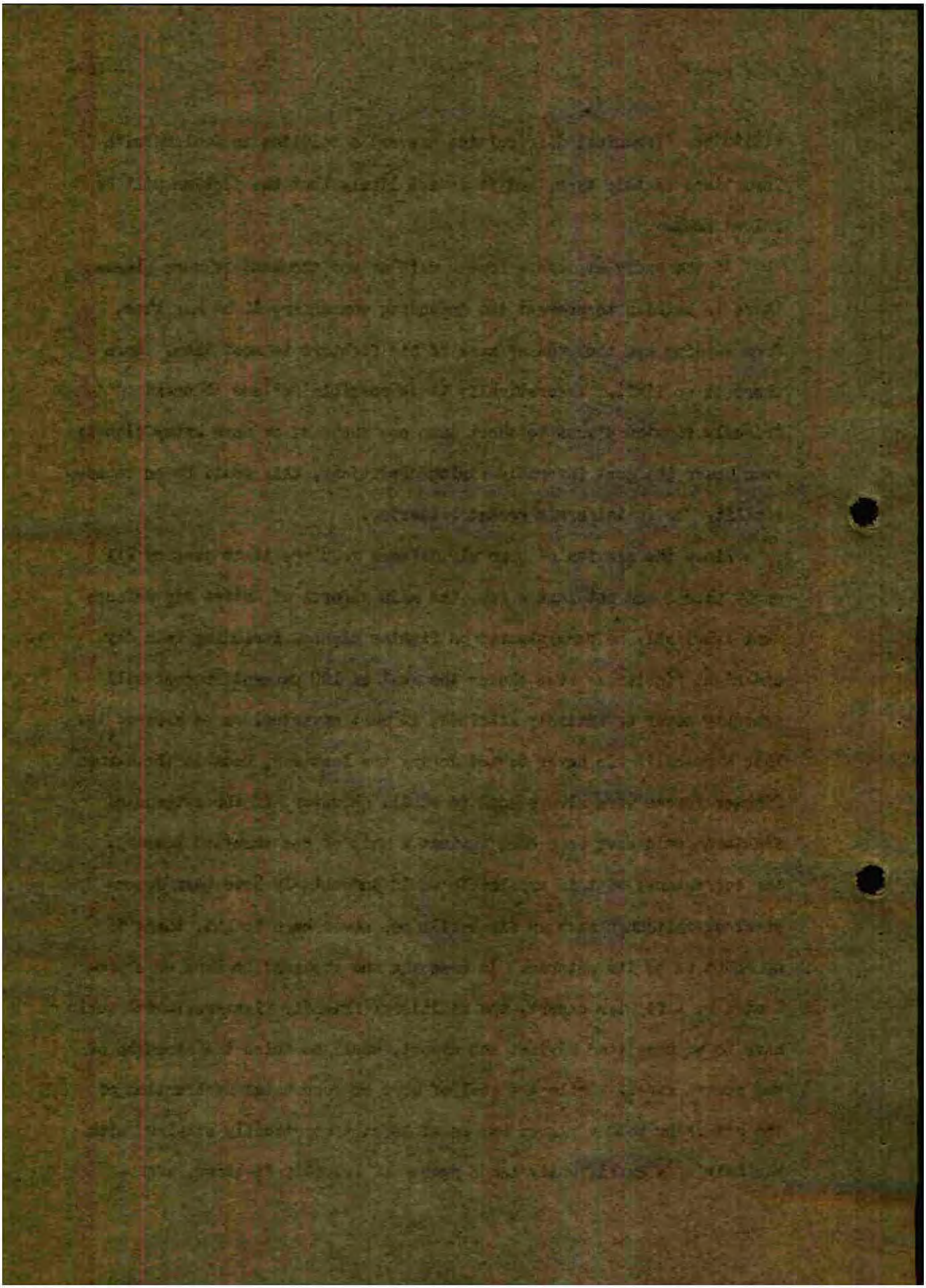
However, there is nothing to prevent the enemy from sending several planes simultaneously into a single battery area. There may be one hundred or more enemy planes at one time within the range of a single antiaircraft rocket battery, flying in line or staggered at various



altitudes. Technical difficulties prevent a solution to dealing with formations of this type, and it is not likely that the problem will be solved soon.

If the enemy employs a bomber unit of one thousand or more planes there is nothing to prevent the defending commander, if he has them, from sending two thousand or more of his fighters to meet them. Here there is no limit. Theoretically it is possible for one thousand friendly fighter planes to shoot down one thousand or more enemy planes; even under the most favorable firing conditions, this would be an impossibility for antiaircraft rocket batteries.

Since the mission of home air defense requires it to destroy all enemy planes and not just a few, the main efforts of active air defense must inevitably be concentrated on fighter planes, including both day and night fighters. Even though the goal of 100 percent success will probably never be entirely attained, it must nevertheless be aspired to. This hypothesis was never tested during the last war, because the German fighter forces were always much to small. However, if three thousand fighters could have been sent against a unit of one thousand bombers, the correctness of this hypothesis would undoubtedly have been demonstrated. Although such an air battle has never been fought, there is no doubt as to its outcome. In case the one thousand bombers were protected by a fighter escort, the additional friendly fighters, which would have to be committed against the escort, would be twice the strength of the escort force. While the goal of more or less total destruction of the attacking bomber planes can be at least theoretically attained with the help of a sufficiently large number of friendly fighters, such a



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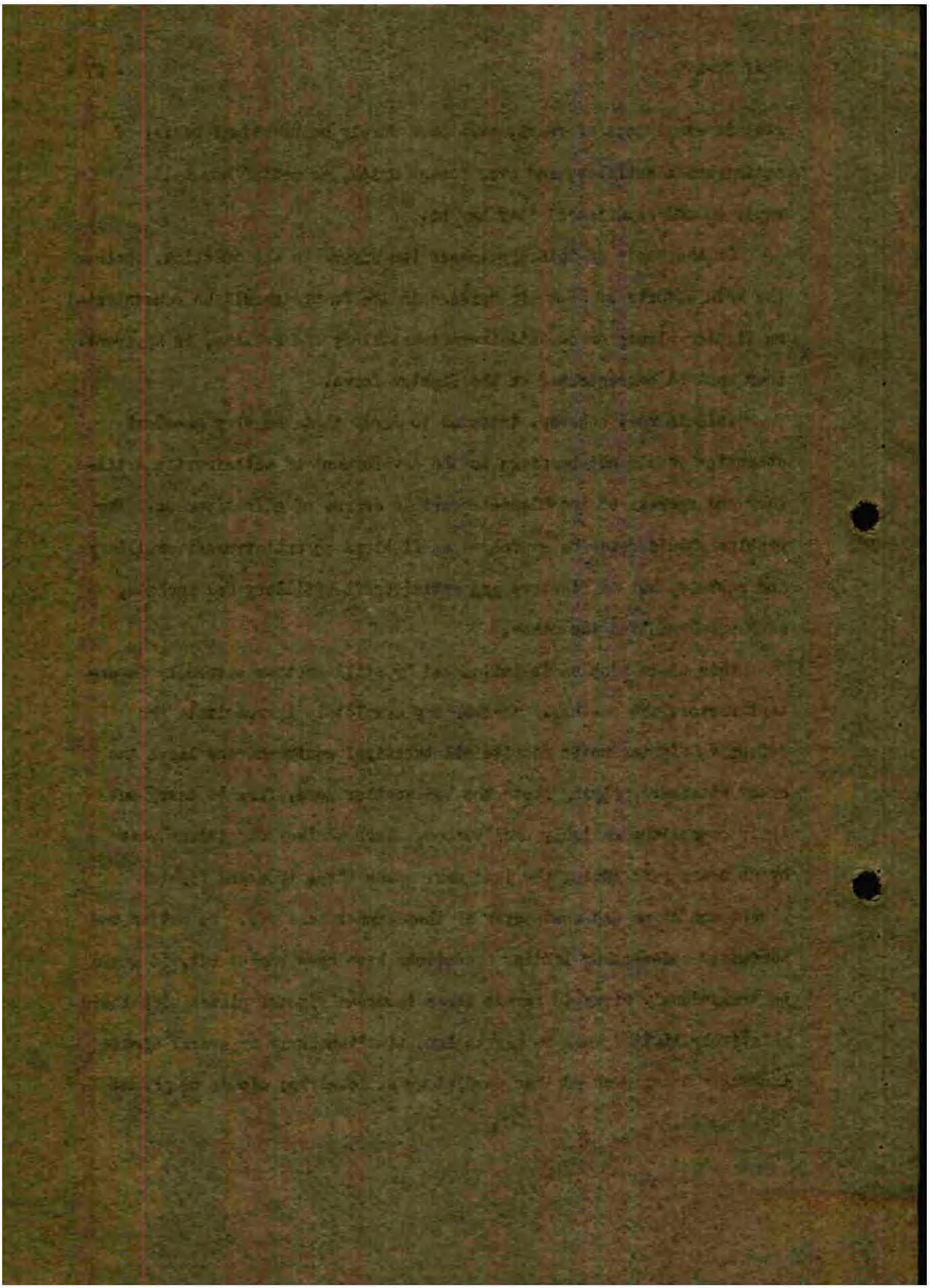
goal is simply out of reach, even on a purely mathematical basis, of antiaircraft artillery and even rocket units, no matter how well equipped and experienced they may be.

On the basis of this hypothesis the answer to the question, whether the main efforts of home air defense in the future should be concentrated on fighter planes or on antiaircraft artillery and rockets, is apparent: they must be concentrated on the fighter force.

This is not, however, intended to imply that the very greatest attention should not be given to the development of antiaircraft artillery and rockets of the highest possible degree of effectiveness. The problem should never be expressed as fighters or antiaircraft artillery and rockets, but as fighters and antiaircraft artillery and rockets, each supplementing the other.

This whole problem is influenced by still another extremely important factor, the weather. Weather may completely incapacitate the defensive fighter units despite all technical equipment and leave the enemy attackers, flying above the bad weather zone, free to carry out their operations entirely undisturbed. Such weather conditions were by no means rare during the last war. Even three thousand fighter planes are of no use whatsoever if they cannot take off. No matter how perfectly bad-weather landing operations have been worked out, it would be tremendously risky to permit three thousand fighter planes with their relatively limited fuel supply to land simultaneously or nearly simultaneously under such weather conditions as low-lying clouds or ground fog.



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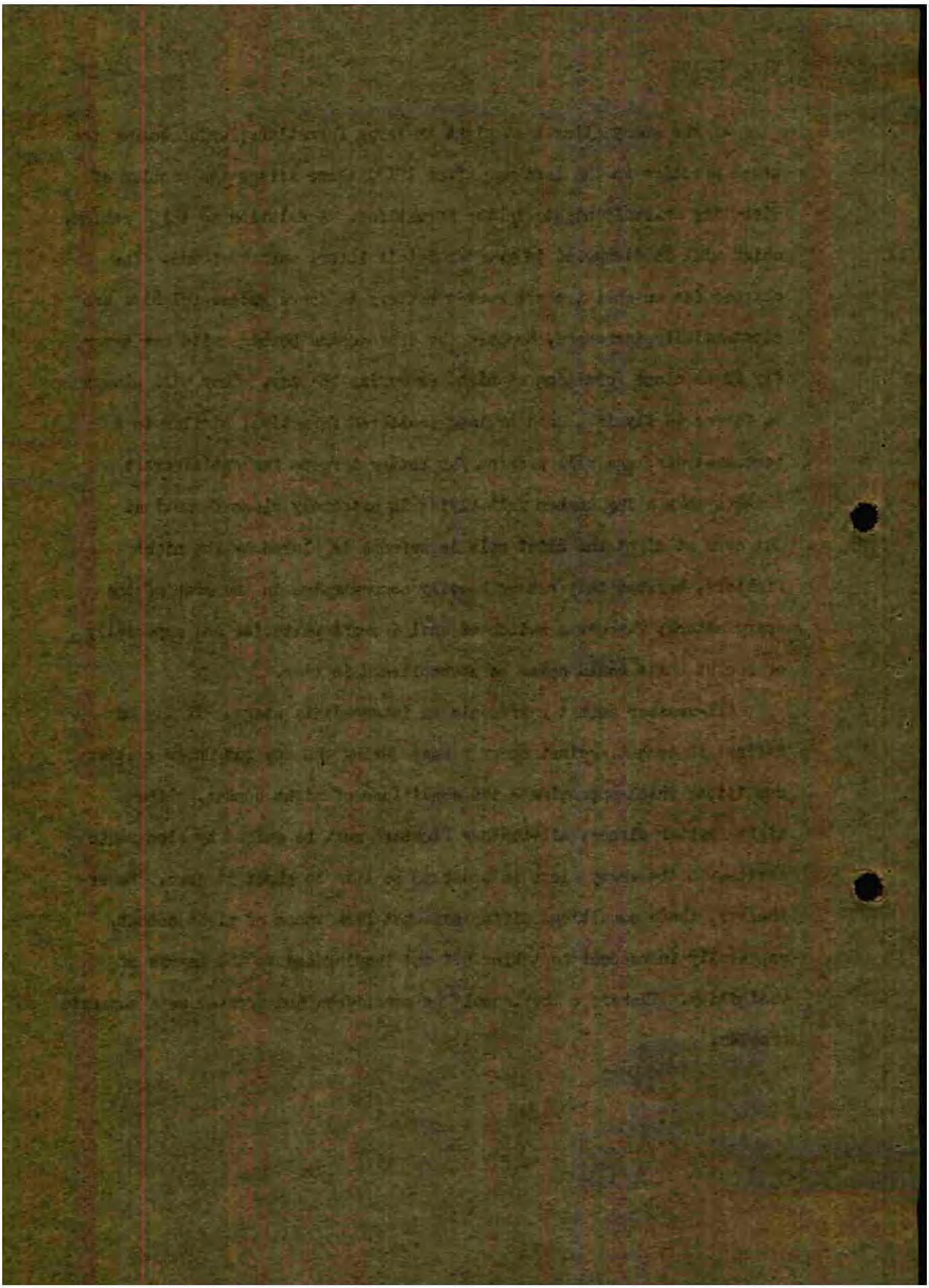
If the enemy attacks at night in large formations, which became the usual practice in the last war after 1943, there arises the problem of directing friendly night fighter formations. A solution to this problem, which will be discussed in greater detail later, must be found. The chances for an antiaircraft rocket battery to score successful hits are substantially increased, because the approaching bomber units can never fly in as close formation at night as during the day. They will always be forced to fly in a more or less scattered formation, similar to a bomber stream, and will present far better targets for antiaircraft rockets than a day bomber unit flying in extremely close formation. But even at night the chief role in defense is played by the night fighters, because they can be heavily concentrated in the area of the enemy attack; whereas a switch of antiaircraft batteries and especially of rocket units could never be accomplished in time.

All-weather combat represents an intermediate stage. It may be defined as combat against enemy planes during the day but under weather conditions which approximate the conditions of night combat. Like night fighter planes, all-weather fighters must be guided by electronic devices to the enemy plane in order to be able to shoot it down. Nevertheless, these conditions differ somewhat from those of night combat, especially in respect to taking off and landing and to the degree of visibility. Therefore they should be considered and treated as a separate problem.



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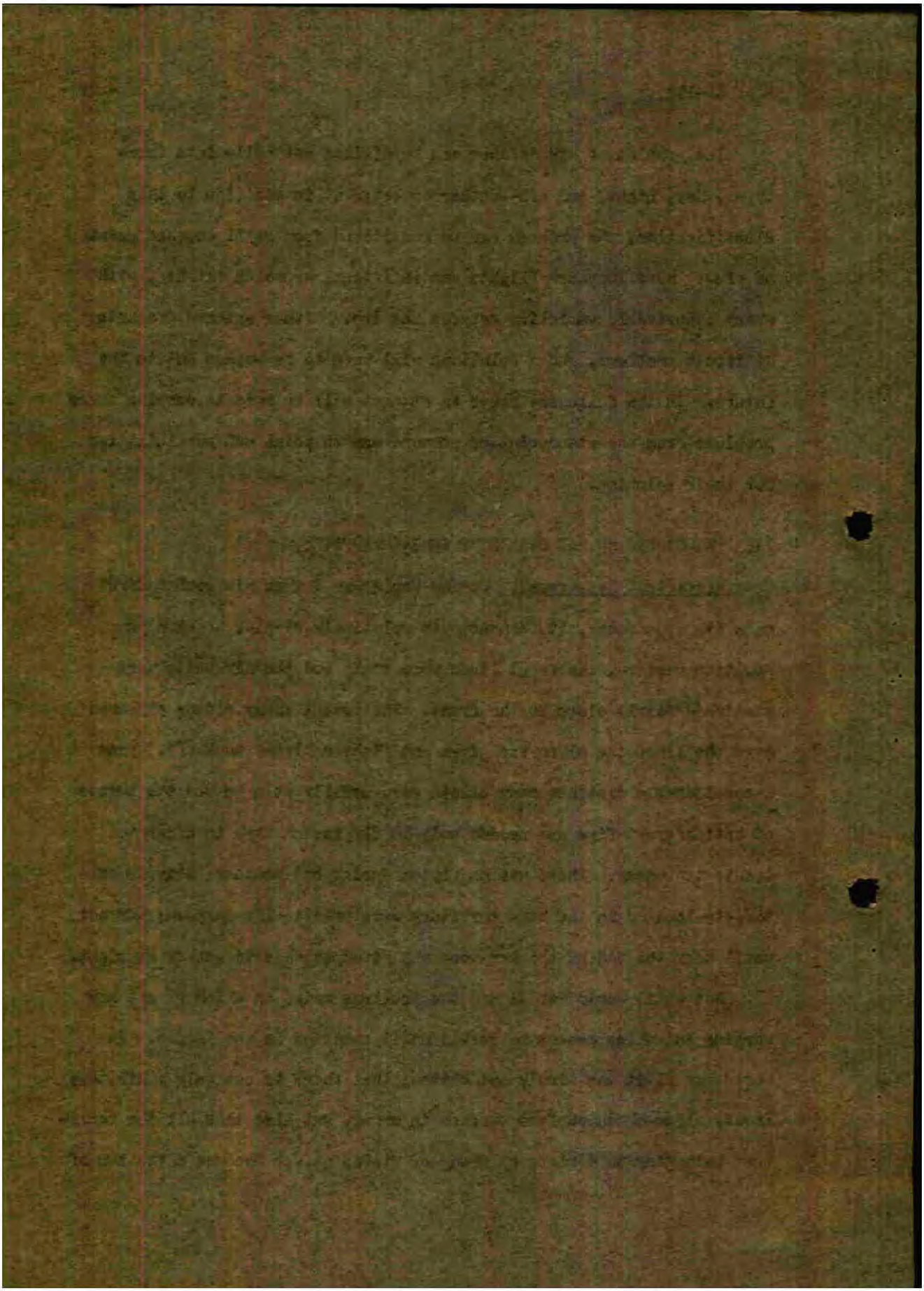
The problem of air defense can be divided naturally into three types, day, night, and all-weather combat; but in addition to this classification, the problem can be considered from still another point of view: mass approach flights and individual approach flights, with every conceivable variation between the two. Either extreme presents difficult problems, whose solutions will have to be worked out in the future. In the following pages an attempt will be made to examine these problems from the standpoint of command and to point out possibilities for their solution.

II. PRINCIPLES OF DAY DEFENSIVE AERIAL WARFARE

Historical Background. During World War I when air combat first made its appearance, its conduct was relatively simple. Locked in position warfare, the front lines were rigid and the air units were stationed fairly close to the front. The moment enemy planes appeared over the lines the alarm was given and fighter planes took off. From a considerable distance away pilots were usually able to see the bursts of antiaircraft fire and needed only to fly toward them in order to locate the enemy. There was no flying during bad weather; attacks on targets located in the home territory were practically unknown; and not until near the end of the war were any attempts made to attack at night.

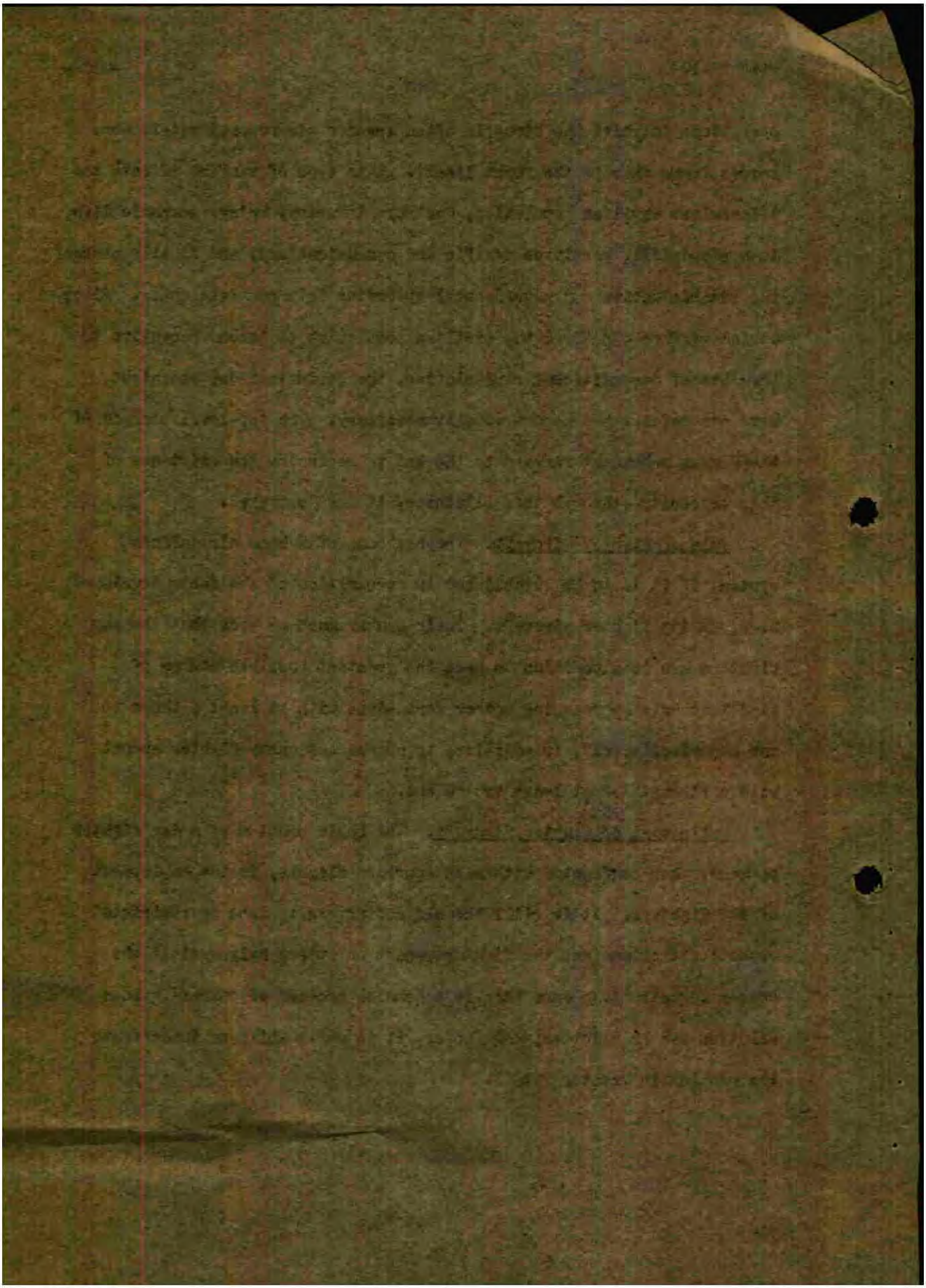
Not until World War II did the problems arise on which we are now working and which cannot be solved until sometime in the future. In World War II it was firmly established that there is not only a military front, along which surface warfare is waged, but also that all the territory belonging to a state or group of states at war becomes a theater of



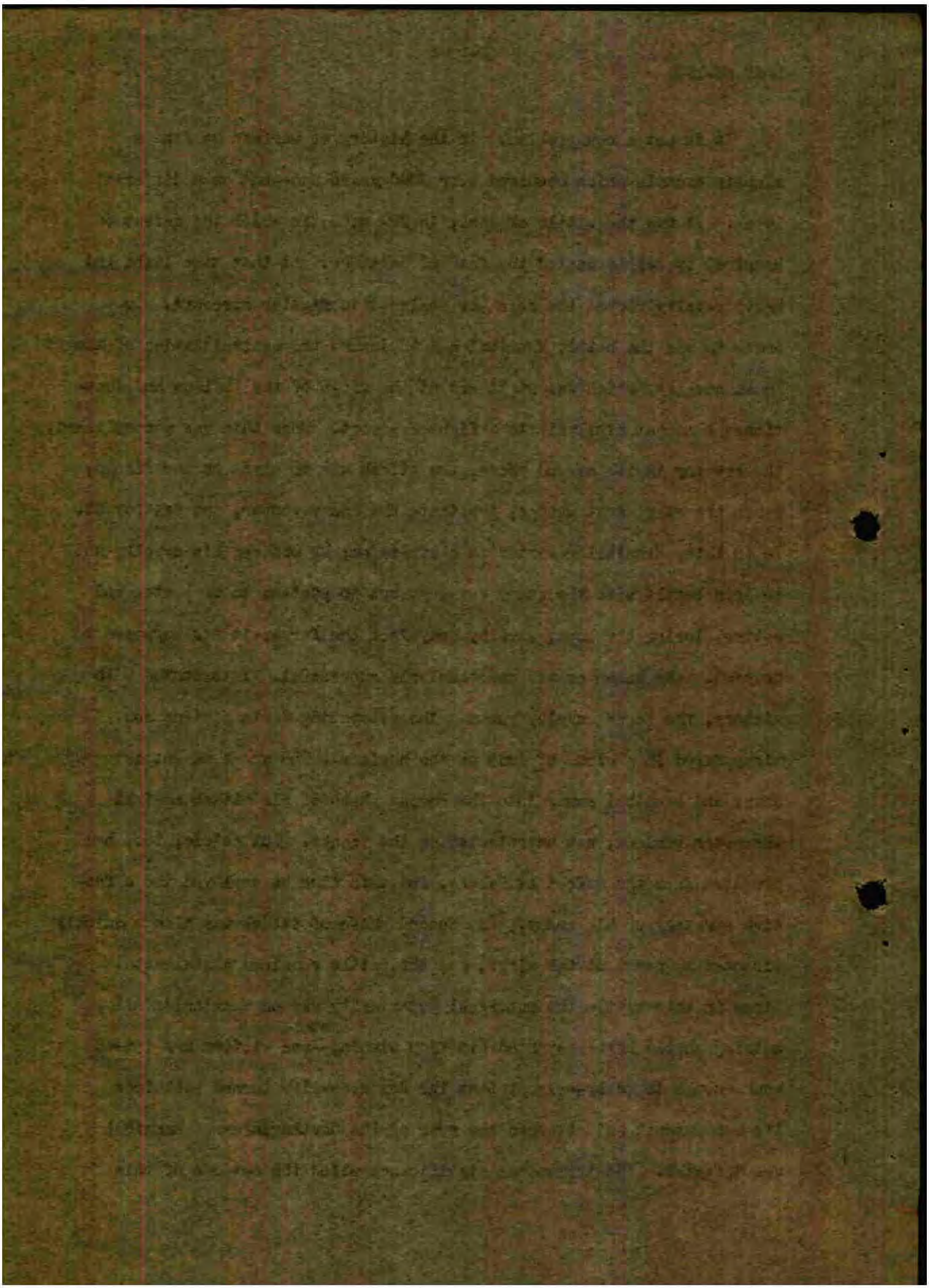
operations in which the struggle often assumes disproportionately more severe forms than at the front itself. This type of warfare affects the defenseless civilian population, destroys industry, brings economic life to a standstill, paralyzes traffic and communications, and finally plunges the administrative and governmental apparatus into complete chaos. Since aerial warfare can force the civilian population to become receptive to the idea of unconditional capitulation, the conduct of day and night home air defense has become vitally necessary. The top-level command of the German Wehrmacht refused to the end to recognize the existence of this necessity--through this blindness, it was destroyed.

Role of Fighter Aircraft. The backbone of a home air defense system, if it is to be established in recognition of the facts developed here, is its fighter aircraft. Their number must be such that the day fighters are in a position to meet the greatest possible number of simultaneously approaching bomber formations with at least a three to one superiority, and, in addition, to oppose an enemy fighter escort with a strength of at least two to one.

Employment of Fighter Aircraft. The basic problem of a day fighter command, when confronted with mass approach flights, is the employment of its fighters. It is still the old controversy: free or restricted combat; attack against the fighter escort or attack only against the bomber formations. Since this is a genuine problem of command, whose solution can be a determining factor, it is worth-while to investigate the problem in greater detail.



It is not a new problem. In the history of warfare we find a classic example which occurred over 2000 years ago—but on a different level. It was the battle of Zama, in 202 B.C., in which the defeat of Hannibal by Scipio sealed the fate of Carthage. At that time light and heavy cavalry played the role now assigned to fighter aircraft. In order to win the battle Hannibal had to insure the neutralization of the Roman cavalry, which was stationed at the wings of the phalanx and functioned somewhat similarly to a fighter escort. Once this was accomplished, the cavalry in its second phase, the attack was to pivot on the flanks, reach the rear as at Cannae, penetrate the enemy center, and destroy it. To do this, Hannibal resorted to a stratagem; he ordered his cavalry not to join battle with the enemy cavalry, but to pretend to be beaten and retire, luring the enemy cavalry away from the forces it was supposed to protect. The maneuver was spectacularly successful. Intoxicated with victory, the Roman cavalry pursued the retreating Carthaginians and disappeared in a cloud of dust on the horizon. The great moment had come, and Hannibal swung into the second phase of his attack against the Roman phalanx, now unprotected on the flanks. But Scipio, too, had profited from the defeat at Cannae, and this time he employed the offensive strategy of his enemy. His second phase of attack was also a quickly directed movement at the wings, and the battle remained a stalemate. Since in this battle the numerical superiority was on Hannibal's side, nothing should have prevented him from winning—and victory was indeed near enough to grasp—except that the Roman cavalry turned back from its mad pursuit and attacked the rear of the Carthaginians. Hannibal was defeated. The tremendous significance which the outcome of this



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battle had for the world at that time--the final decision between Rome and Carthage--is well-known to the student of history.

To be sure, no illustration is perfect, but the basic idea is clearly outlined for us. How can one best protect the unit upon which the outcome of an engagement depends?

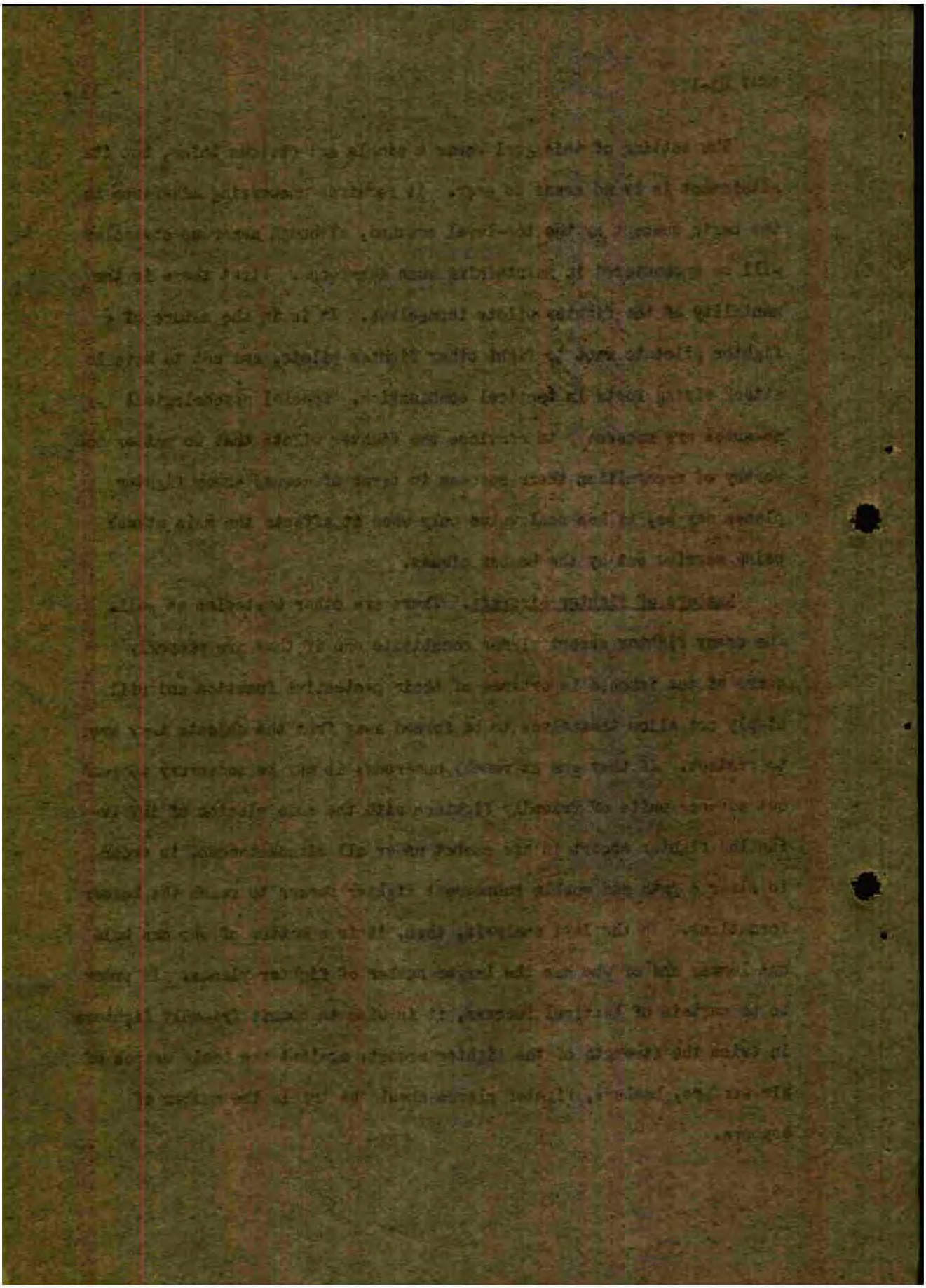
The Roman cavalry accomplished it by pursuing the Carthaginian cavalry, but--and this was the deciding factor--with a precisely defined objective. When this objective had been reached, it turned around and hurried back to the unit under its protection. It arrived just in time to rescue its own wavering center from destruction and turn defeat into victory.

This illustration, when applied to offensive aerial combat, implies that the fighter escort acts correctly if it does not move farther away from the object it is assigned to protect than is absolutely necessary in the direct performance of its protective function, for in this case it is upon the success of the bomber formation that the outcome rests.

In planning the conduct of home air defense, however, it must always be assumed that the enemy's tactics are correct. Therefore, friendly day fighters, whose mission is to protect the home air defense area from attacks by bomber units, must be instructed not to become involved in lengthy combat with the enemy fighter escort, even though success in the form of downed enemy fighter planes looks promising. They must attack and destroy the central core of the enemy bomber formations insofar as possible, and ideally before the bombers have had an opportunity to unload their destructive cargo.

The setting of this goal seems a simple and obvious thing, but its attainment is by no means so easy. It requires unswerving adherence to the basic concept by the top-level command, although numerous obstacles will be encountered in maintaining such adherence. First there is the mentality of the fighter pilots themselves. It is in the nature of a fighter pilot to want to fight other fighter pilots, and not to have to attack flying forts in tactical combination. Special psychological measures are necessary to convince the fighter pilots that no matter how worthy of recognition their success in terms of downed enemy fighter planes may be, it has real value only when it affects the main attack being carried out by the bomber planes.

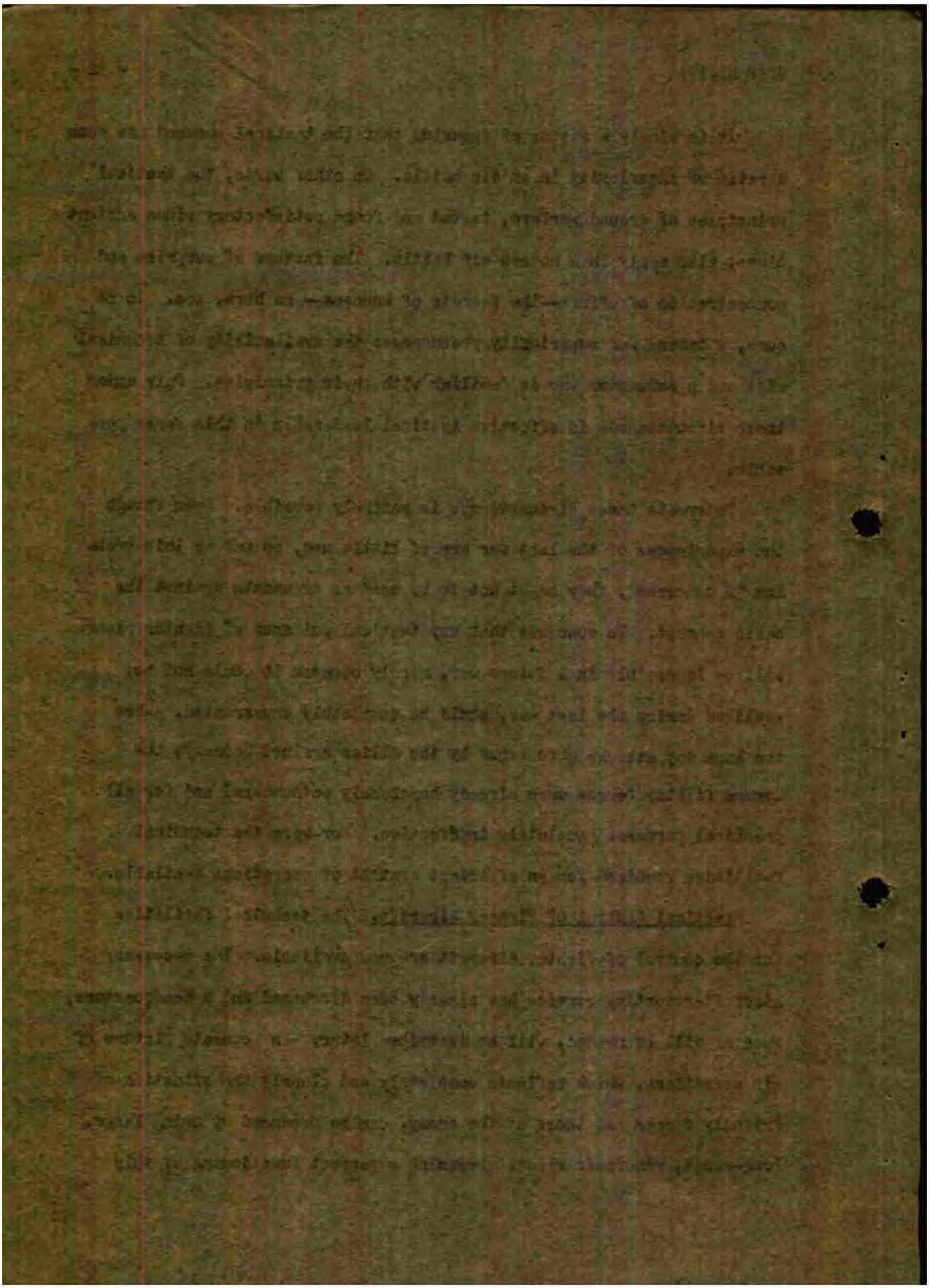
Numbers of Fighter Aircraft. There are other obstacles as well. The enemy fighter escort planes constitute one if they are properly aware of the immense importance of their protective function and will simply not allow themselves to be forced away from the objects they are to protect. If they are extremely numerous, it may be necessary to send out advance units of friendly fighters with the sole mission of involving the fighter escort in air combat under all circumstances, in order to clear a path and enable subsequent fighter forces to reach the bomber formations. In the last analysis, then, it is a matter of who can hold out longer and of who has the larger number of fighter planes. In order to be certain of tactical success, it is wise to commit friendly fighters in twice the strength of the fighter escort; against the basic weapon of air warfare, bombers, fighter planes should be triple the number of bombers.



It is simply a matter of assuring that the tactical command has such a ratio of superiority in an air battle. In other words, the tactical principles of ground warfare, tested and found satisfactory since ancient times, also apply in a modern air battle. The factors of surprise and concentration of effort--the secrets of success--are here, too. To be sure, a demand for superiority presupposes the availability of technical aids and a commander who is familiar with their principles. Only under these circumstances is effective tactical leadership in this sense possible.

To create these circumstances is entirely possible. Even though the experiences of the last war are of little use, so far as this problem is concerned, they ought not to be used as arguments against the basic concept. To conclude that any tactical guidance of fighter planes will be impossible in a future war, merely because it could not be realized during the last war, would be completely unwarranted. When the huge day attacks were begun by the Allies against Germany, the German fighter forces were already hopelessly outnumbered and for all practical purposes completely ineffective. Nor were the technical facilities required for an efficient control of operations available.

Tactical Control of Fighter Aircraft. The technical facilities for the control of fighter aircraft are now available. The necessary aircraft-reporting service has already been discussed and a headquarters, such as will be needed, will be described later. An accurate picture of air operations, which reflects completely and clearly the situation of friendly forces and those of the enemy, can be produced by using large, long-range, panoramic radar. Assuming a perfect functioning of this



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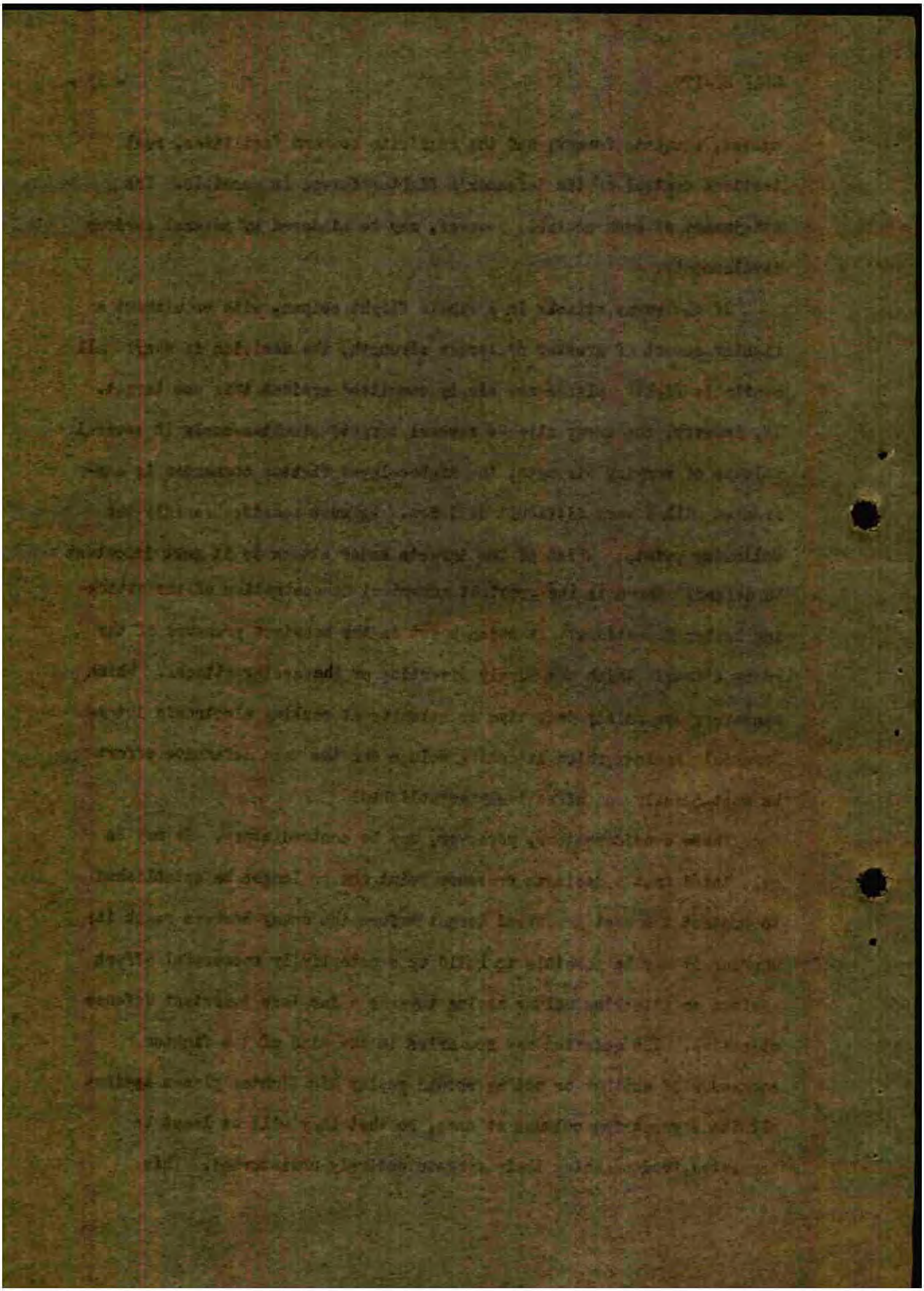
system, adequate forces, and the requisite command facilities, real tactical control of the defender's fighter forces is possible. The attainment of such control, however, may be hindered by several serious developments.

If the enemy attacks in a single flight column, with or without a fighter escort of greater or lesser strength, the decision is easy: all available fighter planes are simply committed against this one target. If, however, the enemy attacks several targets simultaneously in several columns of varying strength, the higher-level fighter commander is confronted with a very difficult decision. He must consider rapidly the following points: Which of the targets under attack is it most important to defend? Where is the greatest numerical concentration of the attacking bomber formations? At which point is the heaviest pressure of the enemy attack? Which are merely diverting or harassing attacks? Which maneuvers are solely deceptive or attempts at causing electronic interference? Against which attacking column can the main defensive effort be most quickly and effectively established?

These considerations, moreover, may be contradictory. It may be calculated that a decisive pressure point can no longer be established to protect the most important target before the enemy bombers reach it; whereas it may be possible to build up a potentially successful effort against an attacking column moving towards a far less important defense objective. The question may now arise in the mind of the fighter commander of whether or not he should employ his fighter planes against all the approaching columns at once, so that they will at least be prevented from reaching their targets entirely undisturbed. This



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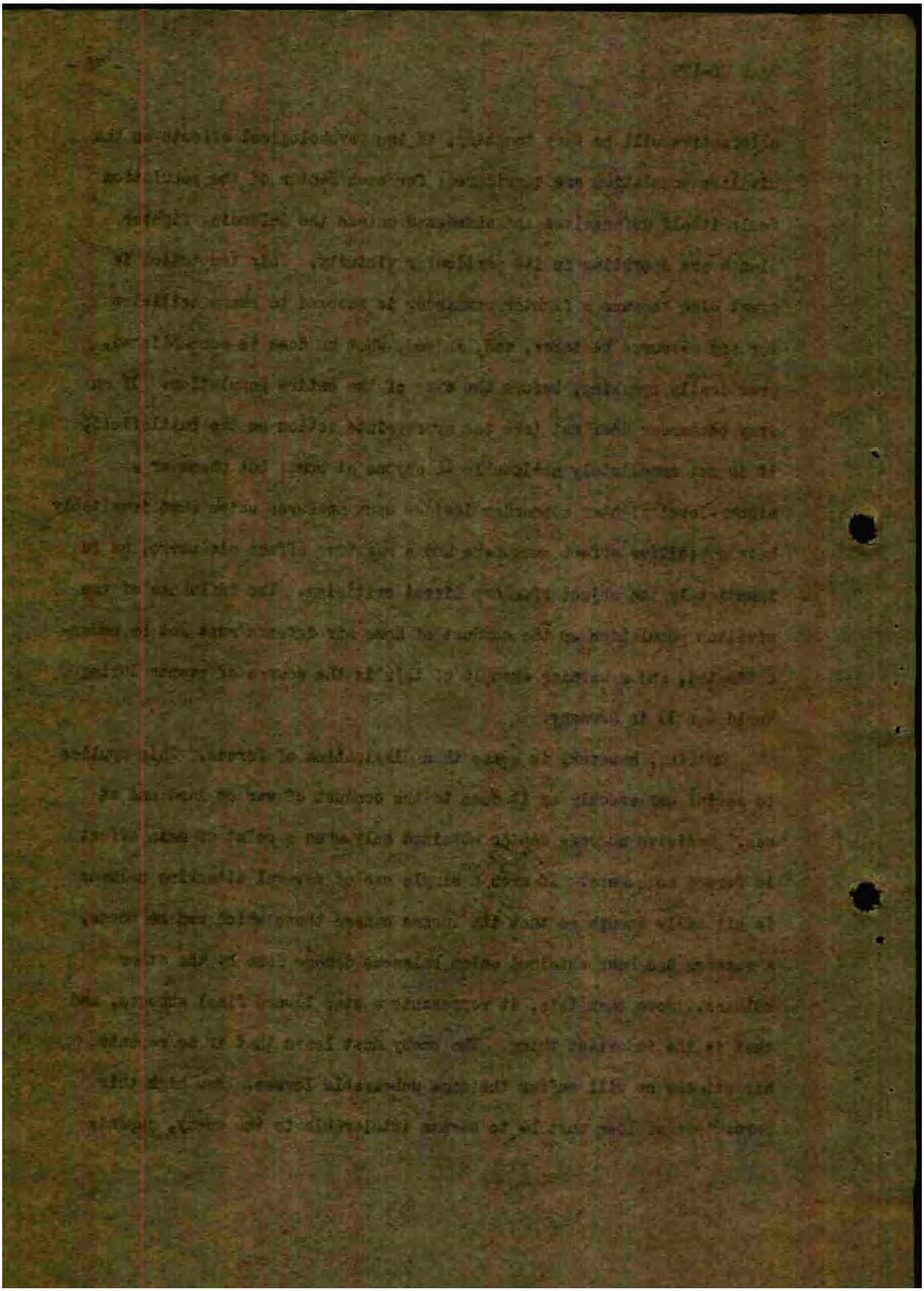
alternative will be very tempting, if the psychological effects on the civilian population are considered; for each sector of the population feels itself defenseless and abandoned unless the defending fighter planes are operating in its particular vicinity. This temptation is great also because a fighter commander is exposed to sharp criticism for any measures he takes, and, indeed, what he does is accomplished, practically speaking, before the eyes of the entire population. If an army commander does not take the appropriate action on the battlefield, it is not immediately noticeable to anyone at home; but whenever a higher-level fighter commander decides upon measures which must inevitably have a positive effect somewhere and a negative effect elsewhere, he is immediately the object of sharp direct criticism. The influence of the civilian population on the conduct of home air defence must not be underestimated, and a warning example of this is the course of events during World War II in Germany.

Nothing, however, is worse than dissipation of forces. This applies to aerial war exactly as it does to the conduct of war on land and at sea. Decisive success can be obtained only when a point of main effort is formed somewhere. If even a single one of several attacking columns is hit badly enough so that its losses exceed those which can be borne, a success has been obtained which balances damage done by the other columns. More than this, it represents a step toward final success, and that is the important thing. The enemy must learn that if he repeats his attacks he will suffer the same unbearable losses. How high this percentage of loss must be to become intolerable to the enemy, depends



upon his production capacity. If the loss is higher than he can replace, it may be considered as unacceptable by the enemy. This level, of course, will differ in every country.

The higher-level fighter commander must always be prepared for the eventuality that the enemy will change his tactics as soon as he realizes that if he continues to follow the same procedures he will keep on suffering unbearable losses. For this reason a rigid pattern can never be established for the conduct of air defense. Fighter commanders must be given maximum freedom in making decisions and in their choice of defense measures.

Naturally, the control of fighter units, as it is described here, enters the picture only when the home air defense area is extensive enough to represent a radius of action for fast aircraft. If the home territory is so small that enemy aircraft need only a few minutes to reach their targets, the only possibility is to get the friendly fighters into the air and started towards their nearest objective; the question of tactical command is largely nonexistent in such a case.

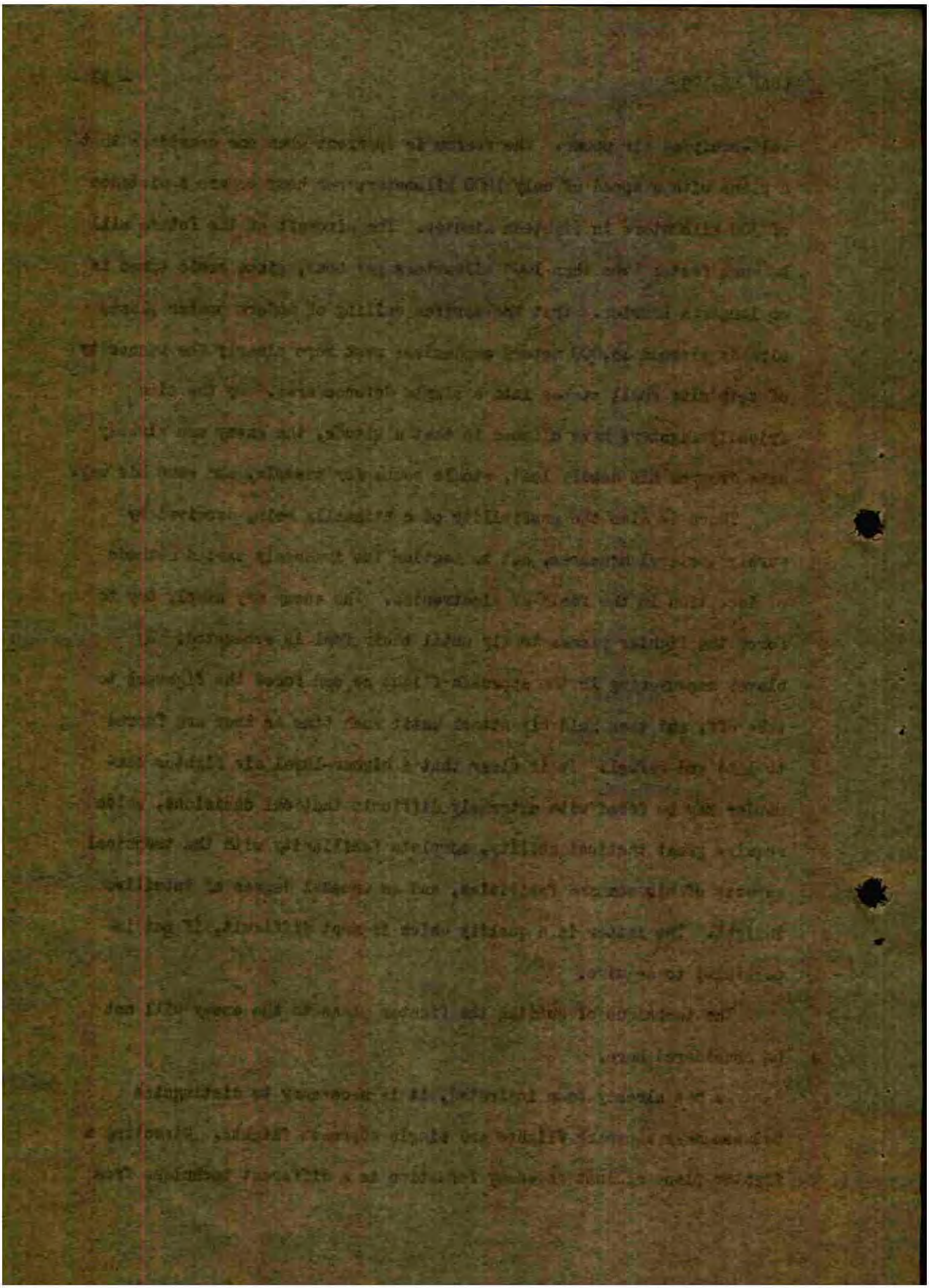
Based on these considerations, two points become clear. The first emphasizes the importance of having an outpost for an aircraft-reporting service which is capable of spotting enemy planes as early as possible, ideally from the moment of take-off, by using electronic devices. The second establishes the necessity of combining the smaller political entities into large air defense regions or areas under a unified command. Because their lack of mobility precludes sufficiently fast coordination between the reporting of enemy aircraft and the taking of actual defense measures, small countries are practically defenseless against a modern,

well-equipped air power. The reason is apparent when one considers that a plane with a speed of only 1000 kilometers per hour covers a distance of 300 kilometers in eighteen minutes. The aircraft of the future will be much faster even than 1000 kilometers per hour, since sonic speed is no longer a barrier. That the service ceiling of modern bomber planes already exceeds 15,000 meters emphasizes even more clearly the necessity of combining small states into a single defense area. By the time friendly fighters have climbed to that altitude, the enemy can already have dropped his deadly load, atomic bombs for example, and gone his way.

There is also the possibility of continually being deceived by purely tactical measures, not to mention the immensely varied methods of deception in the field of electronics. The enemy may simply try to force the fighter planes to fly until their fuel is exhausted. By clever maneuvering in the approach flight he can force the fighters to take off, and then hold his attack until such time as they are forced to land and refuel. It is clear that a higher-level air fighter commander may be faced with extremely difficult tactical decisions, which require great tactical ability, complete familiarity with the technical aspects of his command facilities, and an unusual degree of intuitive insight. The latter is a quality which is most difficult, if not impossible, to acquire.

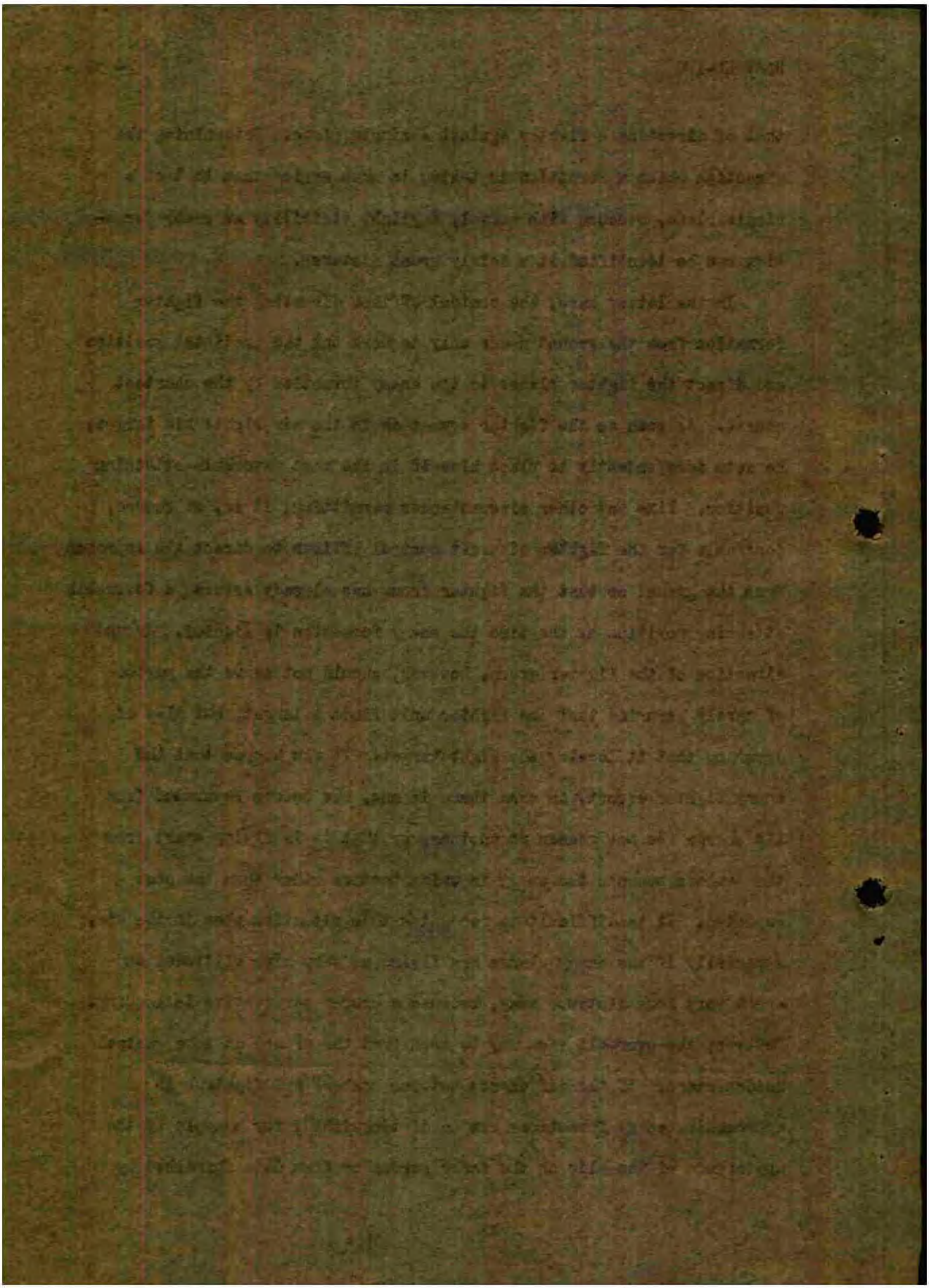
The technique of guiding the fighter plane to the enemy will not be considered here.

As has already been indicated, it is necessary to distinguish between mass approach flights and single approach flights. Directing a fighter plane against an enemy formation is a different technique from



that of directing a fighter against a single plane. Determining the direction which a formation is taking is much easier than that of a single plane, because with normal, daylight visibility an enemy formation can be identified at a fairly great distance.

In the latter case, the control officer directing the fighter formation from the ground needs only to work out the predicted position and direct the fighter planes to the enemy formation by the shortest course. As soon as the fighter commander in the air sights his target, he acts independently to place himself in the most favorable attacking position. Time and other circumstances permitting, it is, of course, desirable for the fighter aircraft control officer to direct the approach from the ground so that the fighter group has already assumed a favorable attacking position by the time the enemy formation is sighted. Ground direction of the fighter group, however, should not serve the purpose of merely assuring that the fighter unit finds a target, but also of assuring that it locates the right target. It can happen that the enemy fighter escort, in case there is one, has become separated from its charge for one reason or another, or that it is flying apart from the bombers because the enemy is using tactics other than the ones expected. It is difficult to recognize this situation when in the air, especially if the enemy planes are flying at very high altitudes and are a very long distance away, because a proper perspective is lacking. However, the over-all view may be seen from the ground at some control headquarters. If the difference between bombers and fighters in approaching enemy formations can be distinguished, for example by the appearance of the blip on the radar screen or from data furnished by



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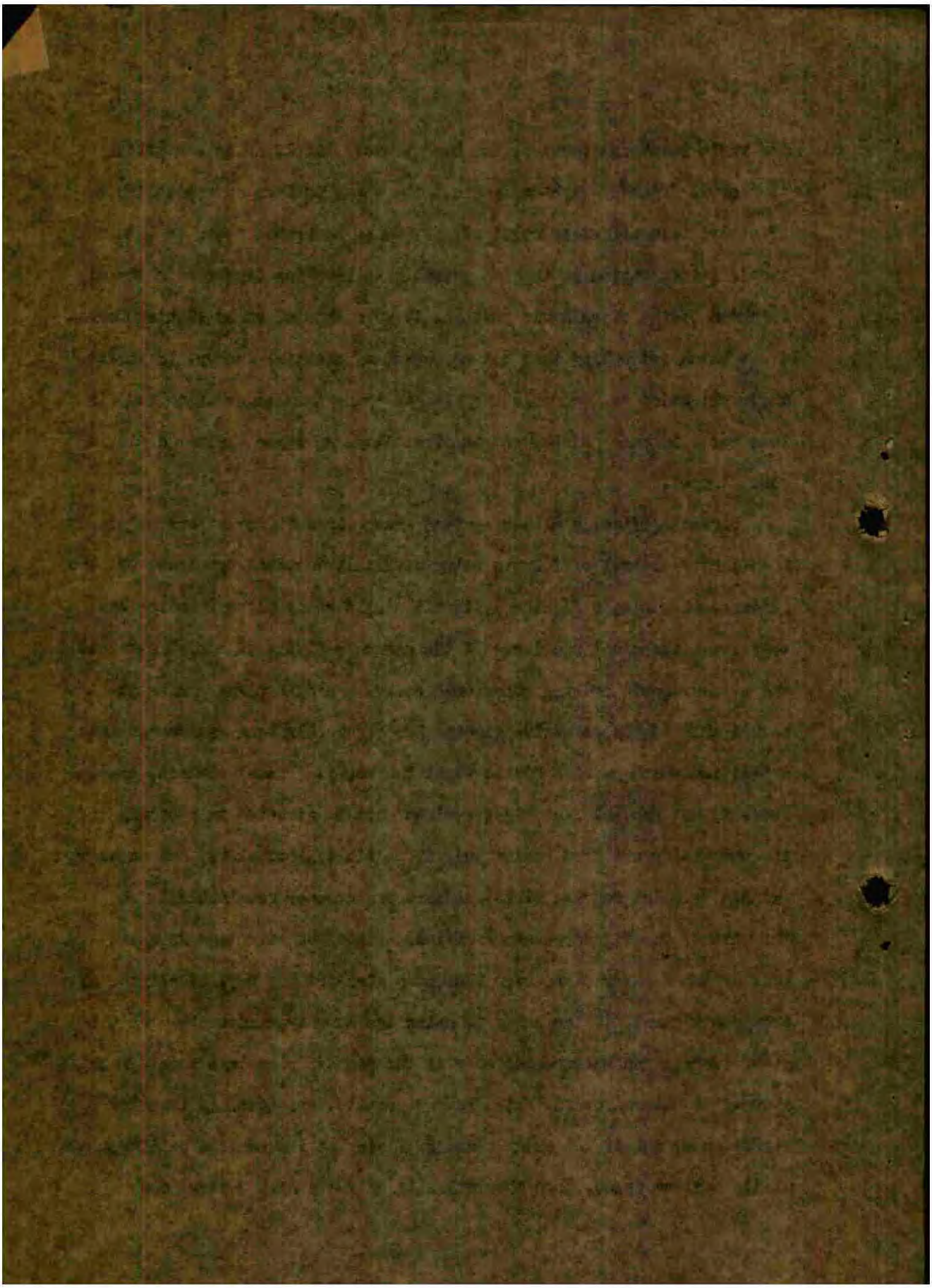
the radio intercept service, the headquarters itself is in a position to commit friendly fighters against the enemy bombers and establish an effective main effort as required. By using panoramic radar to gather tactical information it is also possible to keep the fighters in the air informed of the overall air picture, to warn them of enemy fighter formations which are behind them and represent a potential danger, to direct their attention to favorable targets, to bring them together in the air into focal defense points, and to direct them en masse against a single enemy target.

Directing fighter planes against enemy aircraft formations requires the fighter control officer to solve difficult tactical problems, but the guidance of a single fighter against a single enemy plane requires him to solve a technical problem. If the enemy is flying at a high altitude and at near-sonic or even supersonic speed, a single plane can be attacked only if the defensive fighter has originally been maneuvered into a position which enables him to sight the enemy. Visual contact, however, is not enough. The fighter plane must be directed to approach the enemy aircraft from behind and, if possible, from above, and on an almost parallel course. This guidance presupposes great ability on the part of the fighter control officer, since the advantage in speed held by the fighter plane over the enemy aircraft may be very slight, or even nonexistent, if the enemy is using the same type aircraft. In this case, success can be expected only if the fighter plane can attack from above. If both aircraft, friendly and hostile, are equal in technical performance, and if the enemy plane is flying at its service ceiling and at its maximum speed, then theoretically only a single contact can



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conceivably be computed, and that contact would have to come either from the opposite direction or from a course varying up to 90° on either side of the opposing direction. In this situation, however, there is no real prospect of success, because the time would be too short to enable the friendly fighter to identify and attack the enemy plane. Since this is the most unfavorable situation which can be conceived, it is mentioned merely to emphasize the necessity of meeting the tactical and technical requirements.

Technical Control of Fighter Aircraft. Technical means for control of fighter formations can be provided by modern guide beam units. It is tremendously important to find a satisfactory solution to the problem of how to identify friendly and hostile aircraft by radar. The problem of identification can be considerably simplified if, instead of the usual fighter guide beam equipment, that is, the Egnite control,[1] friendly fighters are directed by data completely and automatically transmitted by radar sets such as the World War II Ehru-2,[2] which operated on the Egnite control principle. With a range equal to line of sight, it permits the completely automatic direction of a plane toward an enemy aircraft. For purposes of daylight combat, this degree of exactness is fully adequate; for night combat, however, it suffices only if the night fighter plane is equipped with an airborne radar to bridge the last gap to the enemy plane.

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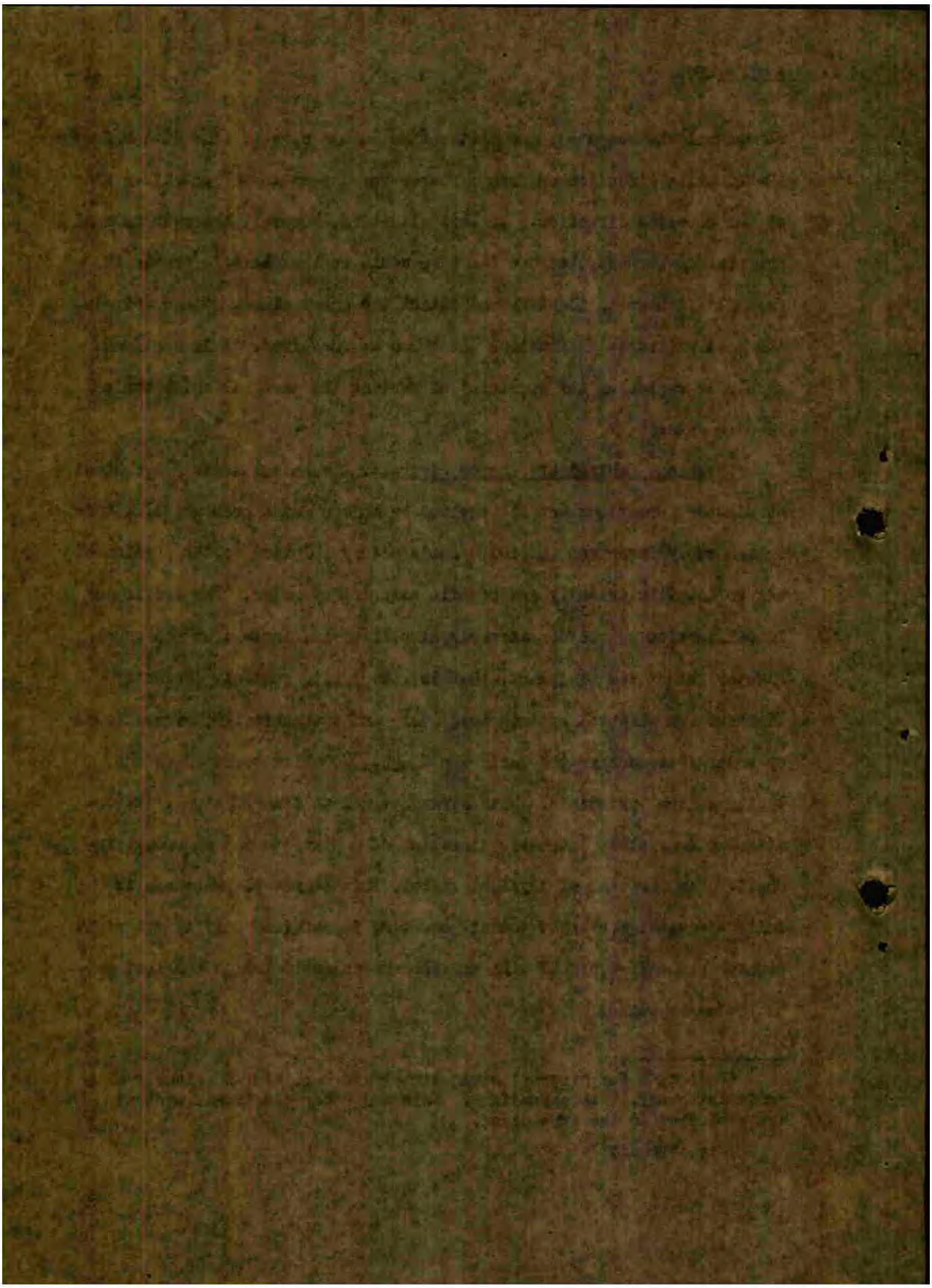
[1]Code name for aircraft navigational aid combining DF signals with radio telephony. See appendix E. This and other electronic systems are explained in the appendixes.

[2]See appendix F.



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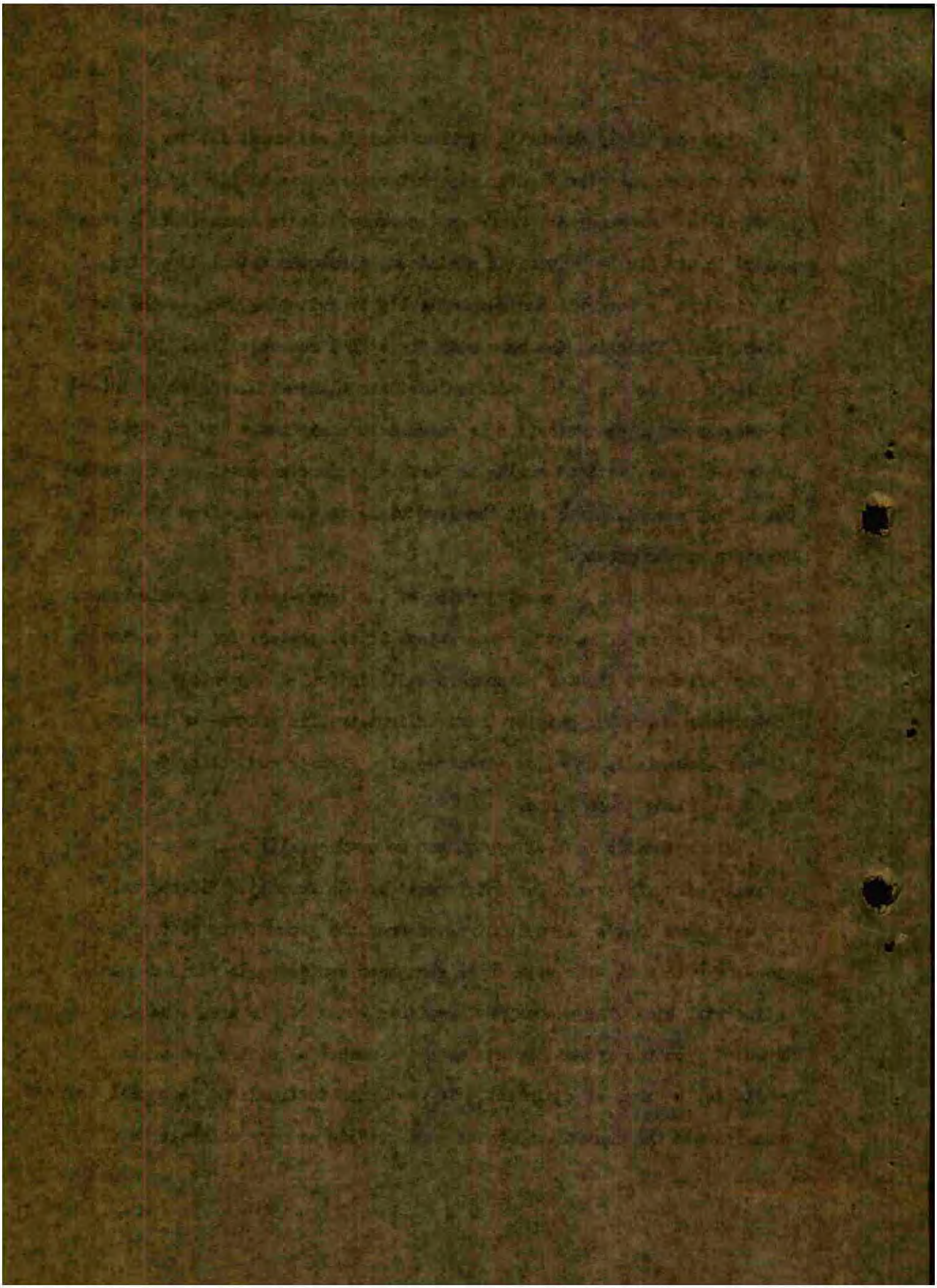
With completely automatic fighter control equipment all the technical requirements of the fighter aircraft control can be ideally met, since it has the necessary range and accuracy. Radio communication from ground to air can be reduced to a minimum, since the actual directing of the aircraft is accomplished automatically by switching over to the automatic pilot, obviating the necessity for verbal communication. Misunderstandings due to acoustical difficulties are eliminated, and enemy interference in radio communication is reduced to a minimum. The fighter control officer, without having to perform tedious computations and without saying a word, can direct the lead plane to the enemy from his headquarters on the ground.

In case of loss or enemy jamming of the large-size, panoramic radar, only the picture of enemy air operations is eliminated, for the positions of the defender's fighter planes are still indicated separately on the instruments which are guiding them. Flight traffic control of friendly fighter aircraft is an added advantage of a fighter control system organized along these lines.

This automatic control system can be used equally well to control a single aircraft or the largest formation. In formation flights only the unit commander's plane is directed from the ground; the rest of the planes fly in formation with their commander and maintain radio communication with him. The number of formations which can be simultaneously directed from the ground depends upon the number of control channels available in terms of equipment. To meet both tactical and technical requirements the control apparatus must provide as many channels as



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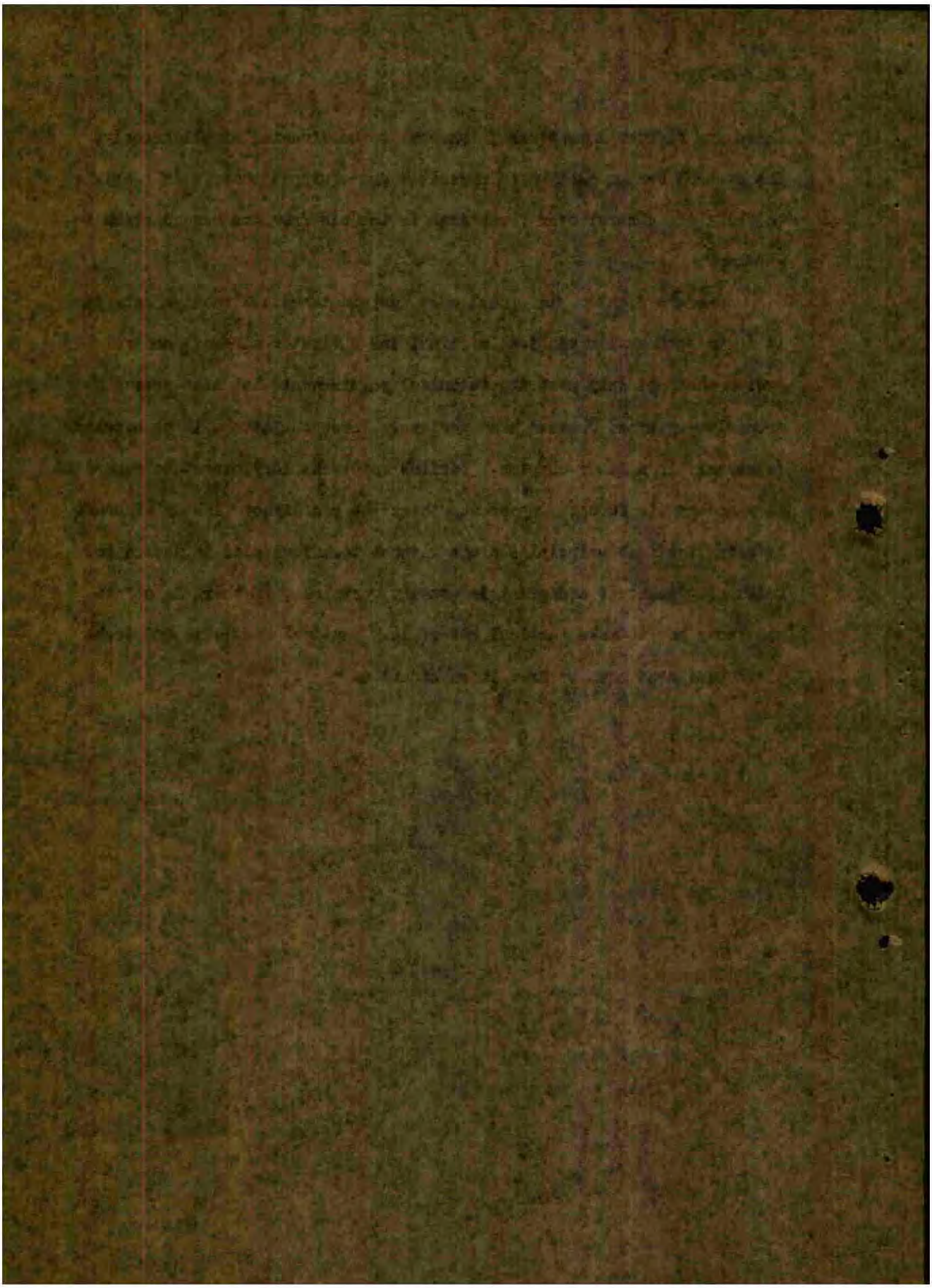
there are fighter formations which have to be directed simultaneously. The control system must be so organized and equipped that it is possible to shift the control over formations in the air from one headquarters to another.

A modern fighter plane must meet certain technical requirements if it is to perform its tactical mission, and a fighter aircraft control system must not only meet the technical requirements but also have a properly organized command headquarters. These subjects will be handled separately in a later chapter. Tactics and technology cannot be separated in a modern air force. Anyone who thinks he can direct fighter aircraft by using tactical principles alone without technical aids is doomed to failure. Technical equipment is equally worthless, if there is no one who knows how to make tactical use of it. Tactical knowledge and technical equipment must be used in combination.



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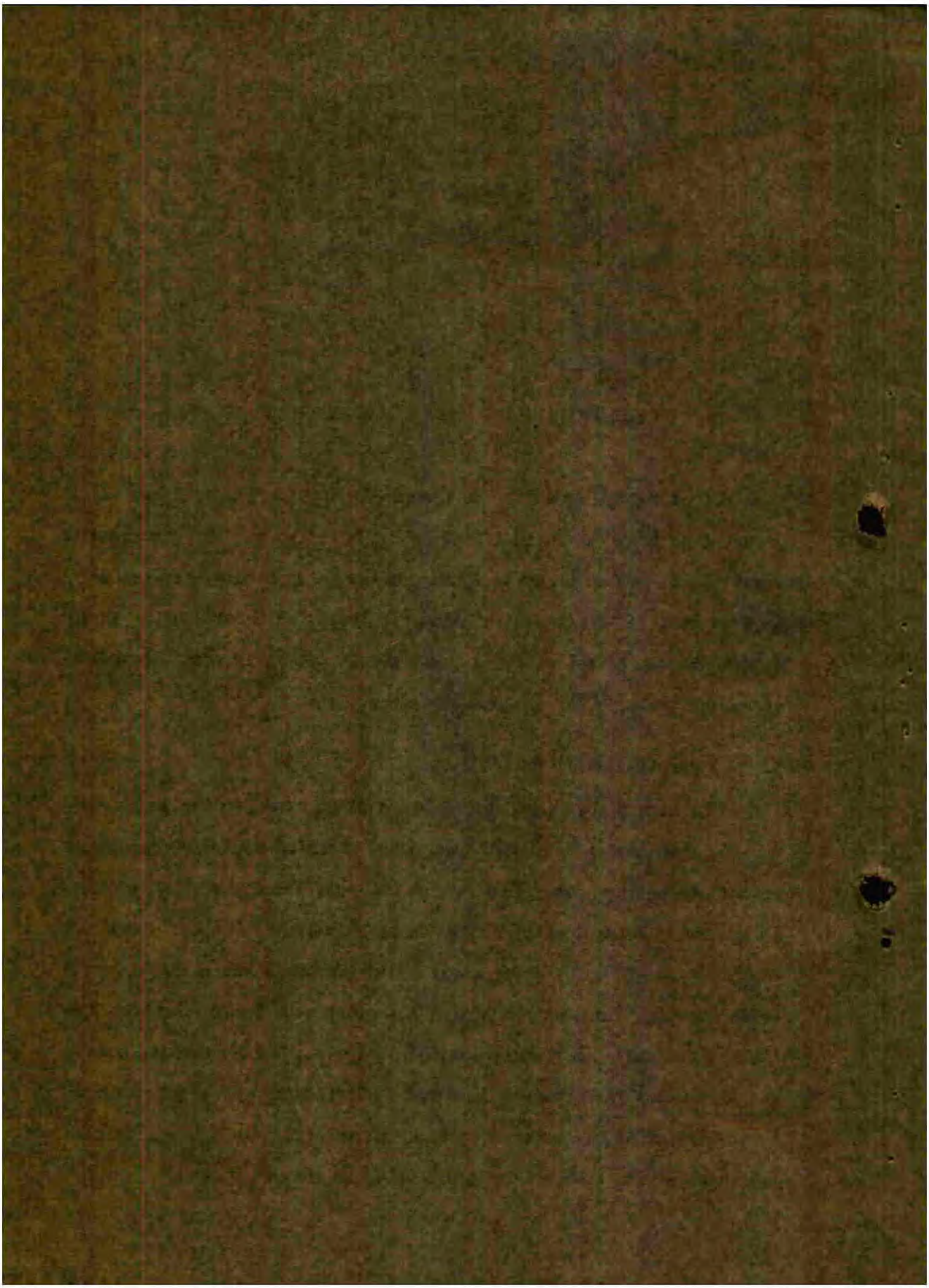
CHAPTER 4

PROBLEMS IN NIGHT DEFENSIVE AERIAL WARFARE

Night aerial combat is an unwanted offspring of World War II. As night bombing was intensified, both the Allies and the Germans were required to develop a night fighter force, which became increasingly important in the defense of home territory. Since the experiences gained from these activities are now available, it is possible to assay the problems and propose solutions.

I. IMPORTANCE OF TECHNICAL AIDS

The conduct of night combat presents an even greater technical problem than day combat, even though the means of control from the ground may be the same. In the last analysis the determining factor is the human being in the plane. Usually in day combat the pilot can use his eyes and act independently of instruments, but at night he is forced to fight in darkness and is dependent even for flying upon his instruments and upon fighter control equipment. Night combat, consequently, makes the greatest demands on all fighter personnel whether in the air or in the control stations on the ground. Since technical instruments play such a very great role, it is better not even to



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attempt to build up a night fighter force if they are not available.

Many systems of night combat can be discerned and can be examined as to their significance and the problems inherent in them. Possible solutions of the problems will suggest themselves.

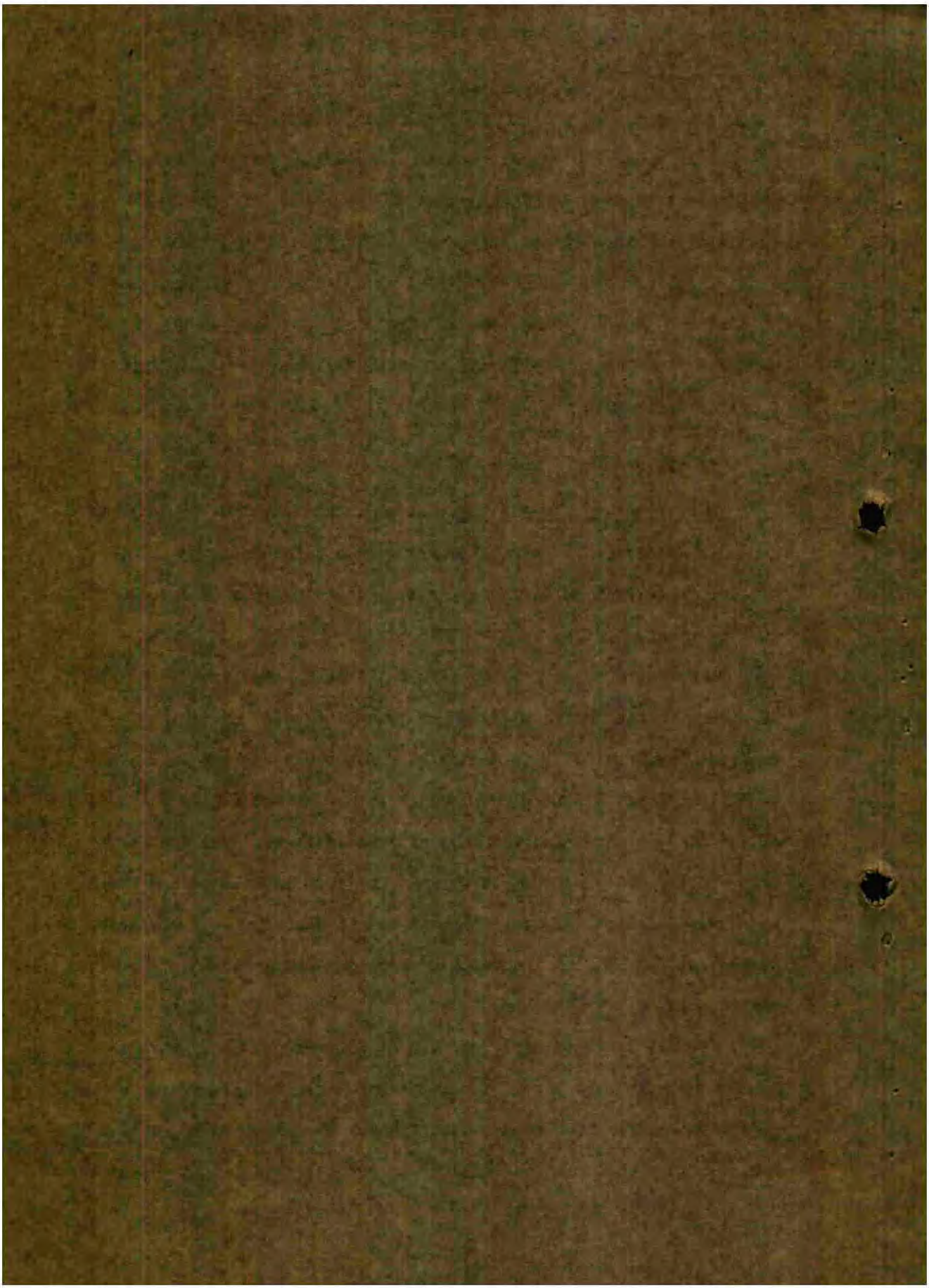
There are two main systems: one is long-range night interception and the other short-range night interception; each has its numerous minor classifications; and each is based on a different tactical principal.

II. LONG-RANGE NIGHT INTERCEPTION

Definition and Importance. In night combat, too, a distinction can be made between an offensive form and a defensive form. The defense is carried on at short range, and the offense is carried on at long range.

Long-range night interception consists in seeking out the enemy in his air bases and destroying him there. A wasp nest is best rendered harmless if it is destroyed while the wasps are in it, or if the entrance hole is blocked so that they cannot fly in and out. If one does not do this, the only alternative is to hunt down each wasp singly, which means that it must be first looked for and found in three-dimensional space before it can be destroyed. The difficulty of seeking and finding increases proportionately to the distance from the source.

Thus it is immediately clear that long-range night interception is tremendously important. The events of World War II have substantiated this. The German night fighter commanders endeavored from the very beginning to build up an effective long-range night



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interceptor force, and they were accomplishing this with increasing success until the effort was ordered abandoned in the fall of 1941 by Hitler, who had failed to appreciate its value.[1] After this date the enemy was able to establish its air bases unhindered and to use them under almost peacetime conditions. An opinion by British experts, which says more than an entire book, stated, "The fact that the Royal Air Force was able to operate from unhampered bases from the fall of 1941 until the spring of 1945 contributed decisively to the final defeat of Germany."[2]

It can be inferred from this statement that a long-range night interceptor force must be made a part of the home air defense system. It can be a decisive factor in dealing with an enemy which is inferior in air armament or one which at the outbreak of war is just beginning to develop its air power--as was England at the start of World War II. In such situations there is a good prospect of hindering decisively the enemy's night operations by the commitment of large long-range interceptor forces. When conditions are as favorable as they were from the German point of view in England, the lack of a long-range night interceptor force can only be viewed as a serious failure of

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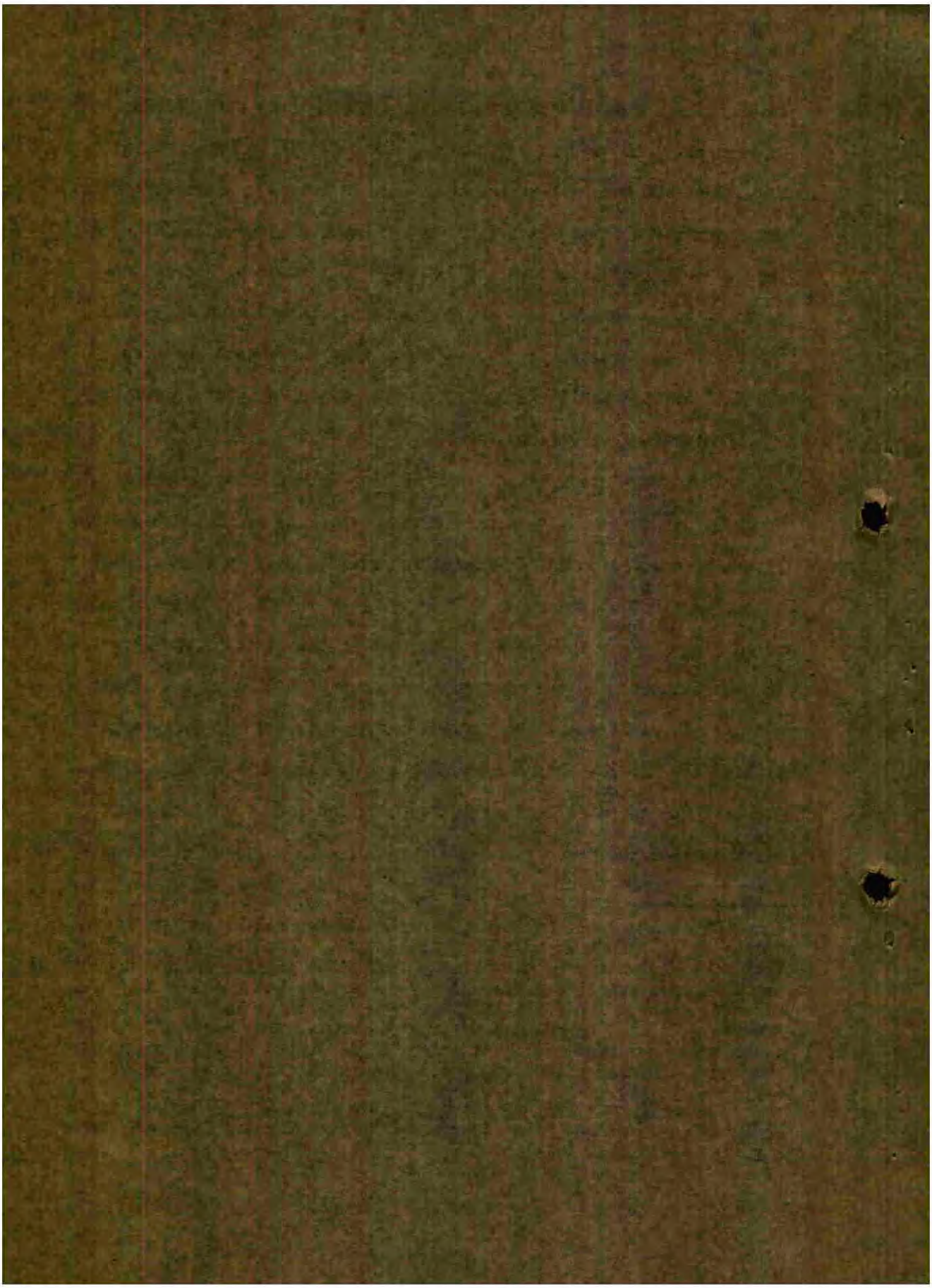
[1] This order was delivered directly to General Kammhuber by Hitler at a conference held in October 1941. Kammhuber reports that Hitler did not believe that this type of night fighter operations could be successful, saying, "If night fighting had any prospect of success, the British would long ago have copied it, for they copy everything that I do and which turns out well. The German citizen whose house has been destroyed by an English bomber would rather see the English bomber shot down by a German night fighter so that he could see it lie beside its burning house."

[2] The Rise and Fall of the German Air Force (1933-1945). Air Ministry Pamphlet No. 248. Issued by the Air Ministry (A. C. A. S. [I]). 1948, page 192.



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economic. In England, because of the form and type of the island's terrain, the position of possible night flight bases was easily predetermined and easily located.

The situation is different if at the outbreak of war the enemy is already well equipped and prepared on his extensive territory at his disposal. A large dispersal area permits the enemy to withdraw at any time to more remote air bases, making the location of targets considerably more difficult for the long-range night interceptors. Long-range interception, however, always has a certain nuisance value, which can be very disturbing to enemy operations. This is confirmed by the experiences of the Germans, who seriously felt the effect of the enemy long-range night fighters. Interceptor operations are most effective when they are immediately preceded by day or even night bomber attacks against the enemy air bases. Long-range night fighter operations can bring night flight in these places to a complete halt, since the enemy will be engaged in repairing damages.

Combat Mission. The combat mission for long-range night fighters consists in continuous harassing of the enemy night bases by attacks on planes landing or taking off in the immediate vicinity of the base and in continuous nuisance bombing and strafing attacks on taxiing planes, parking or servicing areas, especially radio transmission installations such as ultra-high frequency landing beacons and radar instruments.

It has been advocated that these means should be assigned to bomber units as offensive missions. During the latter part of World War II this concept was held by Air Marshal Goering, Commander in Chief of the German Luftwaffe, and accordingly, bomber aircraft

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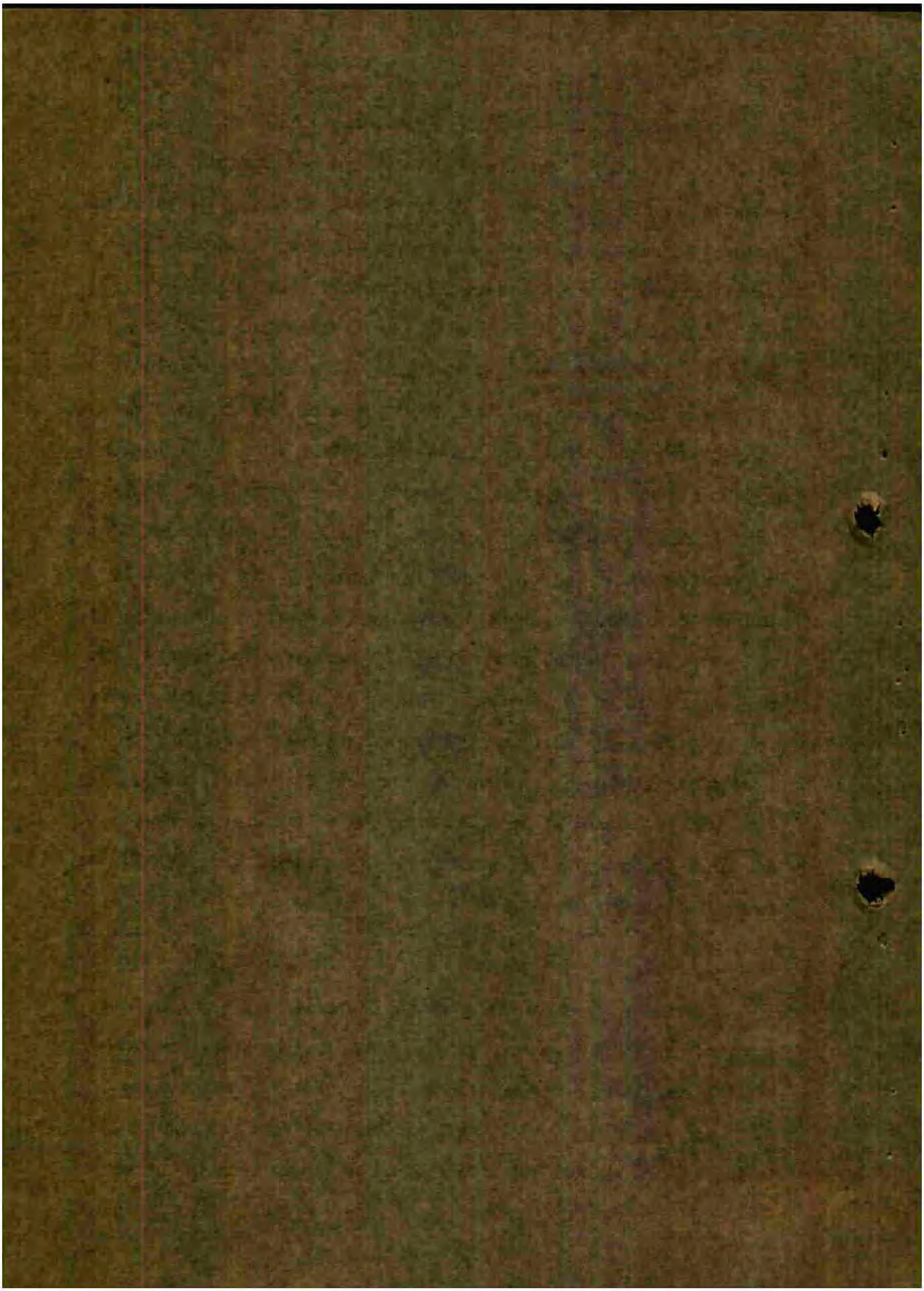
were occasionally employed in long-range night interception missions. Experience revealed, however, that this type of commitment is unsatisfactory for many reasons. A long-range night fighter pilot can become proficient only by becoming a specialist. He needs night-fighter aircraft which has long-flight capabilities and all the usual night-fighter equipment including in particular a long-range radar with lamiscope scanners. He must also become thoroughly familiar with the peculiarities of this type of combat, study the enemy's situation carefully, and be as familiar with the enemy air base as his own. He must be in contact with his own night fighter control station and under its control, because his actions are closely correlated with the short-range night fighters and because his mission is to harass as much as possible the enemy approach flights.

For these reasons it would be an unfortunate solution to turn over the mission of the long-range night fighters to a bomber unit. The objective must be clearly defined and the best method of accomplishing it must be chosen. The best method in this case is to establish long-range night interceptor units as a part of the original organization, and place them under the direction of the night fighter control stations charged with home air defense.

III. ILLUMINATED NIGHT COMBAT

Defensive night combat consists of short-range night interception, and it is necessary to make a distinction among the several subclassifications which have evolved.

Definition and Description. The term "illuminated night combat" is interpreted to mean the illumination of an air target by ground



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searchlights in order to permit the night fighter to see his target with the naked eye. In contrast to this, the term "dark night combat" is interpreted to mean night fighting during which there is no illumination of targets by searchlights.

Illuminated night combat was that type of short-range night fighting which was developed in Germany in 1940. For some time it was the only type of night fighting feasible, since night fighting had not been practiced before the war and radar for controlling fighter planes was still unavailable. The technique of dark night combat was only gradually developed and perfected, first parallel to and then in combination with illuminated night combat techniques. All the dark night fighter pilots gained their initial experience in illuminated night combat. The number of enemy planes downed in illuminated night fighting increased from month to month and justified high hopes.[3] But before it could be fully perfected, all searchlight units were withdrawn from night fighting operations by the direct order of Hitler.[4] The night fighter control command was forced to depend exclusively on the methods of dark night combat, even though it was still in its earliest stages of development. Consequently, no final conclusion as to the value of illuminated night fighting

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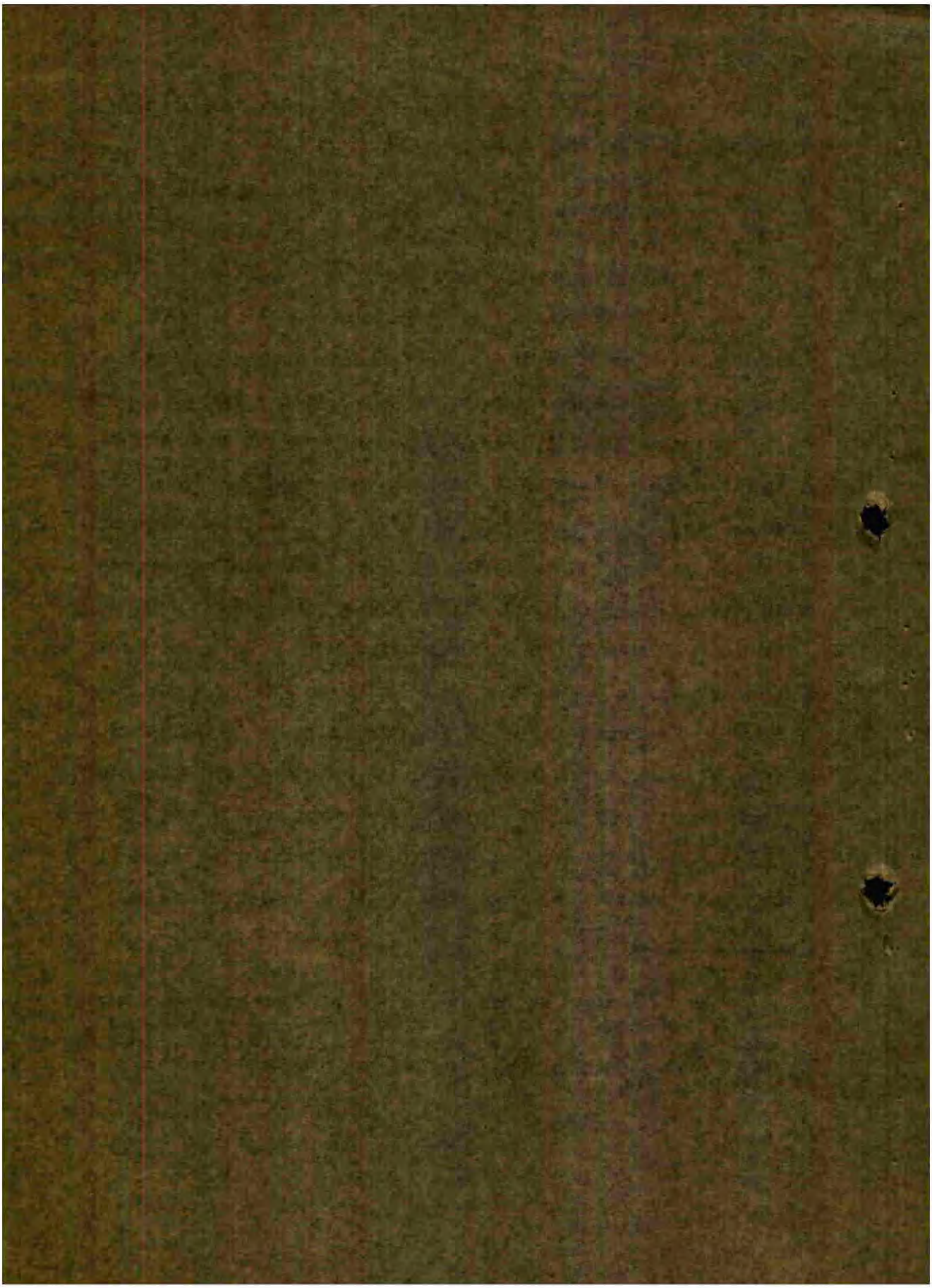
[3]Data is not available in Germany.

[4]No documentary support is available. General Kammhuber states that the order was issued in the spring of 1943. The searchlight units were assigned to the antiaircraft commands in other areas upon the request of the Gauleiters to reinforce antiaircraft defenses in their districts.



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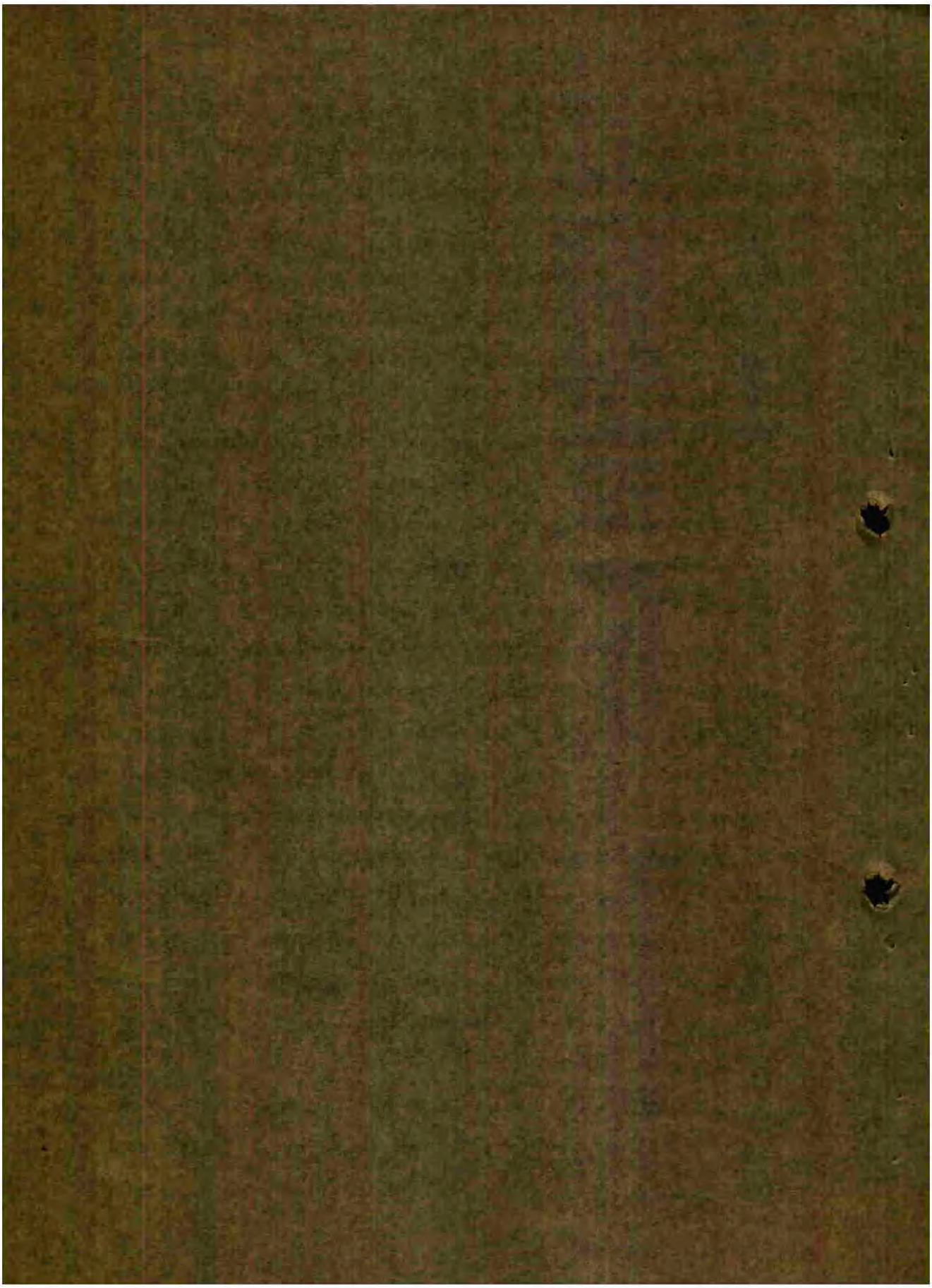
techniques can be drawn from the experiences of the War II.

An opinion of its effectiveness, however, can be formed on the basis of a theoretical assumption. If an adequate number of searchlight units is available with the best possible equipment and thoroughly trained personnel and if these units are organized in a manner ideal for the carrying out of illuminated night fighting, what would such an organization look like and what would be its prospects of success?

Let us assume that we have searchlights with mirrors three meters in diameter, and a range up to 10,000 meters. Each searchlight is connected automatically to a small-size, special radar set of the greatest possible accuracy--ideally 1/16° for azimuth distance and altitude--and a range of 50 kilometers. These searchlights, in batteries of nine lights each, are distributed in a checkerboard pattern over the entire home air defense area, each separated from the next by a distance of three kilometers. The battery, division, and regimental staffs would receive a picture of the air situation from both the short-range and long-range aircraft observation centers.

By this arrangement the enemy night bombers are forced to fly their entire course to their objective and back in the intersecting beams of strong searchlights, offering a continuous target to the fighter planes. If the course of enemy bomber formations could be marked for great distances, it would considerably simplify matters for the night fighters.

Limitations. This searchlight organization, however, would only be effective in good weather with less than 50 percent cloud



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cover and at altitudes below 10,000 meters, and would be useless against top-quality aircraft.

The situation would not be changed in any way, if infrared rather than white lights were used in the searchlights, since infrared does not penetrate heavy cloud layers. Experiments in this direction during World War II ended in negative results. Even the use of the Sponner[5]--the inclusion of an infrared searchlight in the equipment of night fighter planes, which makes the object at which it is aimed visible on a screen--brought no positive results. The inclusion of an infrared searchlight as fighter plane equipment is tantamount to attaching a lantern if the enemy has taken infrared countermeasures.

Possibilities. Prospective use of infrared devices is possible only if technology should be successful in constructing a ground searchlight with a sharply focused infrared beam, which is invisible to the naked eye, penetrates clouds, and is effective at altitudes of ten to twenty kilometers. The fighter pilot with a receiving screen built into the cockpit of his plane would be able to see the enemy machines in the beam of light without being seen himself. This development would represent a workable solution which might serve as a useful supplement to other night combat techniques. Whether its success would warrant the not inconsiderable expenditure in material and personnel can be determined only by experiment.

In illuminated night combat the night fighter maintains his position in a stand-by area above the searchlight positions. When

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[5]Code name for various types of infrared night searching and aiming devices and iconoscopes.

searchlights were equipped with acoustical sound detectors, the stand-by area had to be selected to the side and to the rear of the searchlight positions so that the listeners were not disturbed by the engine sounds of their own fighters. Then radar was introduced to direct the land searchlights (nitrogen diameter two meters, range 7,000 meters) to their targets, the stand-by area could be located directly above the searchlight zone, a factor which increased considerably the chances of downing enemy aircraft.

The night fighter pilot's attack was always made from a height considerably above his target, because he could not start his attack from the stand-by area until the target had been picked up by the searchlights and thus made visible to him. Since the period of time that the enemy plane remained in the searchlight beam was often very short, two or three minutes, the fighter pilot had to move very rapidly in order to reach his target in time. And this was possible only if his position in the stand-by area was already at an altitude far above that of the enemy target. It required a great deal of practice to be able to cut down the extra speed gained through approaching from a higher altitude in time to avoid over shooting the target, especially since the flight path of the target could not be determined until relatively late. The attack was successful only if the friendly fighter could approach the enemy plane from behind, while flying on the same course and at almost the same altitude.

The attack technique was pretty primitive at first, but once a night fighter pilot had acquired experience, he attained rather noteworthy successes in number of enemy planes downed. In the future

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this method will probably be used only for training purposes, if technology provides the technical equipment which will meet the tactical requirements. In that case, inasmuch as the searchlights would provide invisible light, it could no longer be called "illuminated" night combat, but "dark night" combat.

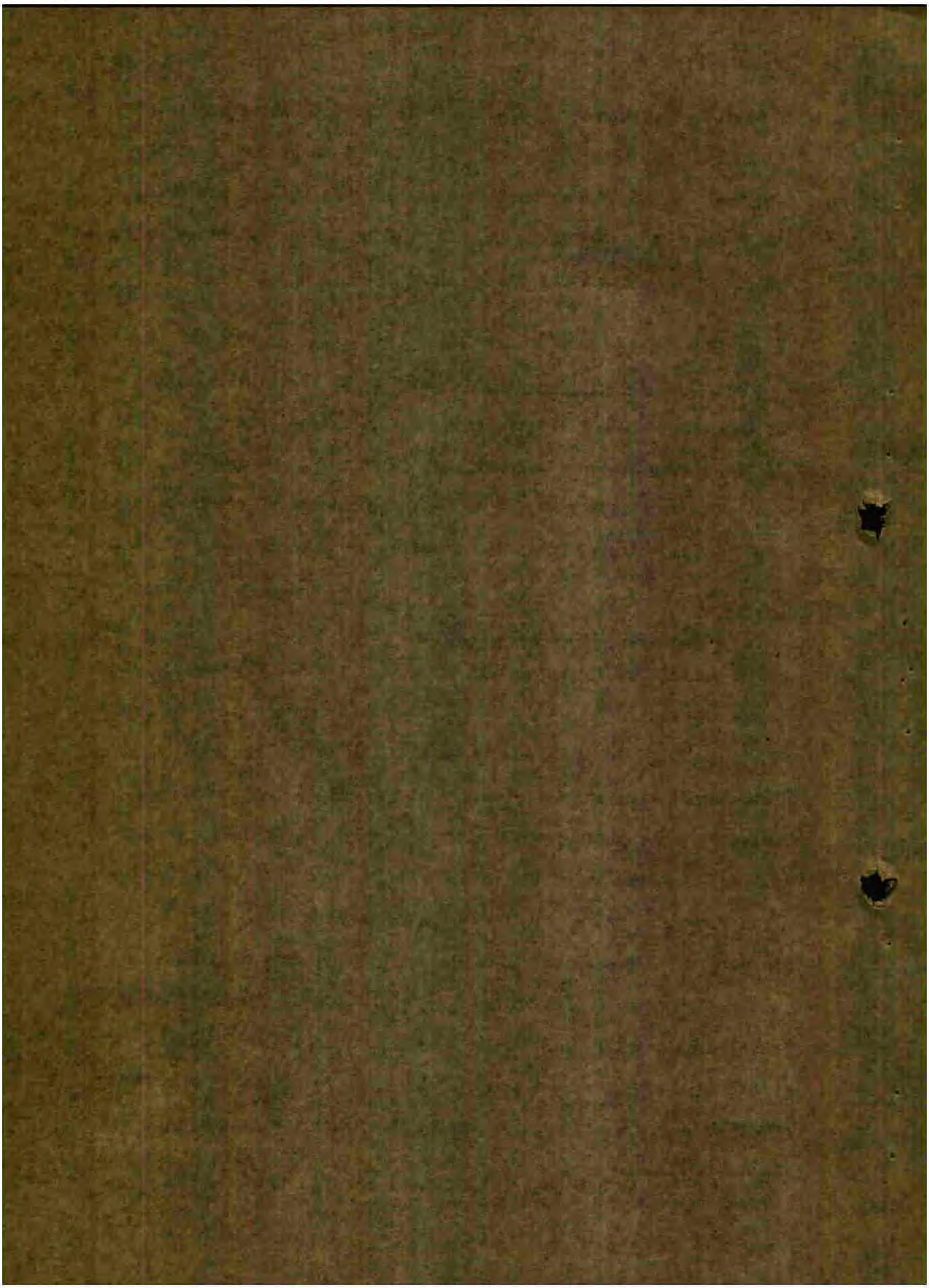
IV. DARK NIGHT COMBAT

Definition and Importance. Dark night combat which is a form of short-range night interception, was developed during World War II to an ever greater degree in both England and Germany. By the end of the war it was almost the only type of night combat in use. Its development also holds the greatest promise of success in the future.

Free, Uncontrolled Night Combat. The very first type of dark night combat in Germany during World War II was free, uncontrolled night combat.

In July of 1940 when the penetration of English night bombers into German home territory increased steadily in regularity and intensity, a combat group,[6] equipped with Ju 88 planes, was assigned a free, uncontrolled night combat mission over the English Channel. From July 1940 on, night fighter patrol areas, which were avoided by German bombers flying to England and back, were established, in which fighter aircraft, flying back and forth on schedule, were to shoot down English night bombers as they crossed the Channel. Not a single enemy plane was downed, although conditions of visibility over the Channel, especially during the moonlit nights of July and

[6] A unit of the German Second Air Fleet. Complete identification not available in Germany.



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the following months of 1940, would be considered very good. It was proved for the first time that night combat without technical aids had no chance for success.[7] Apart from the total failure to complete the mission, the hopelessness of the undertaking had a very demoralizing effect on the participants. Because a better solution was looking, the experiment had been ordered independently by one of the air fleet commands. At that time, however, there was as yet no one with experience in night fighter combat, and no suitable equipment, ground or airborne, for controlling night combat.

The one successful instance in which a night fighter unit was committed in free, uncontrolled combat was in Africa in the spring of 1942, when the same German unit of the same air fleet, which had earlier experienced such a failure, was employed over the narrow passes along the route of advance in Cyrenaica. At that time, in routine patrols alone, twenty-five enemy planes were downed in a period of a few weeks to the considerable relief of German ground troops. This success, however, was determined by the very limited size of the defense area, the relatively very good night visibility in Africa, and, most important, the fact that the enemy aircraft usually betrayed their position by dropping flares to illuminate their targets.

In conclusion it can be said that completely free and uncontrolled dark night fighting--dark night combat without using

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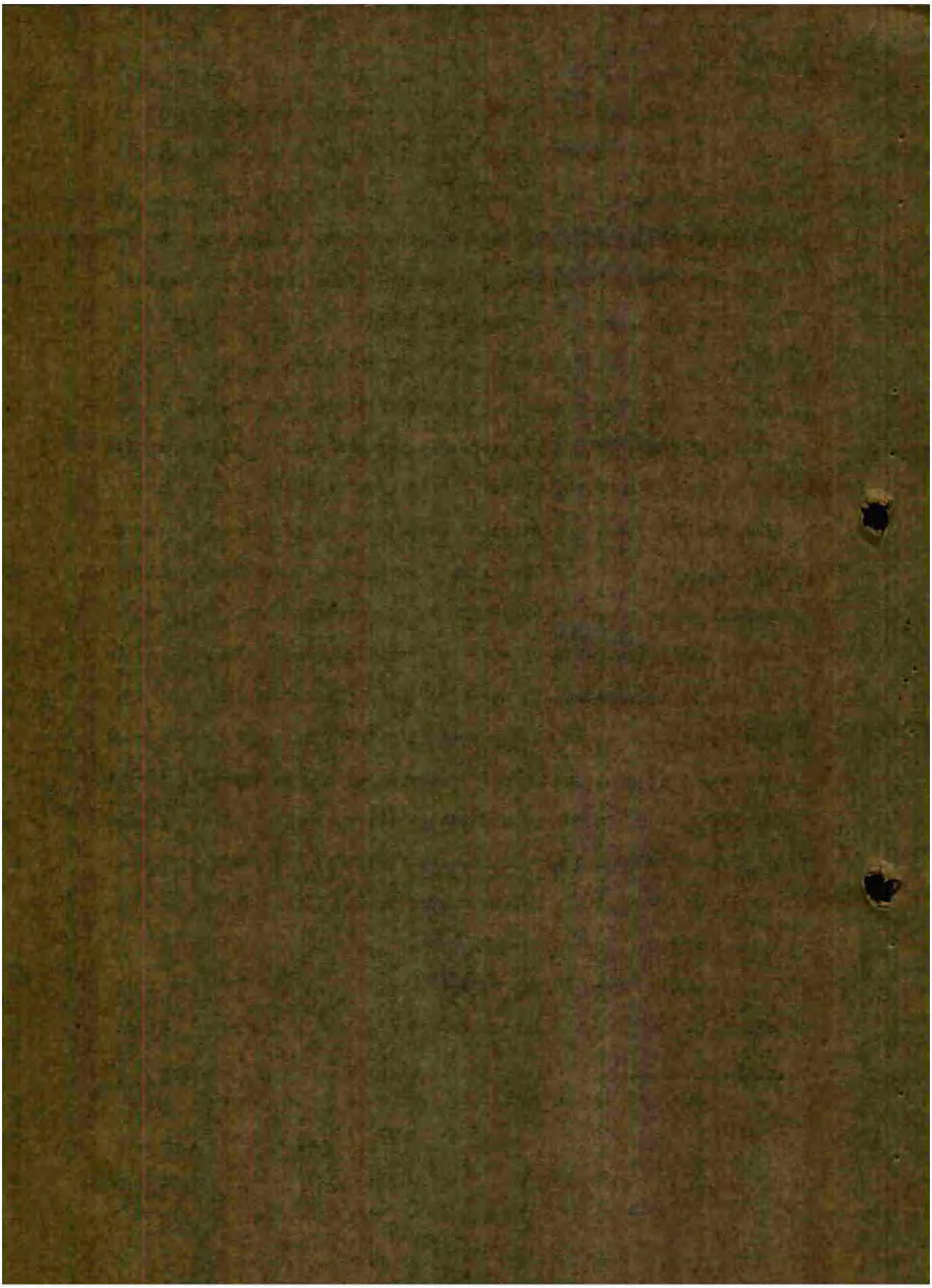
[7]This and similar data not available in Germany.



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ground or airborne technical control devices—has no prospect whatsoever for success, apart from certain exceptional cases. This method might better not be used, unless a country looks the possibility of equipping its night fighter aircraft in time with the necessary technical aids.

Combat Control Equipment. A brief glance at the historical development of dark night fighting on both sides during World War II should precede our discussion of combat control equipment in order to facilitate the forming of an objective opinion as to its value, advantages, disadvantages, and limitations. Prospects for its future development and success can then be evaluated.

Germany at the beginning of the war had no radar with the exception of a few instruments of the Freya[8] type. These instruments, which had a range of approximately 150 kilometers, were set up for the most part along the coast and were used for aircraft reporting and early warning in night fighter patrol areas. They gave the azimuth and distance of an air target, but not its altitude.

Before the Allied large-scale night attacks began, Freya type instruments were used successfully as aircraft reporting equipment, and since night interception at that time was conducted only as illuminated night operations, their performance was quite adequate. But it was soon realized that illuminated night fighting depended entirely on the weather, while the enemy aircraft were

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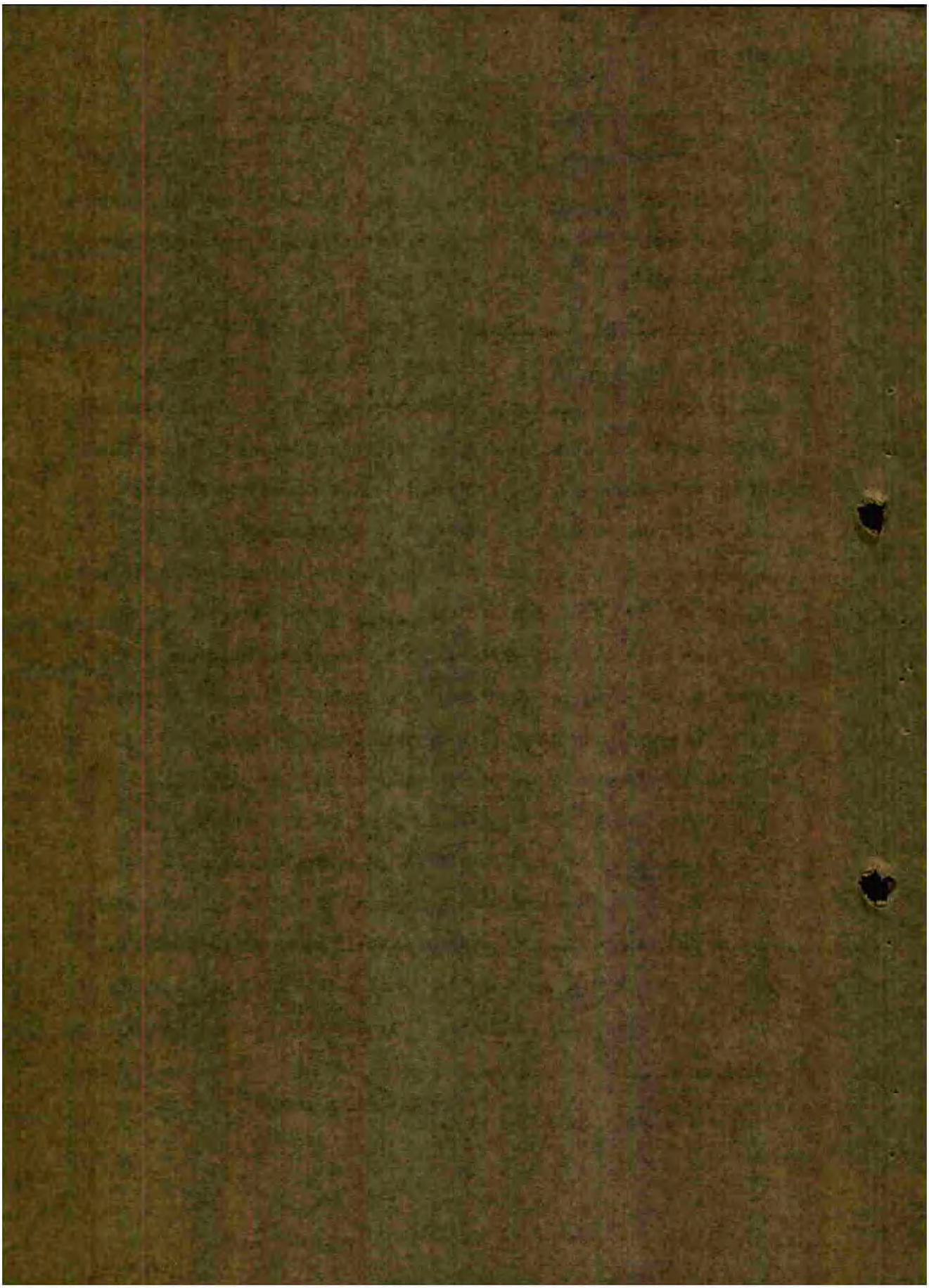
[8] Code name for a type of movable radar installation for warning systems. See Appendix A.



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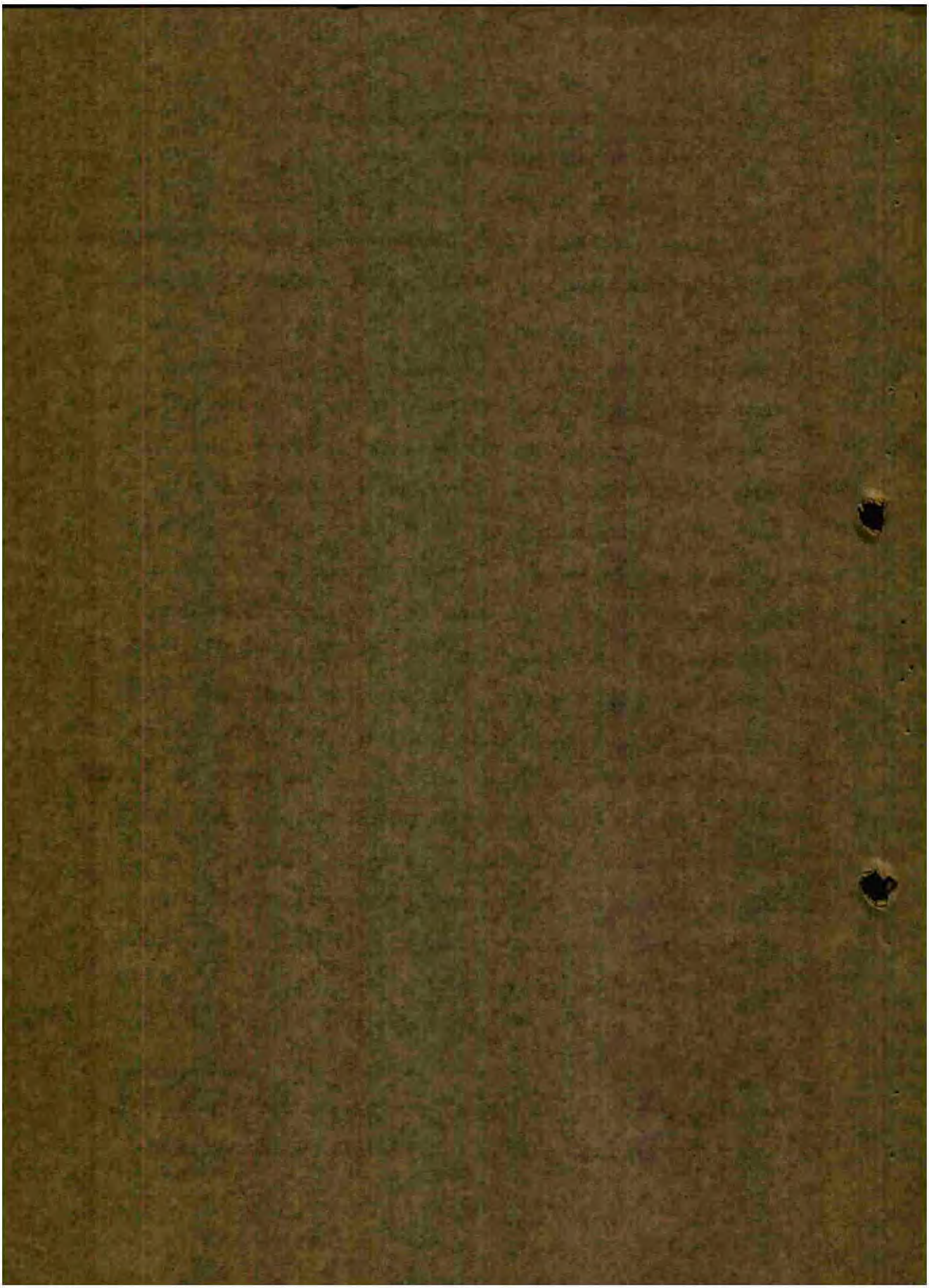
making themselves steadily less dependent upon good weather. The number of searchlights was limited, and naturally they could not be set up everywhere. There were only enough to be placed along a narrow line in front of the main target areas, the Ruhr district and the large industrial cities. This belt was all too narrow, although in time it grew steadily wider. Whenever weather conditions were such that the enemy bombers were not hindered by poor visibility either at their starting point or over their target and whenever a more or less heavy cloud bank lay over the searchlight belt, all night interception operations were at a standstill. Such weather was frequent, and the shifting of searchlight units to positions which had more favorable weather was impossible.

Because of this situation, the night fighter commanders attempted to organize a night fighter for which could operate, as much as possible, independently of weather conditions. To do this three things were necessary: first, a radar which could measure distance, azimuth, and altitude and thus permit the direction of night fighter aircraft from the ground; second, a radar, built into the aircraft itself, which would automatically guide the fighter plane to the target over the last remaining distance; third, a ground plotting station, a sort of headquarters, which could coordinate the individual elements.

The idea was clear but its realization and perfection required a long, desperate struggle. Just as success was attained, the top-level command of the German Wehrmacht, instead of cooperating as had Churchill in England, by direct intervention abolished



everything that had been accomplished. The night fighter command was forced to start all over.[9]

In October 1940, one radar set was issued to the night fighter units for experimental purposes. It was the Würzburg[10] type. The set indicated azimuth, distance, and altitude at ranges of thirty-six kilometers. On 16 October 1940 this equipment was used for the first time at a night fighter station in the vicinity of Arnhem, Holland. Success was conspicuous by its absence. Despite the fact that it was a moonlit night and visibility conditions were such that one could almost see the enemy aircraft approaching with the naked eye, not a single contact was made with the enemy. The reason was clear: success could not be expected without preparation or practice. As discovered later, England was experiencing the same difficulties.

The night fighter command was not discouraged by this failure. It immediately began a systematic training program for its personnel and worked out procedures for successful utilization of the equipment. Using the best technically trained people available among the enlisted men, a transmitting system was worked out by means of which data indicated on two radar sets of the Würzburg, one of which plotted the enemy plane and the other the friendly night

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[9] Illuminated and dark night fighting was the concept upon which the initial establishment of the so-called Kammhuber line was based, when, in the spring of 1942, all searchlight units were withdrawn by Hitler, the organic development of night fighting was torn apart, and defense had to depend on the still imperfect technique of dark night fighting.

[10] Code name for a series of mobile AA gun laying and warning radar. See Appendix B.

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fighters were covered together on improvised plotting tables.[11] With this it was possible to so direct the night fighter that by the time the enemy aircraft was picked up by the searchlights, the fighter plane was already in a favorable position to attack. Sensing an enemy plane without its having been picked up by the searchlights was not yet possible, of course, because the data revealed by the Freya-Würzburg radar set were not sufficiently accurate. This did not become possible until after the introduction of the Würzburg-D and D Riese,[12] which had a particularly accurate ranging unit, the same one which was later used in the Würzburg Riese.[13] Under conditions of good visibility, the Würzburg radars presented an accurate picture which would have been sufficient for dark night fighting, except that their twenty-five-kilometer range was far too short. The introduction of the Würzburg Riese type with the range of sixty kilometers corrected this deficiency.

The elements necessary for dark night interception--radar for ground control and a central plotting station--were now available, but the equipment was still very primitive. The most important device for dark night combat, an airborne searching instrument, was

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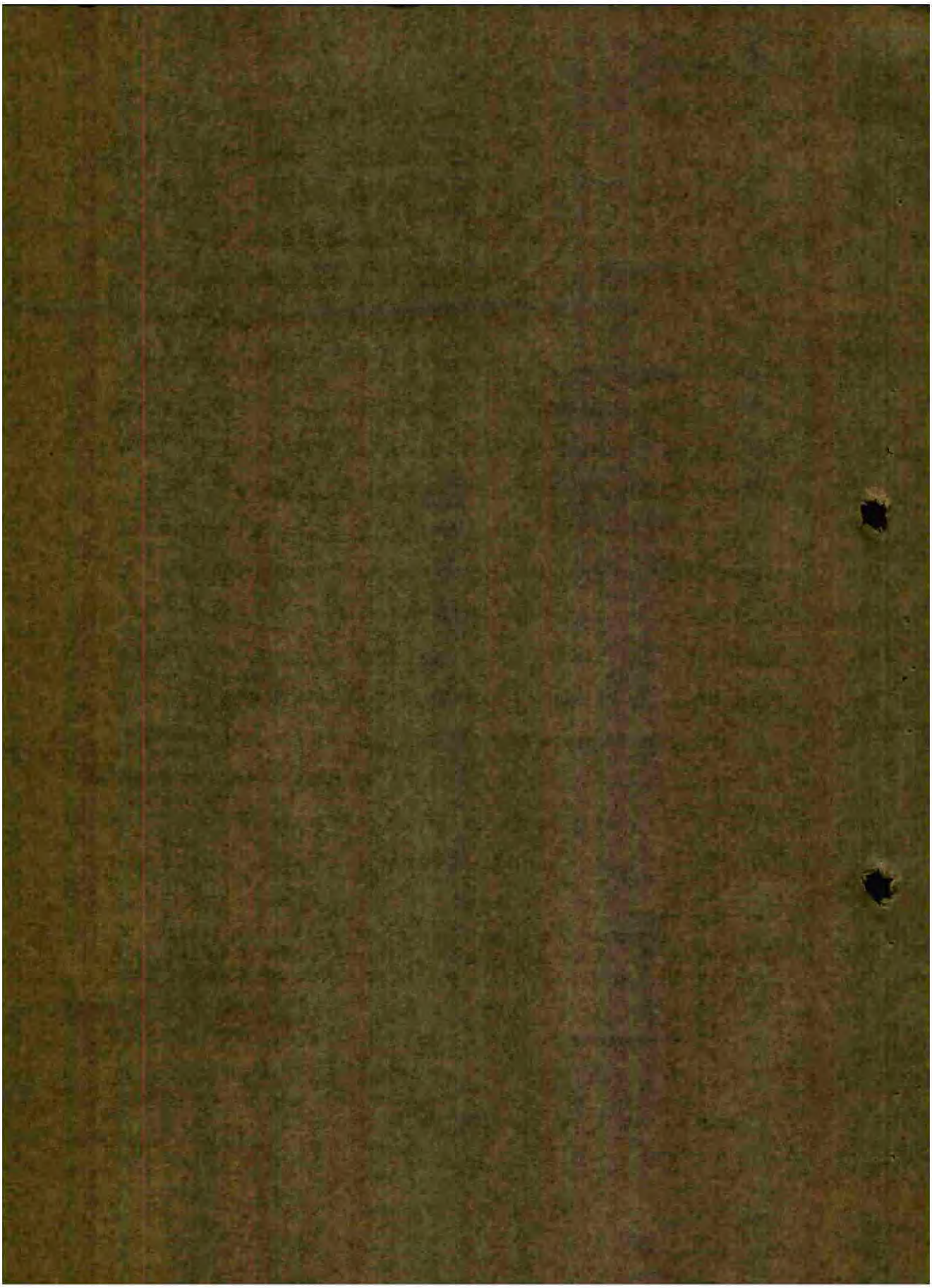
[11] By November 1940, less than a month after the failure of 16 October, the first combat test of this system was carried out from the first night fighter position established at Eutphan in Holland.

[12] See Appendix B. Exact date of initial use not available in Germany.

[13] Code name for a type of fighter control radar set. Introduced in August 1941. See Appendix B.



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still completely lacking. At this st ge, the equipment and instruments were useful only as aids to illuminated night interception. As such they gave good service, but it was not enough to reach the goal of dark night interception.

Not until the Freya-Würzburg had been replaced by the Freya-Würzburg Riese, the Seeburg[14] plotting table using an optical projection apparatus improvised, and the Lichtenstein B/C[15] built into night fighter planes as airborne searching equipment, were the elements provided which made dark night fighting possible. In the early summer of 1941, when these possibilities appeared technically feasible, the commanding general of the night fighter forces succeeded in obtaining, by direct order of the Fuehrer, top priority for the procurement of this equipment. Even so, it was not until fall 1941 that the first instruments were delivered and replaced the improvised equipment.

Combined Illuminated and Dark Night Combat. In the autumn of 1941 the night fighter command decided to establish an additional belt for dark night combat in front of that already established for illuminated night combat. The belt set up for illuminated night fighting, in which the searchlights were distributed in a checkerboard pattern, was only thirty kilometers in depth. Dark night

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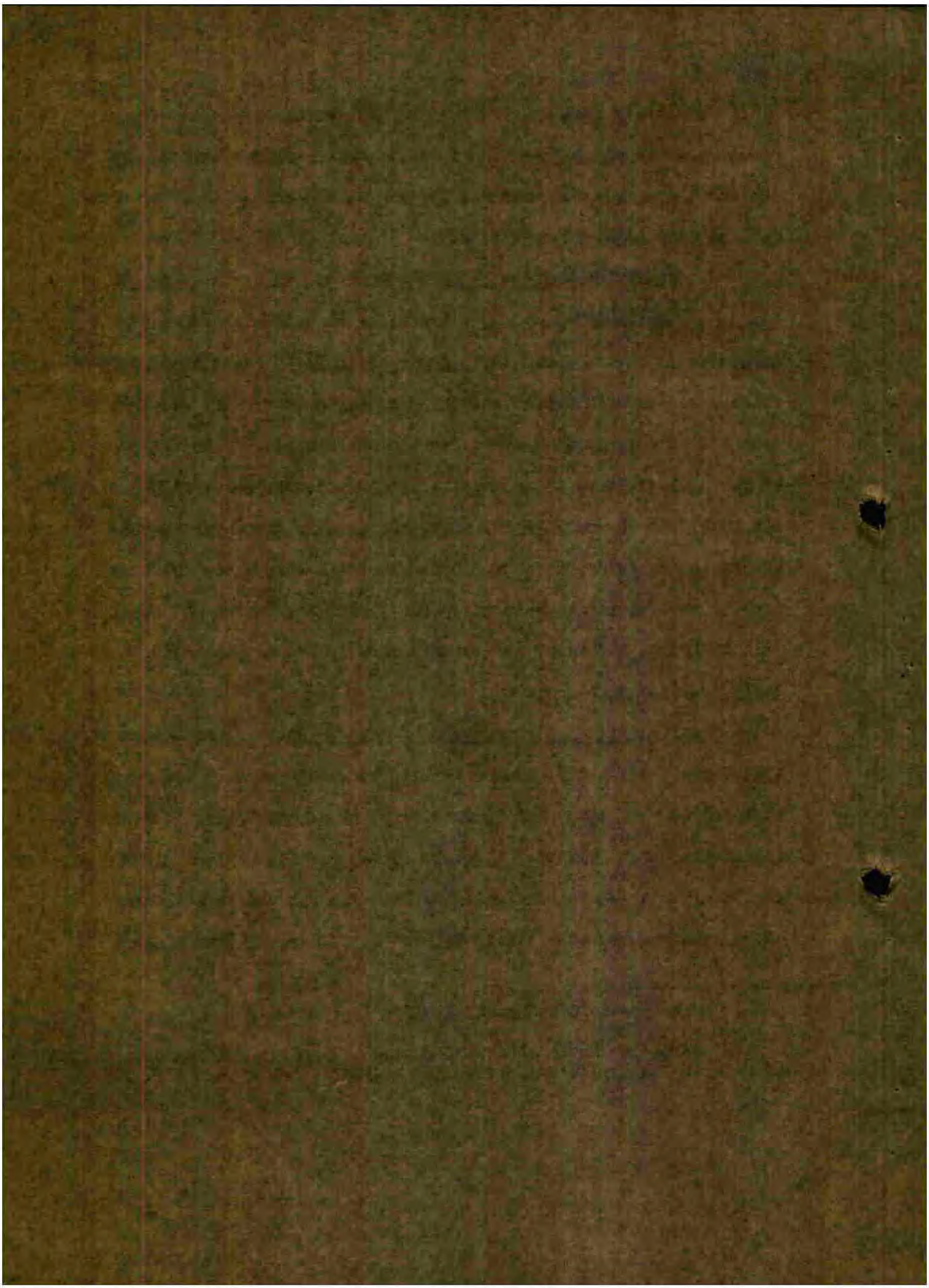
[14] First used in August 1941. See Appendix C.

[15] Code name for a series of BF and ITT radars and search equipment. Introduced during winter 1941-42. See Appendix D.



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fighting areas were established directly adjacent to the bright searchlight belt, into which the night fighter pilot, not yet too well versed in the techniques of dark night combat, could automatically pursue the target assigned to him. When the enemy aircraft was picked up in the searchlight beam, he could easily shoot it down since he was already in position to attack. The night fighter pilot could practice dark night fighting techniques in the dark night combat zone and correct visually when the target was illuminated in the searchlight cone. In this way it was possible for the night fighter pilots to gain more and more confidence in the techniques of dark night combat, techniques which were very unfamiliar to them in the beginning and which they were often reluctant to employ. Many enemy planes were shot down by this method, and the combination of dark night combat and illuminated night combat promised to become a great success. The techniques of illuminated night fighting were also improved by using the Moerchorn Riese. Intervals between searchlight positions were reduced to two and one half kilometers. The number of load searchlights was increased and their target locating was made completely automatic by using Moerchorn Riese equipment. The entire searchlight belt was lengthened,[16] in order to make it difficult for enemy aircraft to detour it. Since the number of dark night combat areas also increased steadily, these areas were also extended not only towards the enemy as far as the coast but also into the territory lying behind the searchlight belt.

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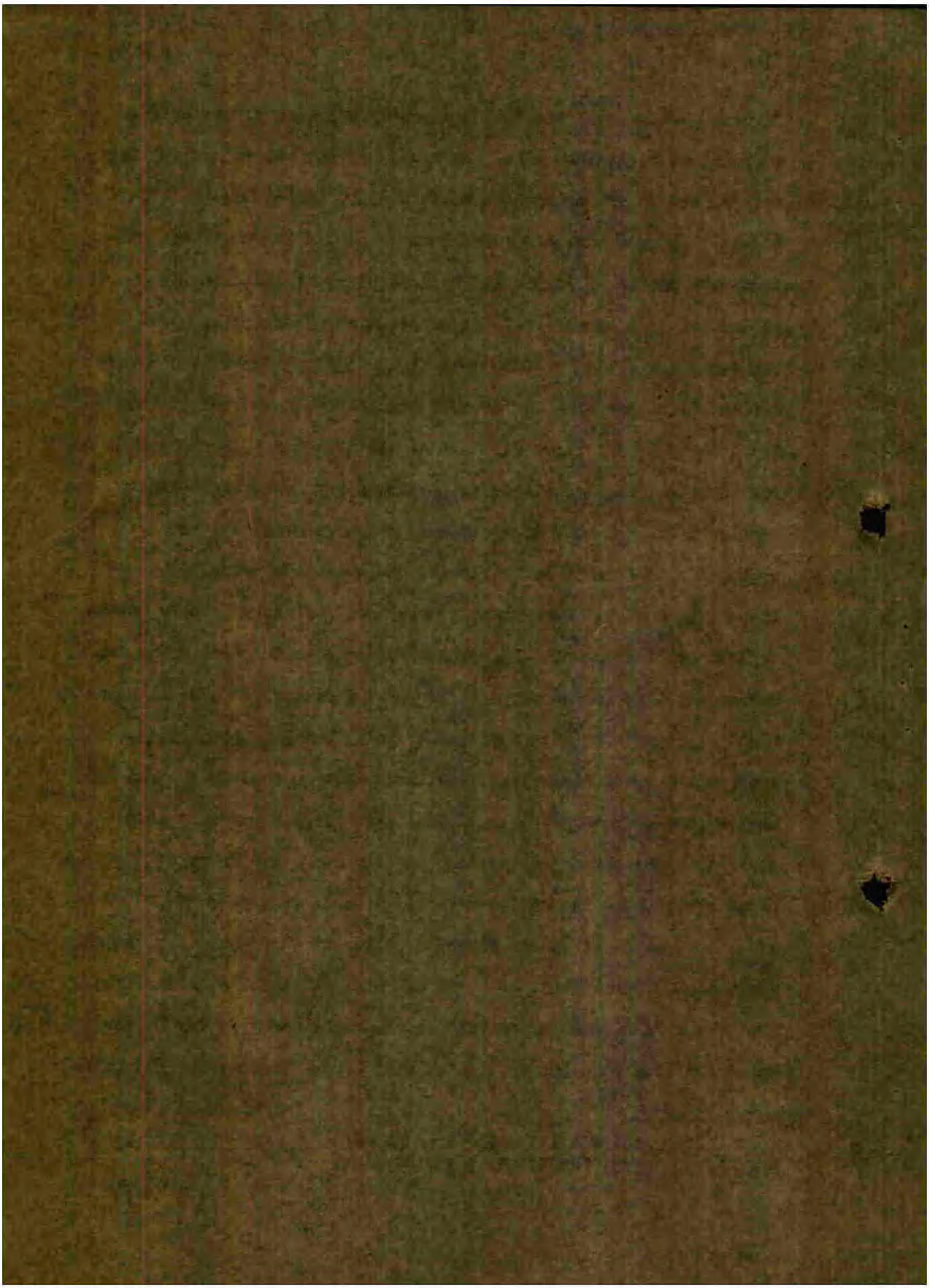
[16] Data not available in Germany. See Rise and Fall of the German Air Force, Chapter 8, pages 185-191.



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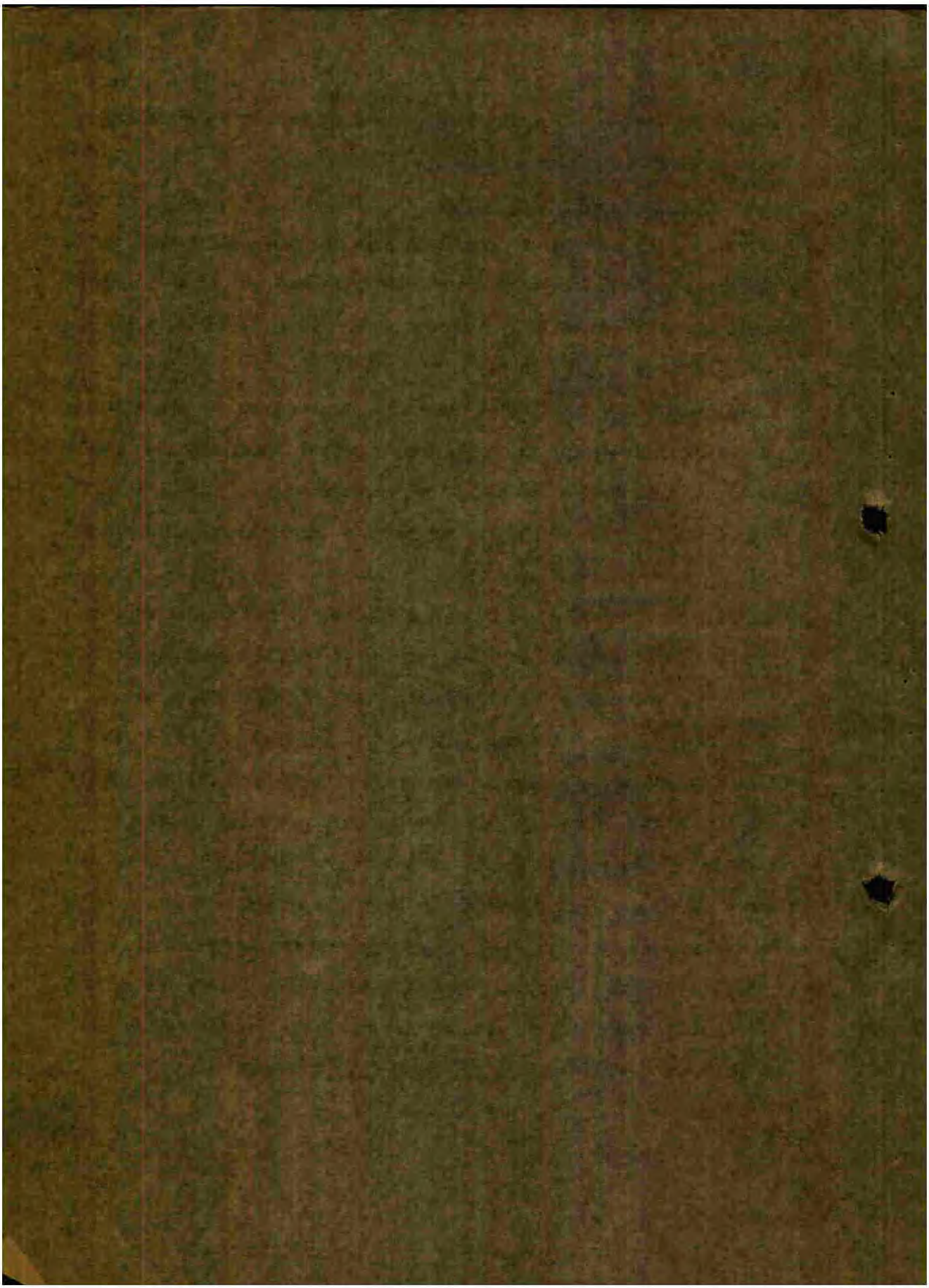
Success in terms of enemy aircraft downed increased to such a degree that complete success was imminent.

Withdrawal of Searchlights. At this moment, the spring of 1942, all six of the searchlight regiments were suddenly withdrawn from the night fighter forces by Hitler, and were assigned to antiaircraft artillery units in cities, located farther in the interior, which happened to be under attack. Only a single training and experimental regiment was left with the night fighter force in the vicinity of Venlo, Holland; but this one, too, was soon withdrawn, when trouble developed somewhere or other in the home territory. This is an instructive example of how, by taking into consideration psychological factors among the civilian population at home, not only the prospects of military success can be ruined, but also extremely great damage can be inflicted on the civilian population in the long run.

This was a terrible blow to the night fighter forces, from which they could never completely recover, especially since further blows, this time inflicted by the enemy, were soon to follow. At the time that the searchlights were snatched away from the night fighter forces, only 25 percent of all night successes in downed enemy planes were being obtained in dark night combat. This meant that the majority of the night fighter pilots had not yet been able, or did not desire, to learn this technique. Pilots preferred illuminated night combat, because many night fighter planes had not as yet been equipped with Lichtenstein B/C instruments.



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