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AIR-WAR

W. O'D. PIERCE

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THE BOOK AND THE AUTHOR

This book comes very timely into a world fast preparing for war. No phase of this preparation has been more discussed or more often used as a gauge of military strength than the airplane. Yesterday it was only a dream; today it is one of man's most formidable weapons. Behind it stands the body of our scientific knowledge, the skill of pilot, technician and military expert. In its shadow are the people of the world, living in their open cities, villages and farms, desiring peace yet fearing the increased threat of air war.

With full technical knowledge and with keen understanding of the social and economic forces at work today, the author answers a number of fundamental questions: What part will aviation play in the next world war; how will the man-in-the-bomber react to his role of mass murderer; will the scientist continue to assist in this destruction; can the civil population withstand the onslaught of prolonged air war and what will happen to morale on the home front? Finally, why are the people of the world being driven, against their will, into an imperialist war from which they have nothing to gain?

W. O'D. Pierce is a young Irish scientist and psychologist. His studies in England, Vienna, America and at the League of Nations in Geneva were concerned with the technical and psychological problems of war. He is the author of several books on psychology and of a popular book on air war recently published in England. At present he is teaching and lecturing in this country.

ALSO BY W. O'D. PIERCE

AIR WAR: *Its Technical and Social Aspects*

London: Watts & Co., 1937

This book has not been published in the United States. However, much of the valuable material on technological development which appeared originally in the English publication is included in the present volume.

Air War

ITS PSYCHOLOGICAL, TECHNICAL AND SOCIAL IMPLICATIONS

By
W. O'D. PIERCE

MODERN AGE BOOKS, INC.
NEW YORK

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INTRODUCTION

> You realize, I am sure, that throughout the world hundreds of millions of human beings are living today in constant fear of a new war or even a series of wars.
>
> The existence of this fear—and the possibility of such a conflict—is of definite concern to the people of the United States for whom I speak, as it must also be to the peoples of the other nations of the entire Western Hemisphere. All of them know that any major war, even if it were to be confined to other continents, must bear heavily on them during its continuance and also for generations to come. . . .
>
> I refuse to believe that the world is, of necessity, such a prisoner to destiny. On the contrary, it is clear that the leaders of great nations have it in their power to liberate their peoples from the disaster that impends. It is equally clear that in their own minds and in their own hearts the peoples themselves desire that their fears be ended.

Thus did President Roosevelt, in his message to Reich Chancellor Adolf Hitler and Premier Benito Mussolini on April 15, 1939, describe the anxiety of the man-in-the-street.

To the man-in-the-street the shadow of the bomber is the sharp expression of what another war must mean. Its shadow falls across his home, across the office and factory and field where he works, across his schools, threatening his liberty and his existence. He has learned to regard the bomber as the long arm of aggression knocking at the gates. It has been suggested that the course of events at Munich in September, 1938, was determined in part by the strength of the German air force. This may or may not be true, but it is certain that the lessons of Spain and China have given the man-in-the-street the harsh, indelible picture of war from the air. He knows if war should break out that even the remotest village is not inaccessible to the bomb.

The picture must sometimes look to him as a bombing flight does to Archibald MacLeish in his description of the prelude to the aerial bombardment of a small village:

THE ANNOUNCER:

They're wheeling round for the town
They're rounding in by the river
They're giving it throttle they're climbing
The timing is perfect they're flying with
Perfect precision of timing
Perfect mechanical certainty. . . .

WOMEN'S VOICES

Show it our skirts!
Show it our shawls
All of us: into the street all of us!

THE ANNOUNCER

They turn like stones on a string:
They swing like steel in a groove:
They move like tools not men:
You'd say they were no men:
You'd say they had no will but the
Will of motor on metal. . . .

(The roar of the plane increases from moment to moment.)

"You'd say they were no men," but they are. "Perfect mechanical certainty" is only the perfection of technology integrated under the control of human beings. This man in the plane is like other men, but disciplined, trained until he seems merely a cog in a mechanized unit. It is the men of science who have made the man-in-the-bomber a possibility. The modern bomber, that marvelous flying laboratory, is the end product of our scientific civilization.

Anatole France has written of the scientist that

> An eye armed with a microscope is only a human eye after all. It sees more than the naked eye does, but not in

any different way. The man of science multiplies the points of contact between man and nature, but it is impossible for him to modify in any particular the essential character of the mutual relations between the two.

The man of science also has the same interests and emotions as the man-in-the-street. He has also to work inside the limitations imposed upon him by the social system which he shares with the man-in-the-street and the man-in-the-bomber. When the bombers take off for their first trip in the next war, they will represent not only the apex of our technical achievement, but also the end result of the social forces which dominate our civilization.

The man-in-the-bomber, too, has the same fundamental desires and hopes as the man-in-the-street and the man-in-the-laboratory. Like the scientist, he has a special job to do. He is one unit in a military machine. He has been very expensively trained to carry out his special duties. One of these is to meet and destroy opponents who are as well trained and equipped as he is. The man-in-the-bomber, like every soldier, knows that his life is no longer his own. He knows that in every military maneuver casualties are expected and replacements already arranged for. The man-in-the-bomber lives in a state of tension.

Part I of this book will present a factual, documentary account of this state of tension, showing how the man-in-the-street reacts when he becomes the man-in-the-bomber. The logic of this approach is simple, since the object of the book is to examine air war in its human, social and psychological setting and to show how technological progress has restricted or advanced social progress. Part I presents the attitudes of four individuals toward aerial warfare and aims at revealing the fundamental drives which control the morale of the war pilot.

Part II is a brief history of civil and military aviation from the earliest beginning to 1918. It gives a survey of the problems, the techniques and methods postulated or used by the earlier pioneers who preceded the Wrights' first flight at Kitty Hawk on December 17, 1903. It traces the development of aviation

and its use as a weapon against civilian populations in the World War.

Part III outlines the technical development of aeronautics since 1918, revealing the social factors which have controlled that development. Modern military plans for the use of the airplane in another war are discussed against the background of the experiences reported from the Abyssinian, Chinese and Spanish Wars.

Part IV attempts to determine whether or not governments can build up a civilian morale capable of withstanding the strain of direct air war. There is a discussion of those elusive psychological attitudes called "fighting tradition," "prestige," and "morale"; and of the new technique for propaganda. The methods employed by the dictatorships to solve this great problem of the "will to fight" are contrasted with those employed by the democracies. Finally there is an appraisal of the probable results of the two very different systems.

Each part tries to show the social influences which actually control aeronautical development and have directed it into military channels. The development of aeronautics is not a special development but only a reflection of the general development of the social system of a particular country. The conclusion aims at synthesizing the facts and trends discussed in the book from the point of view of the present situation and how it may affect the future of the man-in-the-street.

Part I

MORALE IN THE AIR

Four Case Histories from the 1914-18 War

The aftermath of every war has been strewed with histories, memoirs, and biographies. The 1914-18 War has added its quota. No phase has been more fully written about than the war-in-the-air. The names of Richthofen, McCudden, Immelmann, Bishop, Nungesser, Rickenbacker, Udet, and Mannock are known to all. The number of their victories, the machines they flew, and the stories of their bravery have been told in numerous ways. Wherever wartime aviators, present-day pilots, or air-minded schoolboys get together, the old legends are retold and nothing is lost in the retelling.

Four men will be discussed here: a famous German ace, Oswald Boelcke; an unnamed British war pilot who left only a diary; an American ace—an airman of fortune—Frederic Ives (Tex) Lord; an internationally known Dutch aircraft builder, Anton Hermann Gerard Fokker. Two of these are dead; one has never fought; but all have published or made available to the writer diary material which provides a factual basis for the discussion of each case. The writer has chosen three of these individuals because he believes they are typical of the men who make up an air force in any country. Their composite psychostat will help to reveal how the man-in-the-bomber as well as the man-in-the-combat plane reacts to the very messy business of aerial warfare. The fourth person provides the aeronautical industrial background for the three aviators and their period.

Each record will be discussed separately, but only from one

special angle: what the individual thought and felt about the war or wars in which he was engaged; how he responded to the strain and responsibilities aerial warfare placed on him; what psychological defense mechanism he—not as an officer, but as a man—found it necessary to adopt to justify his actions.

All four of these are pleasant personalities, of marked skill and intelligence in their particular field. They seem to have had few enemies, even among their bitter opponents. Two were professional soldiers, but none of them belongs to that small class of men who may be called pathological killers—men like that unlicked cub of a European dictator who can write of the magnificent sport of bombing natives of Abyssinia:

> One group of horsemen gave me the impression of a budding rose unfolding as the bombs fell in their midst and blew them up. It was exceptionally good fun.

Taken then as a group or as individuals, their histories illustrate the reactions of the average man under the strain of aerial warfare. We shall discuss them in the probable order of death, because it was about dying and death that their lives were centered.

CHAPTER I

SOLDIER IN THE AIR

BOELCKE, OSWALD*—1891-1916. Solo flight, July, 1914. Front, September, 1914. First *Fokker* two-seater, December, 1914. First Class Iron Cross, 1915. First air victory, July, 1915. *Pour le Mérite* for ninth victory, January, 1916. Commander of first *Jagdstaffel,* June, 1916. Died October 29, 1916, after forty-one credited air victories.

OSWALD BOELCKE WAS THE fourth child of a high school teacher. At school he was successful in his studies but his real enthusiasm was for sport in every form. On his own initiative he decided to work for a military career. He read military history, and in 1908 wrote three essays: "General Scharnhorst and His Army Reform," "The First Airship Flights," and "Count Zeppelin's Life and His Earliest Experiments in Aeronautics." After graduation, he passed into the Third Telegraph Battalion —radio section. He practiced flying whenever possible. He later transferred to the Flying School in May, 1914, and had flown solo before the war began.

1. THE AIRPLANE AND THE SOLDIER OBSERVER

The German Army like all other armies used the airplane purely for reconnaissance work during the first eight months of the War. Boelcke acted as an observer and then as a relief for a pilot who "had to give his nerves a rest." His first report of a battlefield is characterized by complete objectivity:

> . . . through shell-torn charred villages, with newly-dug soldiers' graves on either side of the road and dead horses

* J. Werner, *Knight of Germany: Oswald Boelcke, German Ace* (John Hamilton, Ltd., London, 1933).

lying about everywhere. Corpses lay still unburied round a churchyard which the Germans had stormed the night before; most of them were N. C. O.'s, who had led the attacks. Then I saw the battlefield. That is to say, we saw nothing or very little. There were no troops visible, only isolated men on foot or horseback here and there. The only things one saw were the bursting shells from the artillery and the burning villages. But in compensation we heard a lot—the dull gurgling of flight artillery, the clearer cracks of the field artillery and the rattle of rifle fire. We passed reserves when on our way to one of the staffs. They looked just like they do on maneuvers; some were cooking a meal, others played about, but most of them lay on their backs, sleeping soundly in spite of the battle going on close at hand.

On the German retreat at Ste. Menehould on September 16, 1914, he wrote as follows:

My observer was Lieut. Jaenicke, whose nerves have gone to pieces completely. I was genuinely sorry for the poor fellow, because it was not at all nice aloft; the machine was badly tossed about by the wind. It was not so bad for me, because as pilot I have my hand on the stick and know what is happening, but that poor fellow must have had a bad time with his nerves.

A few days later he wrote:

We flew 350 kilometers, reached a height of 3100 meters and were in the air from 8 till 11:35 A.M., *i.e.* three and a half hours. Four hours is the longest that our machines can do on their petrol supplies; the others never fly more than two or at the most two and a half hours—their "nerves" cannot stand more. If I only knew what sort of things nerves are! Luckily I know nothing about them, and it is all the same to me whether I fly an hour longer or not.

When trench warfare had been established (December, 1914):

It is no laughing matter for our troops; they are in the trenches day and night, and the nights are very cold al-

ready. One really feels ashamed of the good time we are having in contrast. So far I have always had a bed—we have only once used your sleeping bags, and we are better catered for than in peace time.

All of which would be very nice, if it were not for the horrible inactivity and boredom. I have not been over the enemy for the last ten days; the weather is bad, and there is hardly anything for us to reconnoitre since the war has frozen up. I had my machine taken to pieces during the last few days and thoroughly overhauled; it is as good as new now. Today I tried four flights over the aerodrome, taking a passenger up each time.

This attitude toward trench warfare is found in numerous pilots' comments. The strain of waiting, too, was usual with pilots until later in the War came the strain of continuous aerial fighting.

The bombing of his camp by French airmen caused him to write:

Not long ago a French airman gave us a bit of a change by dropping a few bombs here. He was trying for the tents that house our machines but only hit a couple of innocent Uhlans who were on their way to take their turn at sentry-go. I don't think much of this bomb-throwing business. The heavy things only slow your machine down, and the practical result is very small. But it may be that I underestimate the moral effect which such a bolt from the blue may have on funks, victims of nerves, and the civilian population. Our H. Q. has mounted two howitzers near our aerodrome to fire at enemy airmen. But they have not hit any yet. That is not so easy, you know.

In December he wrote that a German pilot and observer:

. . . flew to Paris with bombs today; they came back safely after a four-hour trip. There is not much sense or object in the business, as they will probably have only hit some old woman, but it is a nice, dashing sort of flight.

Two days later Boelcke started on a bombing reprisal:

We really did not mean to fly today. But when we went

out to our artillery at Fort Berru after lunch, we found that the French had fired at a neighboring village with shells of heavy caliber, and by chance they managed to hit a number of our men who were assembled to draw their rations. That called for revenge. We pelted back to our aerodrome in the car, took off and flew to Rheims. Wilhelm found the guilty battery there, but alas our artillery could not reach it; they were just two hundred meters too short. When we got back at 4, the weather was so fine and calm that I got hold of that nice fellow, Jaenicke, who wants to get used to flying again, and took him to Sillery to drop four bombs. It was a nice little constitutional, in which I was boss of the show; all Jaenicke needed to do was to sit quiet and drop the bombs when I gave the signal.

This period was the dullest part of his life—spotting for the artillery and making isolated bombing raids. He found inactivity a definite strain and hated fog because he could not fly in it. In December he got his first *Fokker,* an efficient two-seater monoplane with a French rotary engine.

At this time he was flying with his brother Wilhelm, under a commander who wanted to separate them. They protested to the Staff, which promised to support them, but the Staff did the usual double-crossing and the brothers were separated. For protesting, Oswald was threatened with being sent to the infantry in the trenches. The army doctor sent him off on a three-week convalescence because of his asthmatic bronchial tubes. Later we shall see Boelcke develop into a strict disciplinarian and a very reserved individual.

It was during the first year of the War that he produced the following leaflet which has been aptly entitled by his biographer "Aircraft Defense Against Troublesome Questioners":

PLEASE!!!

Do not ask me anything about flying.
You will find the usual questions answered below:
(1) Sometimes it is dangerous, sometimes it is not.
(2) Yes, the higher we fly, the colder it is.

(3) Yes, we notice the fact by freezing when it is colder.
(4) Flying height, 2,000-2,500 meters.
(5) Yes, we can see things at that height, although not so well as at 100 meters.
(6) We cannot see well through the telescope because it waggles.
(7) Yes, we have dropped bombs.
(8) Yes, an old woman was supposed to have been injured, and we put the wind up some transport columns.
(9) The observer sits in front and can see a bit.
(10) We cannot talk to each other because the engine makes too much noise.
(11) We have not got a telephone in the machine, but we are provided with electric light.
(12) No, we do not live in caves.

This leaflet was distributed to all questioners. Answers 7 and 8 are important as illustrating both civilian and pilot attitudes toward bombers. They also illustrate Boelcke's dry humor.

In May, 1915, he was transferred to a new aviation corps where he met Immelmann, who had established a reputation for crashing his machines in landing. We have a detailed account of his attitude toward some French deserters during a retreat of a section of French troops under a heavy German artillery bombardment and infantry attack:

> How complete was their defeat is shown by the following incident. Suddenly four fellows got up, waved their caps, swung their arms about and ran to our trenches. They were hardly inside before another fifty of them did the same and started to run. That made the rest of the French angry; they must have been afraid that there would be a general surrender. Bang! four well aimed heavy shells came down in the midst of the deserters. I was quite pleased to see these cowardly curs shot by their own side. But the retreat was now general; at 6:45 the main action was over, and afterward we saw only isolated stragglers running or crawling back. It was vastly interesting for me to experience all this

from quite close; one never sees anything of the sort from the air. But it is a great pity that we airmen cannot take part in such fights from above!

Boelcke's contempt for deserters and his attitude toward infantry fighting reflect his military training. It was his army training which made him the efficient military organizer of air fighting later.

2. THE BEGINNING OF AERIAL WARFARE

The French tactics had now made the Germans arm their planes. Boelcke's two-seater *Fokker Condor* carried an observer machine gunner because firing through the propeller had not yet been perfected. The basic tactic was to fly alongside and open up machine guns on a turn away from the opponent. In a three-day period, Boelcke reported flights in which five French fliers' planes glided down out of the fighting, and three flights in which he and other German pilots retreated.

On July 6, 1915, he shot down his first plane, a French parasol monoplane. The two Frenchmen were killed, their plane crashing in an estate owned by the observer. They were buried with full military honors, and the day after the funeral Boelcke and his observers visited the grave, which was decorated with the French colors. This was his first victory.

Boelcke's comment on a proposed write-up of his victory is worth quoting:

> Father asks whether my report may be published in the papers. You know that I do not think much of publicity in the press. Moreover, I consider that my victory does not afford the proper style and scope for a paper. The good readers want a more poetic and awesome description, with psychical tension of fear-tortured nerves torn to shreds, followed by exultant glee, clouds that tower like Alps or the blue sky of heaven full of whispering zephyrs, etc. If, however, it would give you great pleasure to see it published, I shall not object. But naturally no names must appear.

On July 10, 1915, he took his first *Fokker* single-seater

monoplane fitted with Fokker interrupter machine guns which permitted firing through the propeller. Because the French had not yet perfected this improved mechanism, German pilots were not permitted to fly over the front lines. Boelcke disliked and disobeyed the restrictions placed upon air fighting. He also had little use for the patronage of the lesser German royalty and the Staff. He wrote of taking Prince Aribert up:

> So as to prevent him saying afterward: "Oh, there is nothing much in this flying!" I gave him a bit of a shaking up intentionally and went into a few turns, but he stuck it out splendidly.

When his dog, the beautiful Wolf, was killed attacking the propeller of his plane, he wrote:

> I am terribly sad at losing such a beautiful, clever, faithful beast. It is a good thing that the war prevents us from mourning for our dogs.

This comment illustrates how personal relationships can modify the reaction of an individual to suffering and death. The loss of an animal which he loves may be a greater tragedy for him than the death of either his enemies or his friends.

Boelcke once saved a French boy from drowning. The grateful parent wished to get the French Legion of Honor conferred upon him. His comment was that this "would be a great joke!"

In the summer of 1915, Boelcke was running a neck-and-neck race with Immelmann for the position of No. 1 German Flying Ace.

On September 19, 1915, Boelcke was transferred to Ostend to the First Pigeon Post Section. The squadrons assigned to bombing raids on England were called "Pigeon Posts." Not long after, he was sent to Metz to protect the Kaiser from bombing attacks during his visit to the front. The French bombed the town at the exact time of the Kaiser's arrival, but without success.

Boelcke reported an interesting propaganda story:

> The Berlin Illustration Company will manage quite well without my photo. I beg you not to send them one. I don't like all this publicity. I find quite enough articles in the

papers about myself to be sick of it all. I am told an English paper lately announced that I had bolted to America before the War because I could not pay my debts as a lieutenant and worked as a liftman in a New York hotel.

After having two very tough fights with two English pilots, only one of whom he was successful in taking prisoner, Boelcke captured an English bomber and wrote:

The Englishman was alone in his machine, and still had his fat bombs with him. As he was unwounded, he must have come down because he was scared of us; he certainly said his engine went dead, but we could find no sign of trouble there. This valiant man was then taken to H. Q.

Boelcke was in a hospital with intestinal trouble about the end of January, 1916, and wrote:

Everything is going off well and according to program here on the Verdun front. So now you know why I am here. I could not enlighten you before, because everything was a dead secret. I was not sent here to recuperate my nerves, as you believed. If only Mother would stop worrying about my nerves! I have none—so I cannot suffer from them!

But all the same I am writing to you from the hospital. I had the bad luck to get some stupid intestinal trouble a couple of days before the offensive started. As the doctors are now very careful on account of the constant danger of typhus, they stuck me in the hospital here. The whole thing, however, has now turned out to be quite harmless; I have not had a temperature for the last four days, and I got up for the first time today. I am furious at having to be in bed just on these fighting days instead of at the front where I could have helped a bit.

He left the hospital against orders and shot down a local French bomber.

3. GERMAN AIR ACE NO. 1

Boelcke had developed into the complete master of individual fighting tactics. General von Hoeppner, Commander-in-Chief

of German air forces, wrote: "His *Fokker* always proved itself the master of all enemy aircraft." This statement is not quite correct, because the records show that English airmen on at least three occasions fought Boelcke to a draw in indecisive dog fights.

Here is another entry from early 1916:

On the following day there was also a lot of business in the air. In the morning I arrived on the scene just as an *avion de chasse* attacked a German machine over Fort Douaumont. I went for the former at once and chased him away. It was magnificent to see the hurry in which he went off.

About 1:00 in the afternoon I saw a French squadron near the Mort Homme, flying in the direction of Dun. I picked off a *Voisin* biplane flying somewhat apart from the others on the right of the squadron and dived down on him. As I was high above him, I came down quickly and shot up well before he grasped the situation. He turned tail at once and bolted for his lines. I attacked him vigorously again; then he heeled over by the right and disappeared under my wing. I thought that he had gone down, but went into a turn so as to get a sight of him, and then I saw to my astonishment that the machine was flying level once more. I naturally went for it again. Then I saw a most amazing sight. The observer had climbed out of the machine and was sitting on the left wing, holding on to a strut. He stared up at me in terror and waved his hand. It was such a pitiful spectacle that for a moment I hesitated to fire at him because he was completely defenseless. I must have shot away the controls and caused the machine to heel over; then the observer had climbed out and sat on one of the wings to restore the balance. I sent just a few shots at the pilot so as to force him to go right down; then my attention was diverted by another Frenchman coming to his comrade's aid. As I had only a little ammunition left and was already over the trenches, I did a quick bolt. The other machine then went down for a short stretch in a glide, but

finally crashed from a low height. It is on the ground in front of one of our outposts, to the east of Malancourt village. We can see it quite distinctly from our lines.

Boelcke's diary contains a record of his reactions to over thirty air victories. All these accounts reveal the pilot's attitude toward death, but the preceding is the only account in which Boelcke shows sympathy for the man in the other plane. Here is his normal attitude:

At the very moment that I was pulling my machine up to clear the enemy, I saw him explode—I got a black pillar of smoke in my face. It was a spectacle of ghastly beauty to see the machine break out in flames and then fall like a huge torch. Its remains are on the ground to the east of Les Fosses Wood.

In a fight he became a complete military machine with but one object—to destroy the enemy craft and capture or kill his opponent. Yet he carefully observed the conventional and somewhat absurd hangovers of chivalry. When enemy aviators were captured, they were made honored guests at the German officers' mess—before they were imprisoned.

It is from now on that Boelcke's real contribution starts. He used his great prestige to influence the development not only of individual but of formation fighting. His experimental study of machine-gun alignments was carried out in the practical setting of motor power, altitude effects, and air fighting. He supplied the basic data used by designers to improve the gun positions. His close relation with Fokker and other designers greatly aided him.

A much more important contribution was his development of the famous German *Staffel* system. In February, 1916, he became leader of a small unit which gave Germany air mastery for the Verdun offensive. His first *Staffel* came in June, 1915, and was the practical result of increased intensity of air warfare. It was not directly influenced by theoretical reasoning and was not a permanent organization. To his great disappointment he was forbidden to fly with it because of his prestige and propaganda value to the German Army.

The next day I reported to the chief in Charleville and lo! my anticipations were exceeded in every respect. The chief made a long speech, the purport of which was that I was to sit in a glass case in Charleville; I was not to fly at all for the present, because my "nerves" must be rested, but I could organize a Fokker *Staffel* in Charleville. Well, you can just imagine my rage! I was to sit in a cold water sanitorium in Charleville, stare up at the sky and take over the job of leading a crowd of weak-nerved pilots in need of rest! The chief tried to make me say that I would be willing to take over the post "provisionally" on the strength of the reasons he had adduced. But I could only protest vigorously and then, knowing no better counsel, took my leave.

When I got outside I cursed the adjutant and other pen-pushers in a most offensive fashion, which only, however, provoked mirth from all concerned. One of the fellows gave me a wise lecture to the effect that I was no longer a private individual who could play with his life at will but the property of the German nation, which still expected much from me. Finally Captain Forster told me that for the present I was not to fly any more—there was nothing doing there because it was a direct order from the Emperor who had continually kept himself informed about me through the air chief. But if I had any other wish, I had only to express it. For example, I could go to Turkey and have a look at the other fronts.

It dawned on me that in any case that would be better than sitting idly in Charleville. After I had rung up Wilhelm (even he was pleased instead of pitying me), the business was put into official form. "Captain Boelcke has been sent on an official mission to Turkey, etc., by the chief of the air service." Although that is no substitute for an airman's life, at least it is some sort of plaster on a throbbing wound.

Yet he understood quite well that the death of a famous ace-pilot constituted a serious blow to morale:

> Immelmann lost his life by a silly chance. All that is written in the papers about a fight in the air, etc., is rot. A bit of propeller flew off; the jarring tore the bracing wires connecting up with the fuselage, and then that broke away. Quite apart from the sad personal loss we have sustained, in my opinion we must not underestimate the moral effect on the enemy and the reaction on our own people.

So Boelcke went on his tour of the Eastern Front. At this period the Allied Powers gained air mastery. Professor Werner writes:

> The enemy wrested the unquestioned supremacy of the air into his own hands.
>
> This was fraught with momentous consequences for the battles of the ground troops. Our infantry were defenseless against the machine-gun fire of low-flying enemy fighters; no German airman could give them any protection. The activities of our artillery were crippled because no machines could be sent over the enemy's lines to reconnoitre or watch the effect of their shells. Above all, our leaders were deprived of the army's eyes through the impotence of the German airmen. The great lesson taught by the first battle of the Somme is that all fighting on the ground is dependent on the fighting up above and the supremacy of the air.

Before Boelcke departed, he spent several days at German Air Headquarters and laid down the following basic principles—as valid today as they were then—for air fighting:

> Try to secure advantages before attacking. If possible, keep the sun behind you.
>
> Always carry through an attack when you have started it.
>
> Fire only at close range and only when your opponent is properly in your sights.
>
> Always keep an eye on your opponent, and never let yourself be deceived by ruses.
>
> In any form of attack it is essential to assail your opponent from behind.

If your opponent dives on you, do not try to evade his onslaught, but fly to meet it.

When over the enemy's lines never forget your own line of retreat.

For the *Staffel:* Attack on principle in groups of four or six. When the fight breaks up into a series of single combats, take care that several do not go for one opponent.

The next step was the welding of the *Staffel* into a homogeneous group by strict discipline so that it could fight as a unit and not as a collection of individuals. Boelcke did not create this idea but he was responsible for its technical development. The idea grew out of the Allied pressure, plus the record of his Verdun unit.

At Kovel his brother Wilhelm recommended two officers, Manfred von Richthofen and Erwin Bohme. Boelcke accepted them although Richthofen then had a reputation for crashing his own planes and Bohme was thirty-seven years old. Here we read of the first decorated plane which became characteristic of the German *Staffels:*

On August 3, 1916, Bohme wrote that his machine had been decorated with a fearsome dragon as a talisman, which "at least made a terrifying impression on the Russian peasants."

Then Boelcke's six-week tour ended with a command to return to the Somme front and to take over his *Staffel.*

The record of the *Staffel* is well known. It was formed on September 1, 1916; it started with Boelcke's twentieth victory —Major Wilson, R. F. C., whom he captured and who dined with him at the *Staffel* mess.

4. THE SOLDIER DOES HIS JOB

The result of the *Staffel* work was summarized by General von Hoeppner:

The enemy's superiority in the air that was so oppressive at the beginning of the Battle of the Somme was broken at its end. The merit is due in no slight measure to Boelcke and the *Jagdstaffel* he led. Their joyous, vigorous thrust-

fulness and exemplary teamwork rendered them a model for all German *Jagdstaffels*. Eighty-seven victories won during the fighting on the Somme testify to their activity. Our *Jagdstaffels* forced the enemy, who had hitherto been so sure of himself, to adopt a cautious reserve, the effects of which were gratefully noted by the troops on the ground.

It is important to note that this superiority was gained over an enemy possessing a greater number of aircraft.

It was Boelcke who systematically built this superiority and development—the organized teamwork of the *Staffel* tactics. The factors of this success may be summarized as follows:

(1) The selection of the pilots seems to have been excellent and the most detailed technical training possible was given in the use of the *Staffels'* machines.

(2) Training in the technical details of the enemy aircraft. The strong and weak points of the Allied planes were systematically worked out and interpreted into the best method of attack for the particular craft. Captured machines were used in this training program.

(3) A systematic training in aerial warfare based on a deliberate plan of attack with avoidance of overlapping attack on one enemy and a policy of support for *Staffel* members who were in trouble.

(4) A systematic build-up of strict discipline and the organization of a definite fighting morale. No risks to be taken until the attack was decided on and no reserve in the actual attack. Withdraw always when faced with superior odds. This does not imply enemy numerical superiority. A greater number of enemy aircraft was not necessarily to be taken as superior odds.

(5) A definite leadership policy with strict discipline and control of the officers of the *Staffel*. Fighting was not a game or sport but the serious job of getting the maximum number of enemy casualties with the minimum loss to one's own forces.

Boelcke has summarized his own methods as follows:

> Besides that, I have to give my pilots some training. That is not so simple because they are all inspired with such fiery zeal that it is often difficult to put the brake on them. They have certainly all learned that the main thing is to get the enemy in your power and beat him down at once instead of arguing with him. But until I get it into their heads that everything depends on sticking together through thick and thin when the *Staffel* goes into battle and that it does not matter who actually scores the victory as long as the *Staffel* wins it, well, I can talk myself silly, and sometimes I have to turn my heavy batteries onto them. I always give them some instructions before we take off and deal out severe criticism after every flight and especially after every fight.

This analysis and the quotation show the complete integration of technical skill, training, and discipline for military purpose. It is important to remember it in the discussion of modern methods of air war. Boelcke may be regarded as the high point of this development. His true value can be realized only when it is understood that this method was ably carried out by Bohme and Richthofen after his death and also transferred to other *Staffels*. As Professor Werner writes, ". . . he pointed the way and exercised a decisive influence upon its [air fighting's] development, even after his death."

The major problem of this analysis is the psychological characteristics of the man. He encountered opposition to his idea and overcame it. He was a "forceful influence on all who came in contact with him, including his superiors, purely by virtue of his personality and the naturalness of his character," writes Bohme, and Richthofen says:

> It is remarkable that everyone who knew Boelcke imagined himself to be his one and only friend. I have met about forty of these "one and only friends," and each of them was convinced that he was the only one. This is the one remarkable phenomenon that I noticed in him. He never had an intimate personal friend. He was equally amiable to everyone and neither more nor less to anyone.

> The only person, perhaps, who was on a slightly more intimate footing with him was the man [Erwin Bohme] who participated in the accident I have just described.
>
> Everyone agrees on the charm of his personality, his ability as a leader, and his personal bravery.

5. DISCIPLINE AGAINST DEATH

Was he immune to the fear of death? His fame and prestige have been established beyond dispute. Unfortunately his diary letters were to his father and mother. He never mentions fear in them, but he could not do so because it would upset his parents. This he always avoided. Fortunately we have evidence of his attitude to danger from other sources. After an engagement with an English pilot who not only got away but punctured Boelcke's gas tank, broke his watch, and sent a bullet through his sleeve, Boelcke wrote to his brother in January, 1916: "You don't need to be afraid I'll be too rash; I'm looking after myself all right." Professor Werner comments on the fixed, set, and determined look in the photographs of Boelcke taken in September, 1916. Boelcke's old carefree air has gone and his interests became rigidly canalized. Fischer, his batman, has given us a description of Boelcke's attitude just before his final flight in which he was killed by an accidental collision with Bohme's plane:

> The superhuman burden of seven take-offs a day for fights and the worries about his *Staffel* weighed him down. General von Below, the commander-in-chief of our army, wanted to send him on leave because he was overworked, but he would not go. "I'm needed here," he said. He was always cheerful when he came back from a victory with the *Staffel,* but otherwise he was often in a very depressed mood in the last few days. When he came home from a flight a couple of days before his death, he said to me: "Fischer, I found an opponent who was a match for me today. There'll be hard fighting in the next few days. But no bullet will ever hit me," he added, as he so often did. That was neither pride nor superstition; he did not believe in any charm that made him proof against bullets like some of

the others—only in his firm determination to win. And no bullet did hit him.

The last evening he soon left the mess and came back to his room. "There's too much noise for me," he said. He sat down by the hearth and stared into the fire. Then he said to me: "Fischer, put on the gramophone record: *Father, Mother, Sisters, Brothers, Have I in the World no More.*" Then Lieutenant Bohme came in and asked: "Can I keep you company for a bit, Captain? There's such a row in the mess." They then sat talking a long time by the fireside, until at last I said: "It's time we went to bed, sir, now." "Who's on duty tomorrow?" he asked, and then he said "Good night," and that was all.

Here we see the defense mechanism Boelcke developed—"No bullet will ever hit me." The objectivity had gone. The strain of the *Staffel* was too great. Boelcke could not let up. His whole attitude of a demand for continuous fighting is possibly only another expression of this same defense mechanism—the flight from reality into action. This normally would involve the avoidance of emotionally toned thought, not the avoidance of the technical thinking. Boelcke did not find any defense in alcohol or the other simpler releases, which are discussed later. Boelcke found his release through his military training in action.

CHAPTER II

CIVILIAN-IN-THE-AIR

OTHER, A. N.*—A British pilot who flew in France with a combat squadron, 1917-18.

The editor of this journal describes A. N. Other as one of those who were "not the swashbuckling, pink-

*A. N. Other is the name written into the line-up of a football or other team to denote that a final choice has not been made to fill that particular position. *Death in the Air* (Heinemann, London, 1933), from which this diary material has been taken, contains a very unique set of photos taken by our writer and his friends. Only the diary material is used here. All the extracts are in their historical sequence but they cannot be accurately dated. The period is 1917-18.

> breeched, popular conception of the wartime aviator, but one of the thousands on both sides of the front-line trenches who took their job seriously, not 'reasoning why' but 'carrying on'; who flew and fought day in and day out, giving and taking, unable in their hearts to harbor that frantic and terrific hatred of the enemy as expressed and shown by some of those who never came in contact with that enemy."

He does not seem to be—like Boelcke, Lord, or Fokker—an individual with a passion for flying. In the war he decided "to do his bit," and he preferred to do it with the air force. Had the war not taken place, he might have become a member of a gliding club, or taken an occasional trip by air. As it was, he was an able and successful aviator—a man of considerable mechanical ingenuity to have devised the method he used to take the famous photographs published in the book.

Since nothing more is known of his background, the attitudes revealed in his diary will be directly discussed. This account reveals how his attitude toward fighting developed, and how the strain of his job affected him:

> Had thought I was pretty good! An experienced pilot! Worthy member of the squadron and a credit to the R. F. C.! Instead of which discovered almost too late that am good and easy target. Saw holes all over plane and one of the landing wires broken, and, with memory of other day fresh in my mind, was afraid had been hit in vulnerable spot. Queer thoughts raced through my brain and knew I must get back to drome quickly. Feinted a fall out of control, and as I noticed a Hun following me down, hung my arm over side and head down. All the time I was examining the bus for holes. He tried to put more bullets through me but I carefully fell away when thought he was going to shoot. Fortunately engine undamaged, and when I came to few hundred feet from ground Hun didn't follow, stayed higher up and watched for my crash. I suddenly leveled off and scooted toward our lines. Hun, of course, saw move, dived down and spattered lead all around me, but

good old bus held together and I zigzagged over the lines and shook him off. Even now can't imagine how I managed to scramble out of that predic. Gods certainly with me that time. No amount of drinks ever gave me such a feeling of nausea in pit of stomach.

A remote personal contact was established with an enemy pilot in an engagement. The entry in the diary is exceptionally long. The following extract illustrates vividly the pilot's attitude toward war:

Have a queer feeling tonight, seems kind of rotten to have killed a chap who had waved and smiled at you, no personal reason for blowing him up, fellow like myself. Seems kind of damned silly and senseless. Deliberately killing someone you'd probably drink with and find a pretty decent chap under other circumstances. Gets me under the skin. Bloody futile, all this. Spite of everything, can't get lasting war lust into my blood—feel ashamed of reaction, not the thing. Believe other chaps feel same way, too, only how the devil could one admit that one feels sorry or fed up about it? . . .

Only wait until this filthy mess is over, and if I come through, damned unlikely unless it's soon, I won't half-preach pacifism—let myself go for all I am worth. Couldn't quite do it now, one has to stick to certain ethics now that the war is on, but only wait, I'll know what I'm talking about after the war, bet there'll be thousands of the same kind. Oh, well, what's the use, we won't get that far—will be where the good niggers go by then, no two ways about it. Read pacifist speech in paper other day—"sacrifice of youth on altar to gods of Whitehall and the Wilhelmstrasse. . . ." Damned right, but what can you do when it's on? Got to see it through, and Germans do think they're God Almighty. . . .

1. BULLETS FROM THE AIR. THE GUNNER'S VIEWS

At this period when, as has been described (page 24), machine-gunning from the air had been developed very effectively by the British Air Force, our pilot wrote as follows:

> Circled and dived and picked out nests, and as they popped out at me got them in the ring sight. Fascinating to watch them topple over. Ideal way to kill, in my opinion. No close contact with your victim, no blood, or shrieks, or distorted looks of frenzied pain. Delightfully impersonal. All serene tonight.

"Nests" means machine-gun nests. The quotation shows clearly one of the essential characteristics of air war—the isolation or distance of the pilot from the messy and brutal part of his job. Absence of personal contact provides a defense mechanism of isolation from the tragic effects of machine-gunning and bombing.

After days of heavy fighting with numerous losses in his squadron, he finds sleep a "blessed thing" if only he can get it:

> Angels can play their harps all they like, give me the gentle patter of rain drops on the roof when that roof happens to be a hut in France with a war on, and myself a skyfighter! Rolled over and slept on. Too often wake up in sweat to find I am not falling into space or going down in flames after all. Let all agonies be dreams as long as an occasional victory is a reality!

As his war experiences increase, the strain increases. Machine gunning, at first calmly accepted, is now becoming obnoxious:

> *Sunday*—Heavy ground mist, so we kept on with the ground strafing. God, how I hate that work. How I hate everything out here. Forget how many quids my plane is worth including guns and my useless life, but surely something more than a fiver, and they send us up to shoot dirty Huns wallowing in muck and mud; moral effect, of course, and all that bally rot. Great moral effect when you get a bullet in your bottom or bury yourself in six feet of mud, or go down in flames. Canada gone; then the Bard and now Jock. Told we mustn't think about it. Hell! And the fireside warriors at home whine when an occasional bomb tears up their allotment patch and write to the *Times* about "on to Berlin." Bloody lot of Berlin stuff you would hear if those slackers had to come out here and do some fighting.

Latrine work is about all they would be able to do successfully.

Fred Lord reports a very similar reaction when he was trapped in machine-gun fire from the ground (page 43).

The next quotation is from the period when A. N. Other may have become a squadron commander. He now has the added strain of being responsible not only for himself but also for his pilots:

> Lost another today—Tod. Only out here a week or two. Mess sort of fidgety tonight, bad luck sort of depression. He was damned fine chap, good pilot, too. . . . No wonder they doll us up in shining brass and tinkling cymbals at home, make us think it is going to be some fun across the Channel, instead of bloody murder under the cloak of patriotism. Damnation and hell—when I start to think of it I start to drink, to keep my blood at boiling point—ginger myself up to go out and kill and laugh at my conquests. Great for these days of emancipation, and when man is supposed to be superior to the beast. I don't think. . . .

2. CIVILIAN INTO SOLDIER

His disillusionment is now at its peak. From now on his diary becomes a more routine record. Responsibility and discipline have done their job. His adjustment to a duty he disliked—in fact, hated—is made by a cold mechanical attitude toward fighting. The same psychological hardening as we find in Boelcke (page 28) occurs in this case also. The next quotation illustrates his new development:

> *Saturday*—Just another day. Feeling queer last few days, although nothing matter with me. Played chess with Rags today, got licked every time. Got jim-jams, can't keep still. Must take hold of myself. Going into —— tonight, take —— —— out to dinner, take my mind off things.

Another extract shows the same calm fatalism developing:

> *Saturday*—Not much rest these days. Fighting in the air has got to be a cold matter of business routine. No longer sportive! Sorry in a way. But the War has to be won, I

suppose. We got a Hun today after a long scrap, a two-seater. . . .

But even now this attitude does not remain stable. After a successful fight, but with losses to the squadron, the following sentences appear in his diary:

> . . . even after all this time we don't seem able to laugh with a vacant chair in the mess. Maybe after ten more years of this we shall be able to achieve that enviable state of callousness.

The strain added up and is reflected in internal tension:

> We can only claim for two Huns yesterday. No one saw Rats' "Hun" go down, and personally don't believe he ever shot at one. The speckled Fokker we all saw go spinning out of the scrap was chased by Brech well into his own lines. In coming back Brech got lost. When I think of Rex and Barry gone west while that little white-livered bounder Rats never gets a scratch, I see red. Damn well never looks for one if the truth were known. Keeps well out of it every time. Seen him, and Mac says same, but what can one do? Can't prove he's windy. But Mac is going to see to it that he gets some of the experiences he brags about so much elsewhere.

All armies have their Rats, and in the early days they are sympathized with. But the tension and strain destroy this sympathy. All the more quickly when the nerve-racked person has to cover up his own weakness from himself by boasting.

There is only one more entry. A. N. Other was shot down. He lies in peace with his comrades, having passed on his task to other hands. The British pilot had to acquire the attitude of the trained soldier which Boelcke started with. He, like all the civilians who were not disciplined soldiers, had to acquire the military attitude in war without the long organized conditioning of the professional soldier. He, therefore, reacted very differently from Boelcke. It is only at the end that he attained the cold, deliberate attitude of the professional soldier. His diary is never like Boelcke's with its completely objective account of the air flights and victories. The British pilot did take photo-

graphs of many of the combats in which he was engaged, but he did not write about them as Boelcke did.

The very differences between these biographical records show clearly two sides of the same problem—the problem of killing other men. The differences shown between the professional soldier and the amateur are especially important because they reflect the differences between civilians and soldiers. These differences will be considered at length later on, when the problem of army and civilian morale—a basic problem in air war—is discussed.

CHAPTER III

ADVENTURER IN THE AIR

LORD, FREDERIC IVES*—1900-. United States Third Texas Infantry, Company A, 1916. Seventy-ninth Squadron *Sopwith Dolphin*. 1918 *Croix de Guerre*. Official credit twenty-three victories, 1918. Distinguished Flying Cross. Bar to D. F. C., July, 1919. Officer Commanding R. A. F., Pinega, September, 1919. Air Staff. Allied Expeditionary Force, Archangel, North Russia, 1919. Russian Service Cross. Combat Adviser, Mexican Government, 1928. Major, United States Army, 1935. Combat pilot, Spanish Republican Government, 1936-37.

STRAIGHT FROM HIS AMERICAN school, Lord joined the Texas Infantry in 1916. The supposed Mexican danger was a challenge to his patriotism. The outstanding incident in his nine-month United States Army career was a false alarm at night, the result of a soldier accidentally discharging a rifle. The rough-and-ready conditions and discipline quickly taught him that the romance of the army lay in his dreams and not in the realities of camp life.

*Extracts from F. I. Lord's diary and writings. Also from article by Cy Caldwell, *Aero Digest*, 1937, Vol. 31, p. 62.

Lord got his discharge, and wisely he decided to go home. But somehow he got to Canada, where he joined the Royal Flying Corps. On his arrival in England he went to Flying School, 1917-18. At this period the work of Boelcke and his successors was bearing rich fruit in terms of British pilots' lives. To make the record of the German aces higher, the British Air Command filled the gaps with youngsters who were trained only to keep a plane in the air. Lord, with nine hours' solo flying in a death trap called the *Sopwith Dolphin,* arrived in France. The squadron had twenty-five pilots and twenty-one machines. Inside one fortnight Lord and Coapman were the only two left.

Quick death means quick promotion for survivors. In November, 1918, Lord was an eighteen-year-old squadron leader, with the Distinguished Flying Cross and a wound stripe, in command of his formation of eighteen British combat planes.

He finished his career in the World War in a hospital, after being shot down on November 9, 1918, over his own territory.

1. THE ROMANTIC ADVENTURER

From the hospital he volunteered for service with the Allied Expeditionary Force at Archangel. His attitude is given in his diary.

> The S.S. *Stevens* is steering a course through the English Channel. Aboard her is a detachment of Royal Flying Corps officers. Volunteers all, these modern knights are warriors at heart. Not content with months and years of fighting and bleeding and flying in France, they have answered the King's call for volunteers to fight another enemy—this time along the white wastes of the Arctic Ocean and the White Sea. And answering that call we find in this detachment many Americans in the uniforms of Britain.
>
> These men know full well that the future may bring death and destruction to them. They have tasted the full fruits—bitter fruits—and pangs of war; they know the daily sight of empty chairs, the sound of muffled drum, the plaintive wail of "taps." For them no military band, no

flying banners along Broadway or Main Street to cheer them on their way. And yet they go on. They are lured on by an urge of patriotism or conquest—an urge that is the fickle mistress of all fighting men. She is a mistress who beckons and who usually leads but to her couch of damp earth—rarely to applause or glory or riches.

Such was the attitude with which these men started. The actual strategic position was summarized by Lord as follows:

The Allied troops had been led to believe they were going to Archangel for guard duty. Instead they were rapidly dispatched from there in seven directions, like fingers extending out from Archangel, to follow the retiring Bolo,* from whom they had come to expect little resistance. But when these fingers extended almost 150 miles out from Archangel, the Bolo came to a stand and the Allies found it difficult to maintain their lines of communications open. The Allied troops feared revolts in the Russians supporting them and became panicky.

The Armistice was declared ending the war between the Allies and Germany, yet these troops remained in conflict with the Bolo for a cause that appealed to none. The few engagements were fierce and quarter was often refused by both sides to their captives. And massacres and revolts continued.

Then on January 19, 1919, a Bolo army, estimated at five thousand, attacked and severely defeated the Allied garrison at Shenkursk, over a hundred miles south of Archangel, on one of the tributaries of the Dvina River. The enemy had bided his time until transportation was impossible, as was relief from England or France.

In numerous places our troops were surrounded and cut off from Archangel. Annihilation stared them in the face from the bleak northern night. They issued frantic calls for help. The people in the United States and England then heard, for the first time, that we still were engaged in fighting an enemy. They demanded the withdrawal of

*The Bolsheviki Red Army.

these troops and dispatched help from France and England. The White Sea was frozen over as was the greater part of the Arctic Ocean, the only roads to Archangel, making it impossible to get troops to aid the defenders until late in spring around April. It was impossible to bring troops overland from Murmansk as the distances were too great and we didn't have sufficient bases to supply them en route. This huge Arctic territory is a wilderness less known than Africa and but poorly mapped. It has few trails and contains vast morasses and a wilderness of dense, low, scrubby firs.

Troops were hurriedly ordered from England and France and by March, 1919, several thousand Allied troops were massed at Murmansk waiting for the ice in the White Sea to break up enough to allow the ice-breakers through.

In this campaign Lord played a special part. Colonel Robin Grey, Officer Commanding R. A. F. in North Russia, partly if not solely for disciplinary reasons, sent Lord with a rotary motor *Sopwith* training plane to the small town of Pinega, where with his two mechanics he established an aerodrome.

2. INACTION AND DISCIPLINE

Lord described the situation as follows:

I raised so much hell in Archangel that Colonel Grey threatened to return me to England on the first transport. My chances of getting the *R.E.8* squadron were gone. I was ordered to sober up and steady down this rampage or I would be put on a non-flying basis. What the hell do I care? . . .

Finally, Colonel Grey sent me to Pinega when a job had to be done there. As no other pilot knew where to land there, I at last got a machine—of sorts. As there is no airdrome at Pinega and no means of communication with Archangel, except by floating down the river for ten days, he thought that would be an ideal place to exile me to.

Now I have cleared off the island I landed on in such fear some time ago, constructed several canvas hangars,

and levelled the field—all under difficult circumstances, as the military here would give me nothing but women for laborers.

But I think I now have just about the finest landing field in North Russia, and as the Bolsheviks are becoming aggressive on this front, Colonel Grey has promised me five of the newly assembled *D.H.9*'s and three *Snipes* for my command. Two of the *D.H.*'s and a *Snipe* are already ordered to report to me with pilots and observers.

In the meantime am getting along with an old *R.E.8*.

We now have quite a number of good old reliable Tommies stationed in Pinega under command of General Walsh. I have made several flights to Archangel with him the past month and spent quite a few days there working out details for the offensive coming off here shortly.

Lord did not like inactivity. Pinega became a center of air activity. The Bolsheviki had no air force. An attack by them was made in Pinega. Lord took an active part in its repulse.

At Pocha I discovered a pontoon bridge had been built overnight across the river. The bridge was swarming with cavalry heading out toward our lines. They made no attempt to hurry as I circled over their heads only two hundred feet above them. Flying carefully along the bridge, I dropped three twenty-pound Cooper bombs in rapid succession. Each was a direct hit and the concussion even tossed the plane about. What a surprise! Hadn't their spies informed them that I had no bombs? Men and horses were tossed into the air in all directions; the bridge was broken and sections floated down the river. Panic-stricken horses jumped into the water and drowned their riders.

A mile farther along the river toward Pinega, in what is normally neutral country or "no man's land," I came up to a column of infantry hurrying along. Flying alongside, and just over their heads, we raked them with the Lewis gun, our tracer bullets raining from the sky and spraying the column from end to end. They scattered under the trees and replied with some rifle fire, and at this close range

scored a number of hits on the airplane. It was necessary for me to fly perfectly straight, as my hastily initiated observer forgot my instructions to fire at the ground whenever I banked. He became so confused on the turns that he was actually firing at the sky at times. As a matter of fact Collins was doing pretty good for one who was having his first airplane ride.

I followed the Pinega and quite near Pinega, at Toroma, I located their transport dragging a huge gun along the river bank, obviously to a more forward position. Also a wagon train and ammunition carriers—as though they were sure they would take Pinega. I also saw a barge moored to the bank and, beneath the trees, what I figured must be the gun that was firing on Pinega. I dropped my remaining bomb on this gun and then from only one hundred feet machine-gunned the transport and escort until Collins signalled he had no more ammunition. Horses broke from under cover where their drivers had secreted them and raced along the trail toward Pinega, scattering things right and left from wagons and packs.

As we were now only a couple of miles from Pinega, I thought it might be possible to capture, by air, their transport and supplies. We were being greeted by occasional bursts of machine-gun fire now, but I dived still lower and, roaring over the fleeing horses, fired my Very pistol at them, the light and flame of which, swishing through the air, further spurred them on in their mad flight.

I tossed my empty bottles at whatever I saw move.

Was just wondering what I could do next, when the Bolo decided for me. We were caught in a terrific blast of machine-gun fire at a short, deadly range. The ship shuddered; I expected the wings to be torn off. In the darkness, their tracer bullets looked like a million fingers of lightning clawing at the airplane as though to drag it down out of the sky.

I levelled off the ship and headed for home. An explosive bullet hit the oil tank and drenched me in a bath of hot

oil and fumes. For a moment I was blinded with pain and the burning, clinging oil; I expected to crash each moment. Instinctively holding the ship level, I strained to hold my eyes open and find my direction. At the first moment that the oil struck and burned my face, I had the fear that perhaps I, myself, had been struck and blinded. What brought me to my senses as quickly as anything, was a glowing, smouldering lower wing. It had a ragged, burning hole in it dangerously near the main spar, and that hole was rapidly growing larger and was even now about eighteen inches in diameter.

I saw my field under me and, cutting the switch, landed the ship. Collins and I assured each other that neither of us was hit before clambering out and tearing the smouldering fabric from the wing.

The people of the village were on the river bank to welcome us. And what a welcome! They had heard my bombs exploding, and could see my tracers in the distant darkness. They heard the diminishing fire of the Bolo and the howitzer fired no more after I spotted it. They shouted and clapped me on the back and literally carried me home.

By the time I reached my billet, I was suffering much pain in my eyes. All night long a Russian doctor and nurse bathed my eyes and face while I drank whiskey. And most of that night and the following day, many of the villagers were around my billet clamoring to thank me personally for saving them from the Bolsheviki and death.

For this feat, General E. Ironside, Commander in Chief, Allied Forces at Archangel, awarded Lord a bar to his Distinguished Flying Cross.

3. A SMALL-SCALE AIR WAR

Pinega soon became the center of a larger unit with five planes (a new *D.H.9* for Lord) and an efficient ground staff. There was also an adequate supply of munitions, namely twenty-pound Cooper bombs, hundred-pound phosphorous incendiaries, and four-pound vomiting-gas bombs. Since Lord was not con-

cerned with political maneuvering, he, as a simple soldier, used these munitions and used them effectively. He noted that the Bolsheviki got more efficient at dealing with his attacks. During this time he was twice recommended for the Distinguished Service Cross (D. S. C.).

The story of a trap he fell for is both interesting and significant. It is the story of a raid on a Bolsheviki munition barge. It graphically illustrates what machine-gunning in aerial warfare is really like whether it comes from the ground or another plane:

> Knowing the barge could not move, we took out after the boat as we wanted to sink it as near Pinega as possible. From only five hundred feet we dropped five bombs; two of them hit on the deck and superstructure. I put the bus in a tight turn and held her there right above the ship while Collier jammed down his trigger and held the sights on the ship. It seemed as though several hundred Bolos jumped overboard into the cold, rushing waters. The ship swerved and, full speed, ran ashore. That was that. We had been after that boat for a long time. Now, tomorrow a party could come out from Pinega, repair her, and bring her back to Pinega.
>
> Climbing to fifteen hundred, I returned to the barge. There it was, just as we had left it—the gun still on rollers, several bodies lying about, and a number of trees stripped by the bombs. Not a Bolo in sight. Collier and I grinned at each other. Now we could take our time about sinking it—deserted. I circled lower; not a sign of troops—must have all taken to the woods. I went still lower; Collier and I held a consultation—to sink it or leave it for our men to capture later. I was all for leaving it as I was sure it was really deserted. I wanted that plum to hand G. H. Q. Collier motioned—no, sink it and make sure nobody gets it. So we argued, while we flew lazily around.

4. THE MACHINE GUNNER UNDER FIRE

Suddenly, effectively, all argument was stopped. We heard the mad humming of thousands of wasps passing us

at terrific speeds. I've seen those wasps tear little airplanes just all to pieces quicker than you can say "Jack Robinson!" I jammed the throttle wide open and Collier jumped to his Lewis—shoe was on the other foot now; now it was our time to move—and fast.

My heart was in my mouth and the wasps kept coming; but as long as bullets sound like wasps, they are a few feet away, I remembered from France. It's when the whining stops and you hear a crackling like a hundred mule-skinners cracking their long bull-whips in your ears that they are getting really close. As if in answer to that fleeting thought, the hundred mule-skinners started working on us.

I didn't know which way to turn, so cleverly was the Bolo concealed. They were smart, I couldn't help thinking; they knew we were bound to return and complete what we had started and so they mounted machine guns and waited and sat still—and we stuck our heads right into it. I dropped a bomb at random, then another; but now the Bolo was playing real rough and was real sore and refused to get frightened at my eggs, but kept right on shooting.

I dived this way and that but always ran into a hail of lead. They had also learned not to use tracers which would give their positions away. That dread hunch jumped at me; was this the way I was to go out?

We limped in with a badly shot-about airplane—poor Harris, I'm keeping him busy patching and repairing. As all this occurred close to Pinega, the Russians heard the whole thing and, seeing our badly shot-up ship, wanted to give us a party to forget it. Collier and I locked ourselves in our rooms with a few of them and fell to earnest drinking to soothe our frayed nerves. I don't like m.g. fire from the ground and never will. Can't see where it is coming from like you can in an aerial fight.

We aviators all dread being shot down and captured by the Reds as they have a perfectly swell habit of taking all husky young pilots and mutilating them. They did that to one of our fellows, a Russian, and then returned him to

our lines—living proof of their fiendishness. Excellent for the morale, you know.

The result is that now if any of our men are forced down and surrounded, they simply use their machine guns and try to do as much damage as they can until they are killed. Internecine warfare, this civil warfare, neighbor against neighbor and village against village, is more horrid than anything I ever saw in France. There quarter was usually granted upon request. Not so here; there is rarely quarter granted and fiendish tortures are often practiced—prisoners hanged to a tree by one foot until they die, chained naked to a tree to die of insect bites, salt rubbed into wounds, and many others even more ghastly. Even some of our own troops have became so callous that they would rather shoot their prisoners than share their rations when out on patrol and far from their base.

Right here in Pinega they have captured several spies and just now another one, and before I could finish a drink and get to the crowd, they had hanged him without form of formality. No, I don't like fire from the ground when I am only five hundred feet high.

These reports of the Bolsheviki treatment of prisoners are very significant. They reflect not only the general attitude on the Russian front, but also the attitude which develops in all civil or semi-civil wars—such as those in Ireland, Spain, Abyssinia, Palestine and China—in all war where the clear-cut military objectives become inextricably mixed with local political and social struggles. This variety of atrocity story is characteristic of all such campaigns. Because this type of war may well be the norm of the next war in which all the world may be plunged, the data supplied by Lord's diary will be discussed at length.

5. THE REALITIES OF WAR

Lord's first awakening to the type of war in which he was engaged is described as follows:

On one of my recent visits to Archangel, during which

time I was "standing by" at the drome for orders and supervising assembly of several planes, I noticed, each morning, a squad of soldiers marching several men and women past the drome and out toward the swamp near us.

I thought they were possibly taking political prisoners out to work in the fields. But one of the mechanics said the soldiers always returned in about an hour—alone—and that he thought he heard rifle fire in the direction they took.

So, one morning, I waited at the edge of the airdrome and, when six soldiers came along, marching before them a young woman and three men, I approached and offered cigarettes. Two of the soldiers came forward and each took a cigarette, whereupon I extended the package and motioned that the rest should also smoke.

They thanked me and all, including the prisoners, smoked. . . .

The corporal gave a command and the little party moved on. I was convinced that these prisoners were being moved to another prison or else being marched out to labor in the fields. I told the mechanic he was mistaken and went into the mess for a drink.

In about twenty minutes, the mechanic came after me and said he had again heard rifle fire, in the direction the party had taken, and that he was going to explore the place during the day.

That night I found a note from him stating he had found a ravine which was obviously used as a sort of execution ground. He counted many shallow graves.

I asked one of the Russian officers about it—whether this was the way they executed their prisoners—and he laughed and asked me, why not? Said they were spies and whatnot, and why bother with drums and stone walls and all that stuff? Take them out to the outskirts of the city and shoot them—save draying and coffins—less fuss. Whew!

Well, to look at those people, I certainly would not have

thought they were the condemned and their executioners. Why they even cracked a joke or two. Guess I'm still too young, but I don't like the idea of shooting women, especially young, strong ones.

Many more people besides Lord found it difficult to understand this brutality. Yet a war is only a systematization of the same methods, with a code rule adopted to meet a few military conveniences and certain basic principles of human attitude. To kill as part of organization is not psychologically the same as to kill as a gangster. Lord expressed the general attitude to executions very well as follows:

Another spy was executed here yesterday, but I didn't attend the show. I rebel at executions. To shoot a man who is fully armed and is firing at you is one thing; then he is the enemy, but when weapons are taken from him, he is just another human being with, possibly, different ideas than you have, and to line him up and shoot him for those ideas is repellent to me.

Lord has described just what this type of "show" is like:

Several days ago a battalion of Slavo-British troops revolted at Beresnik, on the Dvina, and went over to the Bolo. An offensive was immediately launched and most of them were recaptured. Eleven of them were chosen at random, by the Russians, and condemned to death by the firing squad. These revolts are bad for the morale of the inhabitants and might influence them to turn against us if the deserters are not promptly and severely dealt with.

The Russian military had charge of the execution and they decided it should be a public one. Strange the power that draws a human being to witness the destruction of another. As it was, the citizens were practically ordered to attend.

The show was held on the airdrome to the east of the field where eleven graves had already been dug. On the south and north ends of the field were hangars of canvas, the sides of which could be raised. Hundreds of citizens were herded onto the field. Before each grave was a ma-

chine gun loaded with but five rounds and manned by a Russian soldier, at the back a post to tie the men to.

It was like a ghastly nightmare. At a signal the condemned were led out in single file from a hangar. The last two were an old gray headed veteran and a youth of fifteen; they clung to each other, both in tears. It was pathetic; they were given a kick, released, and told to rejoin their units.

At the head of the remaining nine was a sergeant, a straight, proud man who walked up to the last post and turned facing the gun. All nine were tied to the posts. Now the sides of the hangars were lifted to show fully manned machine guns facing the assembled crowd—a sort of warning against any demonstration.

The legs sagged under several of the condemned as they looked into the muzzles of death, but their thongs held them up. The sergeant remained erect and expressionless.

At the first burst of fire, six were killed—the remaining three only wounded. The gunners were given another five rounds; they reloaded and fired, killing all but the sergeant. He showed the finest possible courage and bravery in the face of sure death.

At the first burst he was only hit in the legs (as part of their punishment, the executioners were their own comrades who had revolted with them. That is the reason they were given only five shots—to keep them from swinging their guns on our men and making their escape). The sergeant reached down, felt his legs, smiled and painfully drew himself erect. At the second burst, he was hit in the abdomen—drew his hands away dripping and tried to straighten up his torn body. At the third burst, he started to bring his hands up to his breast, dropped them and sagged forward on his bonds—and a brave man was dead.

This prolonged killing sickened even the toughest veteran. The young Russian officer whose duty it was to give the *coup de grâce*—the final shot through the head—did his job, vomited, threw his pistol from him and fainted.

Women fainted and screamed; men turned pale and retched and were silent.

Lord has described what the writer considers will be the type of development in the new era of socio-economic wars which we are now entering. The large-scale air war to be described later may be only the prelude to the local brutal struggles in which

> The brother shall betray the brother to death, and the father the son; and the children shall rise up against their parents, and shall cause them to be put to death.

6. ADVENTURER AGAINST DEATH

Flying on the North Russian front was not a sinecure. Danger in the air and from assassination in his own camp existed. Here again the effect of strain is clearly shown:

> That old hunch is coming back; something is constantly singing in the back of my head: "Your time is coming, your time is coming, your time is coming." The words beat with the rhythm of my motor when I am over the lines; the pounding of my heart keeps time with that warning; I wake up at night in a cold sweat, having dreamed, vividly, I was spinning down in flames.
>
> This sort of warning—this hunch—is not a fear. It is a certain, sure voice of destiny telling me my days are numbered—my time is up. In France, I have often had pilots confess to this same hunch and within a day or a week have seen the warning fulfilled.
>
> After flying for a year in France with never a qualm or a fear, I had a similar warning, and within a week I was shot down by a squadron of *Fokkers* and put into the hospital. That broke the spell.
>
> Now again—well, I don't have it when I'm tight so . . .
>
> Funny thing is that the more I hear this warning, the less I heed it and the more chances I take, as though trying to prove to myself there is nothing to it. But it is strange that one of those many bullets that have found my machine doesn't get me, again, and for good.

Now the phrase in an early quotation—"That dread hunch

jumped at me; was this the way I was to go out?" becomes clear.

Even today Lord's dreams are troubled by the fear of a blazing plane. The adventurer of the air, like the trained soldier, Boelcke, and our British war pilot, shows the same response to strain.

Lord's personality now assumes a concrete form. An excellent flier, he is a man popular with all his associates and even his enemies. He is a firm believer in the American ideals of democracy, patriotism, and morals. Without any political insight into the causes of social issues, he is a technician who flies an airplane well. In flying he finds a mode of expression for his mechanical skill, an excitement which is his main psychological drive, and an independence of action which is essential for his self-satisfaction. In a plane he is no man's servant, but master of a machine which he knows as well as a cowboy his horse. He does not like discipline—especially the discipline of routine training. He drinks—at times far too much—but neither his drinking nor his dislike of routine interferes with the essential discipline that a good war pilot must have. His philosophy is based on personal symbols—on action and excitement—not on any theoretical system of approach. He understands persons and machines—not theories and speculations. He is, in fact, a typical flying individualist who must have freedom of action at all costs.

Lord, ignoring, disliking, and distrusting political theories and reasoning, lives in a world in which politics are controlling all his actions. In Archangel, he realized that here was a war unlike the war in France—a war which showed clearly its fundamental motives—a war in which persons had to be shot because they had "different ideas than you."

He liked the White Russians for whom he was fighting. When the order came to withdraw, he wrote as follows:

> *September 7, 1920.* Well, the offensive is over and Carr is returning to Archangel and leaving me to the grief of more real work. The British are leaving Russia to its fate. Rotten shame, but so have ordered the politicians and Labor Party.

Now then, the sinister thing about my orders: I am ordered to remain here until the twenty-second, yet I learn from officers of Grogan's staff that the last British transport sails from Archangel on the seventeenth, and that they have been warned to get aboard by that time if they do not want to get left behind. Yet five days after that last transport sails I will still be here scrapping Bolos and quelling riots! Something rotten in Denmark! During the World War, men were knowingly sacrificed to cover a retreat, but I'll be damned if they make me, or any of my little gang, the goat in this goofy game. I think I'll go to Archangel and make darn sure a gunboat is standing by to take us aboard at the last minute. I smell a rat and it stinks like a frame-up to me.

September 11, 1920. The British troops are evacuating now. It is pathetic to see the Russian civilians and soldiers waving smiling farewells bravely to our men as they embark in river steamers and launches, towing rafts and barges.

My orders say I am to destroy all my equipment when I leave here. Well, I have better use for it than that. I'm going to give it to my Russian friends. Many of the civilians here face possible execution as soon as the Bolo get here.

Lord could not understand this betrayal of people he liked and for whom he had fought. This betrayal did more to him than this. It sapped his confidence in the Allied Command. He liked the White Russians; so he arranged for a secret store of planes to await his return to fight the Bolsheviki after he had been demobilized from the British Army.

But Lord was not destined to return to Russia. After demobilization he returned to Texas, formed an air line which failed. After acting as combat adviser to the Mexican Government in 1929, he was granted a mail concession and started the Línea Aérea Central Mexicana with *Bellancas* from San Antonio to Monterrey, Mexico. Unsuccessful, he took a job with the Curtiss-Wright Company until 1931. Then he barnstormed with his own flying circus. As a relaxation, he explored and pros-

pected for oil in Texas and Mexico. Finally he became a very successful instructor at the Floyd Bennett Field in Brooklyn. Then the war in Spain got going, and, even though he had married, the appeal was too great.

7. SPANISH WAR, 1936-37

On November 11, 1936, he sailed for Spain as a combat fighter at $1,500 per month. He was again a military hireling. He did not know what side he was fighting for. It happened to be the Spanish Government. At Bilboa he was given an old French *Breguet* and started off bombing the Nationalists' Army aerodromes and trenches. Here he was up against modern Italian and German airplanes *(Caproni—Heinkel)* and the latest in anti-aircraft fire. On his raids from Bilboa he sometimes had the escort of the fast U. S. S. R. *(2KB-19)* combat planes. It was in this war that Lord began to learn again.

What he learned was not new methods of aviation. Lord saw the Nationalists bombing open towns. He knew they were machine-gunning the civilian population in the territory of the Spanish Government. Lord wrote:

> Only the day before I had seen the buildings of Bilboa wrecked by Fascist bombs. Yet I was given explicit orders never to bomb a town. Fascists and Nazis may war on women, I was told, but not the Spanish Government, for the government is the Spanish people, and they do not wish to destroy their own homes. This is proved by the size of the bombs both sides drop. The largest I used at any time in Spain weighed thirty pounds. These are useful against troops in the open, but are not of much use against buildings. The Germans and Italians, on the other hand, drop bombs weighing between six hundred and sixty and twelve hundred pounds. They are especially designed for the destruction of buildings. Franco's air force is entirely maintained and supplied with the latest craft from Germany and Italy.

He was also impressed by the number of volunteers with the Loyalists who were fighting with the Spanish people because they believed that the fight of the Spanish people was a fight

for the ideal of democracy—an ideal which they, too, held. The result of his Spanish experience was a change from a soldier of fortune to the soldier of an ideal. The old pre-War patriotism was regenerated in this new ideal. When sick in Paris, from the effects of the Spanish War, he wrote to his American friends explaining his conversion to the Government cause. One of his letters contains the following passage:

> Those poor souls in Spain are really fighting and suffering for an ideal. Nay, more—for their lives. And it is a blight on the pages of democracy that our so-called democratic nations stand idly by and callously watch them ground into the mud by militaristic foreign invaders. It's democracy against the pomp, vanity, and dictatorship of the Caesars and Attila.

Lord tells one other story of awakening from a fear dream in which the Bolsheviki had captured him and were going to execute him. He woke up to see Russians all around. It took some little time to realize that they were volunteers fighting for democracy just as he was. So a bad dream ended in new orientation. The professional soldier found a meaning for fighting.

Boelcke was a soldier with a complete military code interpreted with a political philosophy. Lord took twenty-three years of fighting to acquire a philosophy. Lord is more important to us than Boelcke because the Lords are much more common than the Boelckes in this mechanized world of ours and because Lord has faced the problem which technicians—whether they are designers, chemists, or pilots—must inevitably face.

CHAPTER IV

WAR AFFECTS THE HEROES

THERE IS ONE COMMON thread which binds these four types of men together, and that is the *Fokker* planes. True, they have had very different interests in these planes. The machine-gun bullets involved linked them in a chain of self-destruction in

which the *Fokkers* supplied a major strand of the string and the interrupter machine gun the threading device. What does the man who did the threading think of it all? He has continued to be actively associated with the aircraft industry in more countries than any of the other early pioneers.

1. DESIGNER AND FLIER

Anthony Fokker,* born in Java, schooled in Holland, built his first plane in Germany and for flying it was given his F.A.I. license on May 16, 1911 by the Mainz Aero Club. His plane was a monoplane and the design centered around the basic idea of inherent stability. He aimed not only at flying, but at doing things safely in the air. His machine looked even more crazy than the early biplanes, and because of its stunt possibilities and its weird appearance, he was a very successful barnstormer.

Fokker moved into the inevitable round of international competition. He met sponsors, financiers, and sabotage in a double dose because he was both a flier and a designer. Like all early fliers, he faced death. He felt the strain. When he first flew, first looped the loop, saw other pilots crash, and when he crashed himself, Fokker sums up the effect as follows:

> Those of us who continue to fly can never quickly brush away from consciousness the shuddering memory of those early days. Pilots who begin their flying today hardly understand the rarely absent sense of dread which afflicts the veteran airman. It is a dark heritage of the time when almost any flight was potentially a one-way trip to oblivion.

During the period 1912-14, Fokker was trying to sell his planes, mainly in the military market. He tried Holland, England, Russia, Italy, and Germany—all without success. His factory was in Germany and he had his closest contact with German financiers and militarists. In 1913 he won a German military competition valued at 45,000 marks and got an order for ten planes. On the basis of this and his own optimism he

* Fokker, A. H. G., and Gould, B., *Flying Dutchman: The Life of Anthony Fokker* (Holt, N. Y., 1931).

started his factory in 1913 at Schwerin, Mecklenburg-Schwerin near the Baltic Sea. This development really consisted of a factory, an air field, and a training school for pilots. Early in 1914 he got an expansion on his army order and was selling some private planes. In August, 1914, his factory employed 150 men and he estimated a profit of about 40,000 marks a year.

The outbreak of the War, August 4, found him as surprised as most people.

> In the peaceful summer of 1914, when the world was publicly congratulating itself that the sword had been sheathed by civilized nations, the World War exploded in its face. This immense irony took me completely by surprise. For more than a year I had been working closely with the German army staff, but no hint had been given me that plans were afoot for the great drive against France which began on August 4, 1914. As far as I was concerned, hostilities opened overnight. However clearly historians in the future may show that the World War was inevitable, my ear was turned away from Destiny and I did not hear the rumbling of the gun caissons until they were rolling toward the French border.

With the War, all his planes were commandeered. The competition of the army and navy and the demand for planes inevitably forced him to become "an industry."

2. THE SYNCHRONIZED MACHINE GUN

Fokker's early development has shown that he was not just an airman, not just an engineer, not just an aeronautical expert, but an inventor. In 1915 he proved this by his invention of the synchronized machine gun in reply to the French use of machine guns in airplanes. Here are extracts from his own account:

> The technical problem was to shoot between the propeller blades, which passed a given point 2,400 times a minute. This meant that the pilot must not pull the trigger or shoot the gun as long as one of the blades was directly in front of the muzzle. Once the problem was stated, its solution came to me in a flash.

The obvious thing to do was to make the propeller shoot the gun, instead of trying to shoot the bullets through the propeller. Inasmuch as the machine gun would shoot only about six hundred times a minute this required some practical working out, but the principle had been found, which was the important thing. . . .

During the night I found out the basic operation, and began next morning to perfect the device. One blade was enough to strike the cam, because the gun could shoot only six hundred times a minute while the blades passed a given point 2,400 times a minute. To the cam was fastened a simple knee lever, which operated a rod held back by a spring. In order that the pilot could control the shooting, a piece of the rod which struck the hammer was hinged to hit or miss as the operator desired. This was the entire device. . . .

Inside four days, Fokker returned to the German Air Headquarters with a working model of his synchronized machine gun. The German staff gave a classical example of military conservatism and technical ignorance. They questioned whether a gun that fired ten shots could fire a hundred shots, whether a mechanism that worked on the ground could work in the air. Fokker demonstrated his gun successfully under all these conditions.

But even then the High Command were not satisfied. They insisted that Fokker should take up a plane and shoot down an enemy airplane. Against all his protests about neutrality, Fokker was sent to the front. He was dressed as a lieutenant in the German Air Force and sent up to find a victim. His opportunity came two days later.

In the following, Fokker describes his feelings as he flew behind a French *Farman* two-seater biplane to execute this order:

While I was flying around about six thousand feet high, a *Farman* two-seater biplane, similar to the ones which had bombed me, appeared out of a cloud two or three thousand feet below. That was my opportunity to show what the gun would do, and I dived rapidly toward it. The plane,

an observation type with propeller in the rear, was flying leisurely along. It may even have been that the Frenchman didn't see me. It takes long practice and constant vigilance to guard against surprise air attack, for the enemy can assail one from any point in the sphere.

Even though they had seen me, they would have no reason to fear bullets through my propeller. While approaching, I thought of what a deadly accurate stream of lead I could send into the plane. It would be just like shooting a rabbit on the sit, because the pilot just couldn't shoot back through his pusher propeller at me.

As the distance between us narrowed, the plane grew larger in my sights. My imagination could vision my shots puncturing the gasoline tanks in front of the engine. The tank would catch fire. Even if my bullets failed to kill the pilot and observer, the ship would fall down in flames. I had my finger on the trigger. What I imagined recalled my own narrow escapes—the time the gasoline tank burst, the breaking of the wing at Johannisthal when my passenger was killed. I had no personal animosity towards the French; I was flying merely to prove that a certain mechanism I had invented would work. By this time I was near enough to open fire and the French pilots were watching me curiously, wondering, no doubt, why I was flying up behind them. In a moment, it would be all over for them.

Suddenly I decided that the whole job could go to hell. It was too much like "cold meat" to suit me. I had no stomach for the whole business, nor any wish to kill Frenchmen for Germans. Let them do their own killing!

After Fokker's refusal, Boelcke was given his plane with its machine gun. The next day Boelcke, on his third flight, shot down a French plane, and the machine gun was accepted with the greatest enthusiasm.

Fokker's reaction is a most interesting psychological study on the incidence of moral responsibility. To build fighting planes, to design a new efficient fighting weapon, to accept even temporarily the idea of shooting down a man (not an enemy) to

prove the efficiency of the device—all this was psychologically possible. The act of killing was not possible. To be an organizer of destruction is psychologically very different from being the destroyer in person. This effect of "distance," as it is called in psychological terminology, is important not only in this case, but in the whole problem of morale which will be discussed later.

Fokker writes as follows of the period when his planes and machine guns dominated aerial warfare:

> Dropping out of the sun, a *Fokker* pilot would dive, pull up underneath the enemy plane and simply sew the opposing airman in a shroud of bullets. The courage of the French and English in facing such disheartening odds seemed almost superhuman to me.

When the Allied Forces replied with similar and better equipment, he had the basis laid for his response:

> Under the driving stimulus of the War, the lash of domestic competition, the unceasing demands of combat pilots, planes were constantly improved. From the first I made it my business to lend a ready ear to what pilots said of every plane they flew or fought against. I had the liveliest sense of the inhuman dangers they daily faced. By heeding their complaints and requests I often knew what the next improvement must be two or three months before the urge took official form. Then I laid my plans accordingly, for whatever talent I possessed was not stinted in an unremitting effort to give them the best fighting plane my brain could devise. As fast as one side appeared at the Front with a superior plane, efforts were redoubled on the other to equal or better it. During the War I designed two or three dozen types, perhaps, concentrating, however, on only the few which completely satisfied me. Thus the temporary advantage drifted back and forth across the lines, with the manufacturers almost as deeply embroiled in the fighting as the combat pilots themselves.

The classic example of his method was the triplane which was built not for speed, but for climb and maneuverability:

> It proved to be one of the most remarkable ships that

had ever been built. When the Allies saw its triple bank of planes glittering red at the head of the Richthofen circus, and saw it fairly float in the air, it threw something of a panic into their men. They never had an opportunity to realize how slow the triplane was because of the way it climbed, flipped and stunted in a fight. In the turmoil of combat, with its extraordinary climb and maneuverability, it proved almost invincible under able piloting. Sometimes even German airmen were unaware of its limitations, the triplane responded so immediately to the demands of the fight when demands became imperative.

Most illuminating is Fokker's next comment:

> Had the Allied airmen only realized it, they could have outwaited the triplanes, which carried less gas than other types, and then, with their greater speed, run them down. The *Spads* of the French were faster and could dive away from any of the German planes like a streamlined brick. But they were not as fast on turns or as speedy in climb. The English *Sopwith Camels* were similarly faster than the *Fokker* triplanes, but not as agile in a scrap.

In this quotation Fokker reveals again the difference between the analytic approach to aerial warfare of Boelcke and Richthofen and the numerical and bulldog reply of the British tacticians. The causes of the terrific losses of the R. A. F. will be discussed later. One of the reasons is now obvious. The lack of this analysis and training in the R. A. F. pilots, compared to the German Air Force thoroughness in these matters, is but the old story of the amateur against the professional.

Fokker knew intimately all the great German aces. His account of their attitude supplements the diary material already quoted:

> When I met them in their headquarters at the Front they jested and sported as though the angel of death were not the permanent leader of their circus, and when they came to Berlin for a fortnight's holiday, they lived as riotously as though they hadn't a care in the world. That is, with a few exceptions, among them Richthofen. He was calm,

cold, ambitious—a born leader of men and Germany's greatest ace.

Richthofen, Boelcke, and Immelmann, Germany's trio of aces, I knew intimately—as intimately at least as one knows men who, having stared at death so often, have learned to wear a mask lest an occasional human weakness betray their almost hypnotic gallantry. They were as different as men of the same breed can be. One by one I saw them die as I knew they must die, for they were in a contest not with a human opponent but with Time, the cruelest foe in the world. Judging their bravery by my own, I reckoned them supreme. Knowing the accuracy of the machine gun and the airplane in the hands of a skilled pilot, calculating the remote chance of surviving by any prolonged campaign in the air, I would never have had the courage to face the enemy. Every man who went aloft was marked for death, sooner or later, once his wheels left the ground.

Richthofen was wounded in 1917, after his fifty-seventh victory. Fokker writes of his attitude as follows:

The news of his fall was kept from the German public which superstitiously regarded him as a superman, beyond death. It was less than a month before he was back in the air again, but never as his old self. "Manfred was changed after he received his wounds," his mother is reported to have said. Now he knew death could reach him as well as the others, and that is no knowledge for an airman to live with, day and night.

3. WAR AND THE CIVILIANS

As an industrialist, Fokker knew the attitudes of his workers as well as those of airmen and industrialists. His account agrees with those of other observers:

All of us in industry could have seen the end coming on. Workmen began to complain more and more loudly of the lack of food. They drifted vainly from one factory to another in search of better conditions. That was permitted, if they arranged for another job before quitting the one they

had. Otherwise the army picked them up. All forms of industry were full of men on the payroll who did no work, but paid to get there in order to escape army service. Some manufacturers, in order to get rid of undesirables whom they didn't dare dismiss, would arrange with the military authorities to have their exemptions terminated. This helped the manufacturers, but injected Bolshevistic workmen into the military forces and greatly stimulated the eventual collapse of the army and navy.

One could not blame workmen or soldiers for complaining about conditions. People were fast losing their humanity. They were tired of war to the marrow of their bones. Confidence in everything had disappeared. Only the long powerlessness of the common people had staved off the Revolution so far. But the groundwork was prepared. When the end came it came with a rush. The straining mass emotion, too long unreleased, broke its dam with a force which carried all before it. Not even the people themselves could stem its flood. The military authorities were swept out of the way like driftwood. Had only this pent-up despair found an earlier escape, Germany would have been spared some of the madness of revolutionary years.

These factory workers show how the war strain reveals its effect on the general mass of civilians. The account of Fokker's wartime experiences can be closed by one more quotation which again illustrates what happened both to the early pilots and to fighting men:

After spending my life helping to bring the airplane to its present stage of development, flying is no longer the thrilling pleasure for me it once was.

When I recall how at Johannisthal I would not let a day pass without flying, because I loved it, the change seems incredible. Its cause, however, is a simple psychological matter and because I can explain it to myself I continue to fly.

The truth is that from beginning to end of my experience with airplanes I have encountered so many different

kinds of failures with the wings, the tail, the guy wires, the controls, the motor, the fuel lines, the gas tank, propellers —everything almost that goes into the making of an airplane—that I cannot stop thinking of them unless I am either piloting myself or concentrating on some important engineering problem. But if my mind is entirely free, my imagination visions the motors running at their enormous speeds, and the hundred-and-one points of stress and strain in the airplane. My reason, of course, tells me this is foolish, but I saw so many things go wrong in the early days and have been so close to death myself more than once because of structural failure, that I have to struggle to convince myself that such things no longer happen.

I know many old pursuit pilots—men who have distinguished themselves by extraordinary courage and skill —who have a certain fear about flying today. They are mentally disturbed because their memories of old dangers have coagulated, like a clot on the brain pressing for recognition and thwarting reasoned thought. Such men fly now because they know they take no risks, and because it is their job. But if they had a chance to quit they would jump at it. Rickenbacker, America's leading ace, who demonstrated, even before he took up flying, the courage he had on the automobile racetrack, had this fear for a long time. By the end of the War he was convinced that each flight would be his last. The human nerves can't stand such a strain forever. After the War he didn't fly for a long time. He is flying now again, and seems to enjoy it. He has succeeded in eliminating this old fear, now that he does not fly among bullets, and planes are no longer dangerous.

The whole of Fokker's account only confirms what the three pilots have told in their own words. This confirmation is important because it shows that tendencies and not individual attitudes are being illustrated. These tendencies could be proved many times over but such proof is unnecessary.

Fokker's own attitudes are of interest. His lack of academic success at school, combined with his energetic optimism, cen-

tralized his drive for success and also determined the only way in which success could really satisfy him—personal independence combined with personal success. The individualistic trends in his character are as marked as those of Lord. They are reflected in his industrial as well as personal and technological attitudes. He had the necessary financial support to allow these individualistic tendencies to develop and to justify themselves.

Aviation was his field and aviation meant war planes. This he accepted without question. The other side of his character was a very realistic fusion of theory and practice. To build planes was not really his objective; his objective was to build planes which effectively fitted into a given set of limitations. But his attitude demanded complete personal freedom with an almost amoral repudiation of social responsibility.

4. THE EFFECTS OF WAR STRAIN

These four men have told their stories of how they felt and acted in war. The extracts quoted from their writings have revealed not only their reactions to flying and fighting, but also considerable insight into their personalities. It should, however, be noted that the books from which these extracts have been taken have not been completely abstracted; only the information relative to the problem of war strain has been quoted. The reader will find in the writings of these men much valuable comment on other topics not directly related to this problem. What these personal records have shown may now be summarized.

That all these men were aviators testifies to their great physical courage. The three fighters were, like all wartime pilots, volunteers. They started with the highest type of military morale—that of voluntary acceptance of their duty to fight. At first, this fighting was conceived as a thrilling personal duel against antagonists with very similar military equipment. Success or failure could be credited to a combination of careful training and personal skill with an added element of chance or luck. It is characteristic of aerial combat that the fight is separated from its consequences to the vanquished. What these consequences are, is, of course, intellectually well known, but they

occur in the heat of action and as a result of a "fair" fight. When even a very remote personal contact is formed with the opponent, then the job of killing him becomes emotionally more difficult. As the war drags on the strain of endless fighting, the narrow personal escapes, the death of their friends, and the clear realization of the practical certainty of death for themselves—all increase the mental conflict for each individual. The ideals for which they are fighting seem to be negated by the long-drawn-out destruction of human beings, individuals against whom they have no personal antipathy and friends whom they have known only too short a time.

To relieve this strain they demand either continuous action or a distraction. The distraction must prevent thought. The greatest strain occurs in waiting. It is of interest to note that airmen on leave in London report the same fear of the air raids as the civilians in the area. The war becomes unthinkable and the fighting becomes a mechanical operation which must be carried out as a routine procedure to help one's friend in a scrap. Each individual in this type of situation will make his own particular adjustment. The one universal characteristic is that the adjustment is not to the war itself, but to ways in which the war may be forgotten.

The three war histories discussed are of men who were successful in withstanding the strain. Two hundred thousand cases of "shell shock" developed among the British troops alone in the last war. The evidence here given strongly supports Culpin's conclusion.* Writing of men without any predisposition to mental disorder, but who show breakdown following actual warfare, he says:

> Meeting men with a history of three or four years of strenuous warfare before their breakdown leads me to believe that everyone, if subjected to sufficient of the terrors of modern warfare, would eventually reach his limit of physical or mental endurance.

Culpin's results are based on a group of 415 cases of mental

* M. Culpin, *Psychoneuroses of War and Peace* (Cambridge University Press, England, 1920).

breakdown. He notes that any bias he may have had was in favor of assuming that a predisposition existed. Yet the percentage of his group who showed "no predisposition symptoms following actual war" was 57.6. In this group, 87 per cent of the patients had symptoms showing an anxiety state* or hysteria state. These figures are not for airmen but for all types of soldiers. The writer has been unable to locate an adequate analysis of airmen alone.

The records also reveal that the external strain—to chances of being killed—is not the only type of strain. There is also the internal strain of justifying killing. In the next war, the majority of airmen will fly bombers. In the 1914-18 War, all airmen tried to avoid the bombing squadrons. Only in special cases, such as the Allied Expeditionary Forces in Russia, were these duties readily accepted. The fact that no journal describing the reactions of bombing pilots seems to be available is further evidence of this attitude. It may be concluded that modern air war will increase internal mental strain. The problem of maintaining air-force morale will therefore become more difficult. The bombing of women and children will not be a popular undertaking.

The problems of morale for military pilots, professional soldiers, conscript soldiers, and civilians are all interrelated. The morale of an army, however, does not depend only on the positive factors which lie behind the "willingness to fight," but also upon the negative factors such as "popular opinion" and the court-martial.

*An "anxiety state" is indicated by the individual being unduly anxious and often very depressed. Headache, loss of sleep with fear dreams, difficulty in concentration, and irritability are some of the specific symptoms.

Part II

THE SCIENCE OF AVIATION AND THE BEGINNING OF AIR WAR

The airplanes that Boelcke, A. N. Other, and Lord flew and Fokker built have a long history of human effort behind them. Like all other similar inventions, the airplane and the airship are not the result of one individual's effort, but the coordination of theoretical reasoning and experimental work by individuals from most European countries, as well as from the United States. The results were synthesized in the early flying machines.

In the World War the airplane developed, at first very slowly, and then more and more rapidly, into an instrument of great military value. The War saw the beginning of the systematic use of aerial bombardment to cripple munition production, to interfere with the transport of troops and munitions, and to attack directly civilian morale. From 1914 to 1918 the airplane developed slowly from a purely tactical weapon to a major strategic weapon. The strategic use is called air war.

Here, as throughout this book, it is the social problems and the traditional limitations imposed upon the early pioneers either by society or by their own psychological attitudes which will be discussed, rather than the technical development.

CHAPTER V

FLYING—THE DREAM

THE TRAGIC NIGHTMARE DESCRIBED in the foregoing chapters is the result of man's age-old daydream. This daydream arose like all our dreams—in a wish.

The wish to fly is very old. It is expressed in legends which were old long before written language was developed. Poets sang about it; primitive philosophers discussed it in the academic fashion of their time; and primitive priests explained why the gods had decreed man could never fly.

Daedalus, it will be remembered, made wings of wax and feathers for himself and his son Icarus as a means of escaping from the island of Crete. It was an impious thing to differentiate himself from common mortals and to take on the power of a god; naturally retribution was swift. Strangely enough, however, it was his son Icarus who paid the penalty, for, being more venturesome than his father, he flew too near the sun, with the result that the wax melted and he returned precipitously to his natural environment on the shore of the sea that bears his name.

Such tales are found in the myths of every civilization. In the Indian classic *Mahabharata,* one of the earliest records of man, it is recounted that Krishna's enemies

> built an aerial chariot with sides of iron and clad with wings. The chariot was driven through the sky till it stood over Dwarakha . . . and from there it hurled down upon the city missiles that destroyed everything on which they fell.

Thus the militaristic import of flight was realized at an early date.

From China, where kites were flown for centuries before

Christ, come legends of the "Yu Min" or flying folk, and it is recorded that about 2220 B.C. the Emperor Shun possessed the art of flying like a bird.

There are numerous books from which the curious may collect such legends. They are chiefly of interest in establishing that, although man has dreamed of flight throughout the ages and probably broken many bones in fruitless efforts to materialize this dream, flying was, until quite recently, but the dream magic of the storyteller.

The writings of such scholars as Roger Bacon in the thirteenth century, Leonardo da Vinci in the fifteenth, John Wilkins, Lord Bishop of Chester, one of the founders of the Royal Philosophical Society, and his contemporary, G. A. Borelli, an Italian scientist of the seventeenth century, show that serious consideration of the practicability of human flight, coupled with the close observation of the mechanism and flight of birds, was common throughout the Middle Ages. Bacon wrote:

> Yea, instruments to flie withall so that one sitting in the midst of the instrument, and doe turne an engine, by which the wings, being artificially composed, may beat the ayre after the manner of a flying bird.

He also proposed a lighter-than-air craft, now called an "aerostat" or a balloon, in the form of a large hollow metal globe filled with "ethereal air or liquid fire."

Da Vinci in his writings and sketches gave actual designs for wing-flapping machines operated by muscular effort. He made a minute study of the anatomy of birds, and in his second design he provided for the use of the legs, as he realized that the arm muscles alone would prove inadequate. With the help of his enthusiastic and loyal assistant, Zoroastro, he built one of these machines. Before it was completed he became convinced of its inadequacy and, realizing the importance of stability and control, he searched for a design of a suitable tail-organ. Zoroastro, however, would entertain no such doubts and, against the express orders of his master, he ventured from the top of a barn equipped with the uncompleted wings. He was, apparently, so badly crippled by his resulting fall that da Vinci was discour-

aged from further practical experiments in the technique of flying and returned to his pursuit of art.

There can be little doubt that da Vinci was primarily debarred from visualizing, hence constructing, the prototype of the modern airplane by the lack of a suitable power unit, for he had a clear conception of the screw propeller, and he had constructed model helicopters or vertical lifting-screws of paper and wire driven by springs which actually lifted themselves in the air, in the manner of the modern flying top driven by elastic or by firework squibs. He also conceived the parachute, which he described in the following words:

> If a man carry a domed roof of starched linen eighteen feet wide and eighteen feet long, he will be able to throw himself from any great height without fear of danger.

He does not appear, however, to have interested himself in balloons, probably because he could not imagine a fluid lighter than air. Bacon's reference to "ethereal air or liquid fire" suggests an appreciation of the levity of heated air or flame, but it is highly unlikely that da Vinci was familiar with the writings of his English precursor.

Bishop Wilkins, in a book called *Dædalus, or Mechanical Motion,* described four methods by which man might fly: as an angel or spirit; by the help of fowls; by wings fastened to the body after practicing from infancy as do the birds; in an aerial chariot with spring-operated wings. He seems to have considered the machine the most practicable method, but apparently he did not attempt a detailed design.

Borelli, an Italian scientist, who was in correspondence with Wilkins, resumed da Vinci's study of the bones and muscles of birds. In his writings published in Rome in 1680, some years after the learned Bishop's book, he discussed the anatomy and weight of man, and came to the following emphatic conclusion:

> It is impossible that men should be able to fly craftily by their own strength.

In all these learned discussions the idea of flying downward, without motive power to maintain height, is singularly lacking, except in da Vinci's conception of the parachute. Yet man, like

the flying animals, had to adopt that method, as we shall see, before he finally mastered the art.

With the Middle Ages historical records of unco-ordinated efforts to fly begin to replace the earlier myths and legends. Yet the similarity of the stories suggests the probability that at least some of the myths had a foundation in actual experiments, and that man had been venturing sporadically upon these experiments throughout the ages.

Gliding models, such as children make with paper, have probably been made since time immemorial; they were possibly so commonplace as to escape the attention of historians. More ambitious model experiments have, however, been frequently recorded. There are many references in early Greek writings to a wooden dove made by Archytas of Tarentum about the year 400 B.C. The following account seems to be the clearest. It is from an English translation titled *Attic Nights of Aulas Gellius:*

> Many men of eminence among the Greeks, and Favorinus the philosopher, a most vigilant searcher into antiquity, have, in a most positive manner, assured us, that the model of a pigeon formed in wood by Archytas, was so contrived, as by certain mechanical art and power to fly; so nicely was it balanced by weights, and put in motion by hidden and enclosed air.

This exploit is said to have excited more discussion among scientists and philosophers for two thousand years than all the attempts of men to fly! The solution generally suggested was that some form of motor is implied by these words, such as a compressed-air engine. The description might, however, suggest an early wind tunnel and an aerodynamic balance for measuring the forces on a suspended model. The idea of moving air past an object so that the object floats like a boat anchored in a stream does not seem ever to have suggested itself to those who argued so heatedly about this early record.

The story of an "aerostol" which flew from Mount Pilatus in Switzerland to Lyons, about A.D. 800, has a mythological flavor, but the statement that its occupants were sentenced to death as sorcerers reminds us that flying accidents were not the only risks

which these early experimenters had to face. The same risk is illustrated by the story of Elmerus, an English monk who is said to have glided an eighth of a mile from the roof of a cathedral about A.D. 1065 and to have been imprisoned for his impiety.

In the fifteenth century, Giovanni Batista Dante, an Italian mathematician, seems to have made many successful glides over Lake Trasimento, showing a wise choice of his terrain for a possible crash. He apparently attempted a more spectacular demonstration by leaping from the highest tower in the city, broke his leg, and abandoned further experiments.

In the year 1678, a French locksmith named Besnier constructed a curious flying machine with which he made successful short glides from a low altitude. After selling this model to a traveling showman, he built a second, with which he is said to have glided from a garret over a near-by cottage. There are many drawings depicting the Besnier machine, but, as the amount of supporting surface shown in these drawings is grossly inadequate, they may be taken to be schematic sketches made from a description rather than from a firsthand knowledge of the apparatus. According to these drawings, Besnier carried two poles across his shoulders with cords connecting the rear ends to his feet. On the front and rear of each pole were two hinged flaps arranged to open flat when they descended and to close together when they ascended. It may have been disappointment at his inability to operate these surfaces as flapping wings that discouraged the craftsman, for he apparently abandoned his efforts unscathed.

The Marquis de Bacqueville, at the age of sixty-two, attempted in the year 1742 to fly from his mansion across the river Seine to the garden of the Tuileries. He fell into a barge occupied by several Parisian laundresses, broke his leg, and injured some of the laundresses. His apparatus consisted of four large paddles fixed to his hands and feet. Such attempts as his, ridiculous in their conception, must have increased the resentment which mankind habitually bears toward pioneers.

The stories of these foolhardy and crude attempts to master the air are legion. They were doomed to failure because the

required technique had not yet developed. Mankind had still to learn the value of printing as a means of storing up experience for the benefit of future generations. Simple arts that could be widely practiced were passed on from father to son, but technically man was still a child. Not only had he not learned to calculate and to measure, he was not even aware of the necessity to do so. The Marquis de Bacqueville, in spite of his years, was, in technique, a typical child, and typically unaware of his limitations.

Flying is not a childish business, and it had to wait for civilization to grow up and to be educated before it could become more than a childish dream.

CHAPTER VI

FLYING—THE SCIENCE

THE EIGHTEENTH CENTURY CHANGED the whole character of man's approach to the problem of flying. Man as a socially organized animal undertook the task of conquering the air by scientific methods. Each worker in the chain of pioneers now learned from the accumulated experience of his predecessors and in turn contributed his quota to the growing pool of knowledge. The necessary communication of ideas and data for the application of this method was of course due to the prevalence of printing, which, three hundred years after Caxton, was making itself felt. Theorists and practical experimenters contributed alternate steps to the progressive advance of the science of flying, as they were doing in other realms of knowledge and technique.

1. THE INFLUENCE OF THE SCIENTIFIC METHOD

Moreover, the growth of trading led to a freer exchange of ideas and literature, thus making knowledge of previous progress generally available to all who were interested. At the same time

flying, in common with other improved methods of transport, acquired a definitely economic significance. Financial support for experiments thus became available, at first from wealthy individuals, then from public subscriptions, and later from governments as the military importance of the dawning science became apparent.

Here it is possible to give only the merest outline of the growth of aeronautical science.

The classification of flying machines into the two categories of heavier-than-air machines and lighter-than-air machines was made, as has been noted, as early as the thirteenth century by Roger Bacon.

Both classes of machines derive their support from a difference in the air pressure on the top and the bottom. In the case of the lighter-than-air machine this difference in pressure arises from the decrease of air pressure with increasing height, which is exactly analogous to the change in water pressure with depth beneath the surface. The lighter-than-air craft thus necessarily has considerable depth in order to avail itself of a sufficient difference in pressure which, taken over its area, will support the weight of the structure and of the gas with which it is filled. Its support is independent of motion, and may be called flotation. The support of a heavier-than-air craft, on the other hand, is derived entirely from motion.

Just as the forces of water are divided into hydrostatic forces (due to static pressure) and hydrodynamic forces (due to fluid motion), so the forces of air are divided into aerostatic and aerodynamic forces. The lighter-than-air craft is thus an aerostat, and the heavier-than-air craft has by some writers been called, quite logically, an aerodyne.

2. THE DEVELOPMENT OF HEAVIER-THAN-AIR MACHINES

Six types of aerodynes, or heavier-than-air craft, are now known, although the last two have not yet been developed to practicable forms. These types are: the parachute, the kite, the airplane, the autogiro (or windmill plane), the helicopter (or vertical lifting-screw), and the ornithopter (or wing-flapper).

All of these, except the parachute, depend ultimately on a common aerodynamic feature, in that the supporting force is derived from the inclined motion of a plane or aerofoil through the air.

The planes may be thin sheets, as in the kite, or they may be nicely shaped, covered structures like modern airplane wings. These wings may be cambered or curved, and in the case of a thin wing considerable advantage in the maximum lift force attainable can be obtained by this camber.

The motion, in common with all translatory motion, is relative—*i.e.*, it matters not whether the air is moving past the surface, as in a wind tunnel or as in the case of a kite, or whether the surface is moving past the air, as in the case of an airplane or airscrew in flight.

When the aerofoil, as it is now called, is inclined at a small angle to the wind, it deflects the air and imparts momentum to it in the downward direction. The reaction to this momentum change supplies the supporting force, or lift, as it is called. (At one time it was called "cross-wind force.")

Measurements of the pressure on the top and bottom surfaces of an aerofoil, by means of exploring holes connected to gauges, have established that about two-thirds of this lift is derived from suction on the upper surface.

The existence of such a "cross-wind force" has been known ever since men have flown kites or had their hats blown off. The sailboat is an application of this same force. Although this force has been known for so long, classical hydrodynamics of the mathematically amenable fluid (called quaintly the "perfect" fluid) supplies no assistance, since it proves that such a force cannot exist! It is only in recent years that, through the work of Prandtl at Göttingen, following up the earlier work of Lanchester in England, it has been established that the fluid friction of air (which is to the mathematicians an "imperfection," since it renders it most intractable to mathematical treatment) permits it to circulate round the aerofoil, causing an increased velocity on the top surface and a reduced velocity on the lower surface. With this amendment classical theory came into its

own again, for it was known that a reduction of velocity leads to an increase of pressure and vice versa.

The parachute also derives its lift from the "imperfection" of air, since, like the aerofoil, it is subject to no force in a "perfect" fluid. In this case the air fails to follow the difficult passage round the edge of the parachute and inwards over the top surface, with the result that a following wake is established on the top. The wind pressure on the lower surface, having no counterpart on the top surface, thus supplies the supporting force or lift. The speed of descent is of course determined by that required to supply the necessary pressure for the weight carried for each square foot of the parachute surface.

Again the knowledge and use of this force, both in the sailboat running before the wind and in the parachute, preceded by centuries the understanding of its cause. The explanation that a screen stops a wind, and thus suffers a reacting force, was good enough for the men who made sailboats and for Leonardo da Vinci when he proposed the parachute. It was probably good enough for hundreds of men who, like Faust Veranzio in 1617, jumped from high walls holding something resembling a large umbrella.

Evidence of the probability of unrecorded cases of this exploit is given by the story of a well-known airplane pilot of today who, at the age of twelve, detached a large umbrella from his father's pony cart and jumped with it from a fifteen-foot wall. The age and weight of this experimenter, together with the limited height of the wall, saved him from serious consequences when the umbrella turned inside out. The reproof of his father supplied the further discouragement which all such experimenters must have received from their fellowmen.

Da Vinci virtually started the known literature of aerodynes. The fact that he gave a reasonable estimate of the area required for a man-bearing parachute suggests that he had conducted model experiments, as indeed many people have with a small weight attached to a linen handkerchief. Unfortunately, like so many of the pioneers, he was obsessed by the ornithopter or flapping-wing machine. Borelli's anatomical researches should

have discouraged further pursuit of the manually operated ornithopter, but, as we have seen, it was not until the eighteenth century that the literature of the subject became important.

Sir George Cayley, an English gentleman of independent means, born in 1774, devoted his life to serious study of the problem. He confirmed Borelli's conclusions on the inadequacy of man's muscles and, after experimenting with the flying tops or model helicopters described by da Vinci, he passed on to the serious study of aerofoils and the problem of gliding flight. From the kite he learned the lesson of relativity applied to lifting surfaces. He ascertained that, for thin aerofoils, a cambered wing can be inclined to give a greater lift before the flow breaks away than can a flat surface. (Camber is of much less importance for the relatively thick wings which are in use today.) His outstanding contribution to the subject, however, was his appreciation of the importance of stability—the property of recovery after a disturbance, such as a gust. As a result of his researches he built gliders which were prototypes of the modern monoplane and biplane. He realized that the supporting force was a cross-wind force derived from relative motion, and that gliders in still air must derive their propulsion from the force of gravity by gliding downhill; and he measured the angle of descent of his gliders as approximately eighteen degrees. He observed that

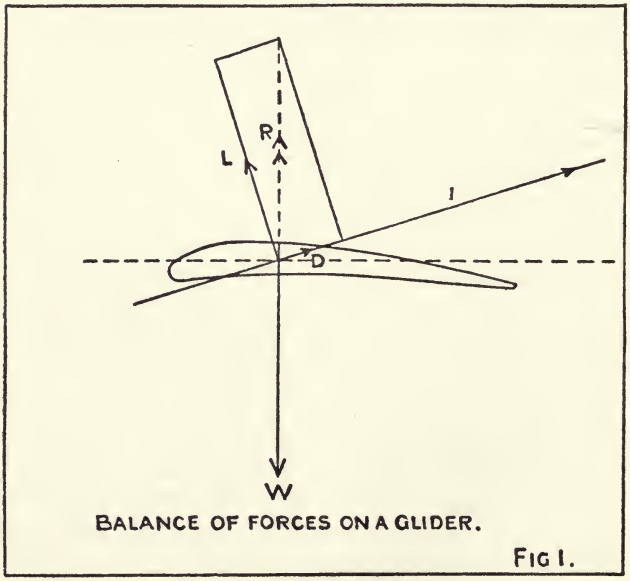
> the whole problem is confined within these limits—viz., to make a surface support a given weight by the application of power to the resistance of the air.

A study of Fig. 1 will clarify this condensed statement of the problem of dynamic flight.

The aerofoil or wing is subject to a "cross-wind force" or lift designated by the arrow-line L. It is also subject to a down-wind force or drag designated by D. The resultant of these two wind forces, R, balances the weight of the glider W. Thus the weight is supported by the relative motion. It is clear that the resultant R, owing to the presence of D, can be vertical only when the relative wind is inclined upward as along line 1. Thus without the application of a driving force to counter the drag, the glider must, like an unpedalled bicycle, proceed on a down-

ward inclined path. It may be noted that, when the propulsive force is greater than the drag, the position is reversed and the airplane can climb.

Stability in pitching Cayley provided by the now well-known tail-plane, which acts after the manner of a weathercock. He also forecast control by altering the angle of the tail-plane. For directional stability he provided the tail-fin or vertical rudder.



BALANCE OF FORCES ON A GLIDER.

FIG 1.

From the birds he copied the upward inclination of the wings which is now called "dihedral." By this means the airplane or glider derives a tendency to regain an even keel; for, should it drop one wing, the resulting sideslip causes the wind to meet the lowered wing at a greater angle than the other, thus providing a righting moment.

After experimenting with smaller models, he constructed a perfectly stable man-lifting glider of which he wrote:

> It was beautiful to see this noble white bird sailing majestically from the top of a hill to any given point on

the plain below it with perfect steadiness and safety, according to the set of its rudders.

He persuaded his coachman (such is the power of a wealthy employer!) to attempt a flight on this glider. After a short run downhill into wind, the coachman took off and glided across a small valley. He preferred horses to gliders, however, and handed in his notice.

Nothing but the absence of a suitable motor prevented Sir George Cayley from forestalling the Wright brothers in achieving sustained flight with a heavier-than-air machine.

The success of aerostatic flight, which began with the *Montgolfier* hot-air balloon in 1783, diverted Cayley from aerodynes to aerostats. After designing, without constructing, elongated dirigible balloons with a number of gas-bags, such as are used today, he returned to aerodynes, and constructed a model helicopter with four lifting-screws and two propulsive-screws which still looks like a reasonable design.

Fortunately for those who were to follow his trail, Sir George Cayley left ample records of his work. He has with some justification been described as "the father of aerodynamics."

The problem of dynamic flight was now clearly formulated. The lifting aerofoil or wing was sufficiently understood, also the need for stability and control. Man-carrying gliders were practicable for any experimenter of the required courage who cared to study the literature. Gliding flight, however, did not apparently fire the imagination of many researchers, and attention was mainly directed to the problem of providing the motor required to sustain the forward speed necessary for support without progressive loss of altitude.

William Samuel Henson, at first alone and later with the assistance of John Stringfellow—both gentlemen of leisure in Somersetshire—took up the problem early in the nineteenth century. They proposed the steam engine as the motive power, and built flying models with light steam engines which apparently achieved sustained flights for short distances in Stringfellow's lace factory at Chard.

One such successful model built by Stringfellow, after Hen-

son had gone to America, bore a close resemblance to the modern airplane. It had a wing area of fourteen square feet and an all-up weight of eight pounds, giving a loading of six-tenths pounds per square foot. The modern airplane, with a correspondingly higher minimum speed of flight, is loaded to about twenty pounds per square foot. We may deduce that the minimum speed of flight of this model was about fifteen miles per hour. The power plant was a single-cylindered steam engine with a bore of three-quarters of an inch and a stroke of two inches. It drove two four-bladed airscrews geared to revolve at three times the engine speed. These model flights were achieved in 1848.

Meanwhile, in spite of, or perhaps because of, the successful advance of aeronautical science and the achievements of ballooning, the idea of the man-operated ornithopter still attracted attention, and many imaginative but unscientific persons produced unsuccessful machines of this kind. Their work must be passed over in a short review of the main line of aeronautical advance.

Experiments in gliding were continued in 1855 by a retired French sea captain, Le Bris. He had been impressed, while at sea, by the gliding feats of the albatross, and, after experiencing the lifting force when he held a stuffed albatross with its wings outspread to a breeze, he decided to build a man-carrying glider of the same form. In spite of a broken leg sustained in his experiments, he continued, and met with some success. As a means of launching his glider he employed a horse-drawn cart trotting into the wind. Later he employed a scaffolding and lifting-tackle to obtain the required height. He also flew one of his gliders as a kite, thus linking up the two arts. His very promising experiments were terminated, like so many others, by shortage of funds.

The latter half of the nineteenth century witnessed an intensive study of the problems of flight. Many successful model gliders were produced, and at the first meeting of the British Aeronautical Society in 1866, Francis Herbert Wenham read a learned paper setting forth many of the principles of the modern

airplane. He also constructed the first recorded wind tunnel for studying the action of the air forces on a suspended model.

Model flying machines with the familiar rubber-band form of motor were produced by an invalid French mathematician, Alphonse Penaud. These first took the form of helicopters, and later of airplanes with screws made of two stiff feathers. The latter form was widely sold as a toy and was known as a "Planophore."

In 1876 Penaud patented a biplane with control organs and most of the features of the airplane as now known. Shortage of funds, however, precluded him from attempting to construct this machine, and in despair he committed suicide.

There are numerous records of further attempts to produce power-operated helicopters and ornithopters, but the next big step forward was taken by the brothers Otto and Gustav Lilienthal of Germany, who began, as schoolboys, experimenting with man-lifting gliders. These experiments were interrupted by the Franco-Prussian War of 1870, but Otto continued his researches, an account of which he published in 1889. After a close study of gliding birds and various experiments, he directed his attention to the fixed-wing glider and attempted to solve the problems of control by practical gliding experiments. Between 1891 and 1895 he accumulated about five hours of gliding experience as the aggregate of numerous short glides on various machines. During this period he progressed from a simple wing, controlled entirely by gymnastic body movements, to a glider with stabilizing fins and a controllable elevator or flap on a horizontal tail-fin.

He then designed a two-and-a-half-horsepower motor, weighing about ninety pounds and driven by compressed carbon dioxide. Before attempting to fly a machine to which this was fitted, he was killed through an error of judgment in controlling his glider. The accident was probably the first of a series of such accidents caused by a maneuver which is now known as a "stall." When the angle of attack of an aerofoil is increased, the lift force at first increases in proportion, enabling flight to be maintained at a slower speed. Beyond a limited angle of about

twenty degrees, however, the stream separates from the upper surface of the aerofoil, causing a sudden loss of lift. The result is a fall until sufficient speed has been attained to enable the machine to become air-borne again at a conventional angle of attack, or angle of incidence, as the angle of attack is now called. Without an elevator or pitch control such an accident would be difficult to produce. Lilienthal's death was, therefore, paradoxically the result of a control failure caused by the presence of a control.

His work undoubtedly contributed largely to the success of those who followed him, and his long record of successful gliding shattered the superstitious belief that men could never fly. Although he studied assiduously the gliding flight of birds, he appears to have neglected the literature of his subject; for he should not have had to rediscover the tail-organs, which had been clearly established by Sir George Cayley. Moreover, his powered machine was intended to be driven by an absurd arrangement for flapping its wing-tips, although the screw propeller was already well known. Thus he was an intelligent student of nature rather than a scientist.

By the time Lilienthal was killed, numerous people in many countries were working both on the gliding problem and on the provision of a suitable motor. Professor Montgomery, Langley, and Chanute in America, Hargrave in Australia, Pilcher and Maxim in England, Ader in France, and many others contributed their quotas to a rapidly growing science of aerodynamics.

Sir Hiram Maxim brought his scientific engineering genius to bear on the problem, and set to work to design a steam engine of three hundred horsepower to satisfy himself that the required propulsive effort could be achieved on a practicable scale and with a practicable weight of power unit and structure.

Maxim was driven by an interest in the development and sale of machinery for war. In the airplane he saw immense possibilities in this direction, and hence he was prepared to hazard a considerable sum of money in the expectation of large profits from the sale of a new and potent weapon. His economic interests thus

prompted a more farseeing view than that of contemporary militarists.

He believed that airplanes would never serve any useful purpose in peace, and he vigorously decried the potentialities of airships, declaring: "The helpless dirigible [balloon] is to the air as is the jellyfish to the sea."

With his characteristic acerbity, he disposed of the efforts of the bird emulators with the remark: "If aeroplanes should be built like birds, then locomotives should be built like horses." Lilienthal he dismissed as "the flying squirrel" or a "mere parachutist." After Maxim's *Colossus,* with 5,550 square feet of wing area had, in 1894, lifted clear of its supporting rails, brushed aside the guard-rails intended to prevent it from rising too far, and crashed when the power was immediately cut off, Lilienthal retorted that Maxim had accomplished a great deal by teaching man how not to fly!

Nevertheless, Maxim's work, in conjunction with that of Lilienthal and the host of others who were now working on the problem, had established clearly that man could fly. The first airplane race had started—the race to be the first to control an airplane in flight under its own power. Gliding was an accomplished fact, power "hops" had been made, the internal-combustion motor was emerging as a successor to the steam engine. It remained only to go in and win.

But humanity at large scoffed at the efforts of these pioneers, and the scientific pundits proved conclusively that the thing could not be done.

A rare admixture of scientific precision of method, romantic imagination, and physical and moral courage was required to complete the conquest of the air; furthermore, the gifted experimenter had to be in possession of the necessary funds. Naturally, therefore, the entrants for the race to fly were comparatively few. Naturally also, America, with its pioneering outlook and comparative freedom from the dead hand of conventional learning, was to provide the winner. On December 17, 1903, a strange contraption of bamboo and linen with a clanking in-

ternal-combustion motor, bicycle chains, and two propellers, carried Orville Wright into the air from the slope of Kill Devil Hill, Kitty Hawk, North Carolina. He and his brother Wilbur, two bicycle dealers, possessed all the required characteristics and, after seven years' hard work, they had won the race.

Samuel Pierpont Langley, an eminent scientist, and Secretary of the Smithsonian Institution, might have been the winner had he been less of a man of science and more of an adventurer. He had been engaged on the problem since 1889, when his interest was aroused by one of Stringfellow's engines which was presented to the Smithsonian Institution. After some years' work, he succeeded, in 1895, in flying for six seconds a model airplane which he called an "aerodrome" under the power of a small steam engine which he had designed for the purpose.

Passing on to larger models, he built one weighing twenty-seven pounds with a span of thirteen feet and a steam engine developing one and a half horsepower. By the end of 1896, this model had made a flight of nearly a mile at thirty miles per hour. As Maxim had done, he used a whirling-arm for the purpose of driving supported models through the air and measuring the forces on them.

The United States War Department was quick to see the importance of his achievements and subsidized his researches with $50,000 to produce a man-carrying plane. Dissatisfied with the weight of a steam engine of the required power, Langley and his assistant, C. M. Manly, produced a radial gasoline motor. It had five cylinders and developed sixty-two horsepower at a speed of 950 revolutions per minute. Its weight, including a radiator, was only two hundred pounds.

The completed full-sized "aerodrome" had a wing area of 1,040 square feet and weighed only 830 pounds. It was an exact replica of his most successful model, and had two wings mounted one in front of the other in tandem. A quarter-scale model was successfully flown in August, 1903, a catapult being employed to launch it.

In October the full-scale "aerodrome," manned by the intrepid Manly, was launched from a spring-driven catapult on

the top of a houseboat on the Potomac River. In the words of one of the eyewitnesses, it "slid into the water like a handful of mortar."

Manly was unhurt, and he and the bitterly disappointed Langley toiled day and night, analyzing their failure and preparing for a second attempt. Two months later, on December 8, 1903, nine days before the Wrights' successful flight, the ignominious failure was repeated.

Langley ascribed both failures to parts of the supporting structure fouling the machine during the launch. He might be excused one such oversight—professors are proverbially absent-minded—but two such excuses in succession suggest that his faith in his "aerodrome" excelled his judgment. The fact is that his approach to the problem was too academic and, as Maxim had done, he scorned the practical experience which the Wrights and Lilienthal had accumulated on gliders over about five years.

The Wrights, before they attempted a power flight, had made themselves the most experienced gliders in the world. They had also found the whirling-arm data provided by Maxim and Langley unreliable, and had built themselves a wind tunnel to make their own aerodynamic measurements.

Characteristically the scientists Maxim and Langley believed in inherent stability—the property of unaided recovery from disturbances—and Lilienthal and the Wrights believed in control and pilotage. Indeed, the Wrights, seeing that stability tended to make the machine respond to every change in the direction of the wind, aimed at the elimination of this quality with a view to minimizing the amount of control required. They did not abandon the weathercock fins which others had found necessary, but they made them movable as rudders and, to avoid a stable rolling moment when the machine side-slipped, they swept the wings down toward the tips instead of using the conventional upsweep called "dihedral." After thirty-three years of flying, these ideas are again attracting attention.

Instead of the ailerons or wing-flaps which are now used for lateral control, the Wrights employed an ingenious system of warping the wings, which suggested itself from the handling of

a cardboard box used for packing bicycle tubes. In this they were emulating the system of lateral control used by birds, which they studied as assiduously as Lilienthal and many other pioneers had done. The modern airplane, with its stiff wings, is subject to heavy twisting loads, especially when the ailerons are used at high speeds of flight. As the size and speed of airplanes increase the required structural weight, it is becoming more important to prevent the ailerons from twisting the wings to such an extent as to counteract the effect of the ailerons, and it is possible that airplane designers may soon have to dispense with ailerons and revert to the Wrights' idea of warping the wings.

For control in pitch the Wrights used a movable small plane or elevator in front instead of the conventional tail-plane. Such an arrangement possesses a great advantage on the score of safety, for, when the angle of incidence of the main planes is increased by such an elevator, the latter will stall first. It is not improbable that this feature is responsible for the Wrights' escaping the fate of Lilienthal and hundreds of others who have been killed as the result of the stalling of airplanes. The autogiro of today owes its origin to the late Señor de la Cierva's desire to provide an aerodyne which could not be stalled. Years of research have been devoted to the problem, but still the stall collects its victims, and the official investigators classify the accidents as caused by "an error of judgment of the pilot."

The historic first powered flight of Orville Wright lasted twelve seconds, and he covered a distance of 120 feet against a wind estimated at twenty miles per hour. Four such short flights were made by the brothers in turn, in the last of which Wilbur covered 852 feet in fifty-nine seconds. A few minutes after landing, the airplane was blown over by a gust and partly wrecked. The speed of the machine must have been about thirty miles per hour.

The Wrights' plane had literally no reserve of power—the engine developed between twelve and fifteen horsepower. Consequently any sideslip, caused by an attempt to turn, was bound to cause a loss of height which could not be afforded, since the

machine was always close to the ground. The brothers therefore devoted themselves to increasing the motor power and to perfecting their skill in turning with just sufficient banking to avoid slipping either outwards or inwards.

Progress was slow, and by the end of 1905 they had exhausted their meager funds. They had, however, increased the speed of their plane to thirty-four miles per hour and covered twenty-seven miles in circling flight at Simms Station near Dayton.

The original Wright airplane has often been referred to in patronizing terms, and some have even written disparagingly of its creators, suggesting, in the light of the developments in design which quickly followed in France, that their success was something of a fluke. Such criticisms betray a lack of insight and knowledge on the part of the critics. The Wrights, by their thoroughness, clear-sightedness, courage, and persistence, earned the imperishable distinction of being the first men to fly an airplane.

3. THE DEVELOPMENT OF LIGHTER-THAN-AIR CRAFT

One hundred and twenty years (1783) before the historic flight of the Wrights, two French brothers, Joseph and Etienne Montgolfier, had produced a man-carrying balloon in which Jean François Pilatre de Rozier had made a successful flight. The balloon was made of paper and linen, and was filled with air heated by a fire carried on an iron grate below the open mouth.

Ballooning rapidly became a craze in France and spread to other countries. On January 7, 1785, Jean Pierre François Blanchard, financed by a Dr. Jeffries, crossed the English Channel in a hydrogen balloon, with his backer as a passenger.

But mere drifting did not satisfy the ambitions of even these earliest balloonists, and most of them attempted to control their craft with oars. Some even revived the old illusion that balloons could be sailed like a ship, regardless of the fact that a balloon drifting with the air currents experiences no relative wind.

For nearly a hundred years little progress in aerostats, or lighter-than-air craft, was made, although they were used in

practically every war, either flying free for conveyance or tethered for observation. In America, Professor Lowe abandoned an ambitious scheme to cross the Atlantic by balloon and devoted himself to the organization of the United States Army Aeronautic Corps for service in the Civil War. In this war he made about three thousand ascents in captive ethered balloons, and often remained aloft all day reporting the movements of the Confederate forces. In the Franco-Prussian War a French balloonist, Felix Nadar, formed an organization named the *Ballon Poste,* for conveying mail and passengers out of beleaguered Paris. Finally, when the fall of the city seemed imminent, the entire Government escaped by balloon.

In France, under the stimulus of the *Ballon Poste,* the problem was being actively tackled. Aided by a Government subsidy, de Lome produced a dirigible in which the airscrew was driven by eight men turning a windlass. Colonel Renard, with a subsidy of 200,000 francs from the French Government, using an eight-and-a-half-horsepower electric motor, produced the first successful dirigible, *La France,* which achieved a speed of fourteen miles per hour round a circular course.

Schwarz produced the first rigid airship with an internal lattice framework and an aluminum skin. His first design collapsed when he attempted to inflate it, but a second design made a successful flight of four miles in 1897 before being destroyed on the first landing. It was powered by a two-cylinder Daimler gasoline motor.

Many other attempts were made and several experimenters met with disaster, but in the beginning of the twentieth century, simultaneously with the development of the airplane, Santos-Dumont and Count Zeppelin, working on very different lines, developed the airship to a practicable stage. As in the case of the airplane, the final step depended upon the modern gasoline motor.

In spite of the extent to which Zeppelins were used by the Germans in the European War, and in spite of the success of the post-War *Graf Zeppelin* and of many other large rigid air-

ships, the long history of disasters of these craft, typified by the loss of the *R.101* in 1930, together with their unquestionable vulnerability in war, suggests that aerostats are but an ephemeral stage in man's conquest of the air.

Lighter-than-air craft must be large and frail to carry a really useful load. Their bulk precludes them from competing with the airplane for speed, and their frailty appears to doom them to destruction when really adverse weather conditions are encountered. It must be admitted, however, that the chief obstacle to their development at present is their high cost and their relative vulnerability in war.

Since civilization, in its present phase, can spare no considerable sums for any purpose other than defense in the apparently inevitable clash of competing imperial powers, and since the further development of airships involves colossal expenditure, it is probable that little progress will be made until the advent of a new social and economic order in which the impetus for development is derived from the needs of peaceful activity.

In this connection, it is of interest to note that, during 1937, the only country to develop the airship has been Soviet Russia. In October, 1937, the Soviet airship, *U.S.S.R. V6,* completed a flight of 130 hours, 27 minutes. This is claimed to be a record flight.

CHAPTER VII

WAR DOMINATES DEVELOPMENT

FROM THE FOREGOING SKETCH of the prenatal history of flying it is clear that romance was its father and scientific technique its young mother. Romance, although biologically an ideal father, proved too impractical to provide for the latest addition to his family in the cutthroat capitalist world of the twentieth century. The newborn infant would have fared badly had it not been immediately adopted by military strategy.

The foster father was at first highly dubious about the utility of the infant, but could not afford to let it die. Militarists are proverbially shortsighted and spend most of their time preparing for the last war. They are, however, forced to keep abreast of the technical developments of their rivals, and they have an unlimited call on finance.

1. EUROPE PREPARING FOR WAR

Little attention was paid at first to the work of the Wright brothers. Dirigible balloons were achieving much more spectacular flights, and the journalistic world was slow to realize the important difference of aerodynamic flight. The Wrights themselves wanted little publicity until they had reached a stage when they could exploit their invention with confidence. As Wilbur characteristically remarked: "The parrot talks the most, but is not a bird of high flight."

The United States Government, after backing a loser in Langley, was slow to come to the assistance of the Wrights, who consequently sought assistance from Europe.

The British War Office informed them that it "was not prepared to enter into negotiations with manufacturers of flying machines." The British War Office was perhaps wise in not officiously striving to develop a weapon which was destined to destroy the strategic advantage of Britain's insular position. That the decision was more likely due to lack of vision is suggested by the attitude of the Master-General of Ordnance. When at a later date he was told that an engine of fifty horsepower was required to continue experiments, he replied that if motors of such power were required for airplanes costing so much money, the idea of using aircraft for military purposes would have to be abandoned.

The French Government, however, sent a representative to negotiate with the Wrights, but for some reason no contract was arranged at the time.

By 1908 the Wrights had obtained the backing of a business syndicate; and their own Government, alarmed at their negotiations in Europe, had given them a contract to produce a military

airplane capable of carrying two men for one hour with a top speed of forty miles per hour and a fuel capacity for 125 miles. In the same year they secured a French contract for £20,000. With two new two-seater machines, Orville in America and Wilbur in France were soon making spectacular flights of over an hour, and although an accident, in which Orville was severely injured, delayed the fulfillment of the American contract until the following year, the Wrights' financial difficulties were at an end.

In the meantime rivals had arisen, particularly in France, where the Voisin brothers were building gliders, man-carrying kites, and airplanes for Archdeacon, Delagrange, Farman, Blériot, Vuia, and others. Helped by the first Antoinette gasoline motor, which developed twenty-four horsepower for a weight of 112 pounds and was produced by Levavasseur in 1906, these French pioneers were soon grappling with the first steps toward powered flight. Santos-Dumont, of airship fame, joined the camp in 1906, and within three months had won the Archdeacon Cup for the first public man-carrying flight in France of more than twenty-five meters.

By 1908, when Wilbur Wright was putting his airplane through its acceptance tests for his French contract, Delagrange, Vuia, Farman, and Blériot had achieved successful flights. Glenn Curtiss in America and A. V. Roe and Cody in England were also starting to fly.

The Wrights, flying in 1903 with a bare sufficiency of motor power, had adopted a prone position for the pilot to reduce the air resistance of drag to a minimum—there was no cockpit or cabin—and for the same reason the airplane in landing was supported by wooden skids instead of the landing wheels which are now used. The absence of landing wheels resulted also in a very material saving in weight, but necessitated flying only in the immediate vicinity of the flying field.

The French pioneers, having a little more motor power, started straightaway with landing wheels, with the result that by the end of 1908 they had achieved cross-country flying.

A new source of finance and stimulus soon appeared in the

form of prizes for specific achievements offered for publicity purposes, or perhaps from purely altruistic motives, by powerful business concerns such as Michelin and by Lord Northcliffe, the founder of the modern commercialized press. Thus the *Daily Mail* offered a prize of £1,000 to the first airplane pilot to cross the English Channel, and in the same year a further £1,000 to the first British aviator to fly a circuit of a mile in a British airplane. A little later the *Daily Mail* again was offering prizes of £10,000 to encourage British aviation, and it was stated in 1930 that no less than £50,000 had been presented in prizes for aviation by this enterprising journal.

On July 25, 1909, Blériot crossed from Calais to Dover in a small monoplane, qualified for the *Daily Mail* prize, and thereby ended the strategic insularity upon which, more than upon any other factor, the might of Britain depended.

Blériot immediately became the idol of England. Perhaps one or two Englishmen who failed to respond to the general jubilation were conscious of the historic significance of the event. Thirty years have passed, and the power of Britain has been challenged once since then; but during the years of the European War the military airplane was but a half-fledged eaglet learning to fly.

The period between 1909 and the beginning of the European War in August, 1914, was one of startling advance in the technique of flying. Financial support was plentiful. Other powerful newspapers offered large prizes for races or for specified achievements in various countries. Flying meetings were organized in one country after another, and the public flocked to see these death-defying pioneers looping the loop and displaying their prowess in other ways. Often there were fatal accidents, but as long as they were not too numerous they merely whetted the public appetite for thrills.

All the time the design of airplanes was progressing rapidly from the primitive structures of bamboo and wire toward the modern enclosed and streamlined version with which we are familiar today. The original precarious position of the pilot, perched on a seat exposed to the full blast of the wind, or lying

on an exposed platform, gave place to the cockpit with a windscreen to protect the pilot's head. The structure carrying the tail was covered in with fabric to form the fuselage. The controllable elevator in front of the Wrights' machine was found to be too sensitive, and the rear tail-plane, with hinged flaps to serve the function of elevators, became general.

From the first, the French school paid more attention to stability and less to control than the Wrights had done, and in time the controversy was more or less settled by providing both stability and control about all three axes—*i.e.,* in pitch, in yaw, and in roll.

Monoplanes vied with biplanes, but the latter were generally favored, as they lent themselves to lightness of structure on account of the depth of the girder provided by the spars of the top and bottom wings, the interplane struts, and the diagonal bracing wires.

Blériot continuously advocated the monoplane structure, but, when looping and inverted flying began, the monoplanes frequently broke up in the air. Blériot, with commendable scientific detachment, investigated the problem, and published to the world that the monoplane was inherently weak if the wings were subjected to a download. The advantage in low wind resistance which the modern internally braced, or cantilever monoplane, as it is called, possesses was of minor importance at the low speed of flight which was then attainable, and the biplane was rightly standardized as the practical line of advance.

While most pilots were devoting themselves to the spectacular aspects of flying, a few were trying to develop the utility of this new toy, particularly for military purposes. Thus Fabre in France and Curtiss in America demonstrated the practicability of the seaplane on floats, extending the field of operation of the airplane from land to sea.

Eugene Ely, a Curtiss test pilot, took off from a platform on the deck of the United States cruiser *Birmingham* in 1910, and in the following year he landed on the deck of the cruiser *Pennsylvania* with the aid of arresting gear by which loaded sandbags were successively dragged into motion as the airplane

was brought to rest. After lunching on board he flew back to land, thus demonstrating that airplanes could be used from fighting ships when required. In England a start with naval aviation was also made in 1911, when Lieutenant Samson, R.N., took off from the deck of H.M.S. *Africa*.

The carrying of passengers was also begun in various countries, primarily as a means of increasing revenue. Public companies were formed. Thus in 1909 the Wright brothers floated the Wright Company with a capital of $1,000,000.

By 1910 every major nation had begun to adopt the airplane for military service, albeit grudgingly except in the cases of France and Germany, where the possibilities of aviation in war were never lost sight of. In other countries, particularly England, the military authorities were contemptuous of the new weapon, but they were compelled to give some support lest something might develop in which their lack of experience would place them at a serious disadvantage.

At the beginning of 1911 the numbers of certified airplane pilots in the principal countries were as follows:

France	353	Belgium	27
England	57	U. S. A.	26
Germany	46	Austria	19
Italy	32		

Already the efforts of the *Daily Mail* and of a few pioneers, notably Claude Graham-White, who conducted a campaign with the slogan "Wake up, England," had forced England up to second place in respect of the number of certified pilots, in spite of the shortsightedness of the authorities. Thus in 1911 Graham-White, with the sanction of the Postmaster-General, established the first air mail—between Hendon and Windsor. In the short life of this venture no less than 130,000 letters and postcards were carried on this route.

In the same year, under the auspices of the Parliamentary Aerial Defense Committee, Graham-White gave a demonstration of the military potentialities of the airplane to a number of leading Ministers of the Crown. This demonstration included

scouting, dispatch-carrying, and bomb-dropping. His efforts bore fruit in the following year, 1912, with the formation of the Royal Flying Corps with naval and military wings and a common Central Flying School. This organization replaced the Army Air Battalion which had been formed in the preceding year.

The popular craze for flying suffered a temporary setback in 1910, when Delagrange, Lefèbvre, and Chavez in France, Johnstone, Hoxsey, and Moisant in America, the Hon C. S. Rolls and Grace in England, and a number of other popular heroes met their deaths in flying accidents. In this year there were no less than twenty-nine fatal accidents. Nevertheless the setback was only temporary, and prize money continued to pour in to give a fresh stimulus. In 1914 no less than £400,000 was offered in prizes for cross-country flights in Europe alone.

By the beginning of the European War the speed of airplanes in races had increased to 127 miles per hour (the speed achieved in the Gordon Bennett race of 1913), and the altitude and endurance records of airplanes had been pushed up to the unbelievable figures of 25,780 feet and twenty-four hours twelve minutes respectively. Both these records were held by Germany. After concentrating at first on airships, in which, thanks to the successful development of a regular passenger-carrying service by Count Zeppelin, she held a very decided lead, she devoted large sums to the development of airplanes in the last few years before the War.

England, in spite of a poor start with military airplanes in 1912, when the *Cody Cathedral*—a name coined to designate the contrary of the conventional dihedral or upward sweep of the wings—was selected from a number of competitors, apparently because its antiquated, exposed seating accommodation provided a wider range of vision for the pilot than any of the competing machines, had, by the beginning of the War, scouting airplanes doing about a hundred miles per hour. The fastest of these was the *Sopwith Tabloid*, with a hundred-horsepower Gnome engine, which did 105 miles per hour.

2. AVIATION TECHNIQUE AND THE FIRST EUROPEAN WAR

At the beginning of the War, Germany and France each possessed about six hundred military planes and England 150, of which eighty-two were fit to go overseas.

Nevertheless the military authorities of all the belligerent countries had completely failed to foresee the uses to which airplanes would be put. Scouting and reconnaissance work was the only end they had in view, and no provision for offense or defense had been made. In the early stages of the War, when belligerent pilots encountered each other in the air, they merely waved their hands and passed on their way.

Numerous writers have grown lyrical about the development of aviation during the War years. The argument is on a par with the modern Fascist cult of glorification of war as the most noble occupation of man. The cold truth is that the War was demonstrably an interruption of five and a half years in the growth of the technique of aviation. This is most clearly brought out by the figures of the winning speeds of landplane and seaplane races before and after the War. Thus, in the Gordon Bennett race for airplanes the winning speed increased regularly by about twenty miles per hour each year, from 46 in 1909 to 126 in 1913. Between 1919 and 1923 the winning speed of the Aerial Derby, a similar contest, increased by seventeen miles per hour each year from the figure of 127 miles per hour in 1919. There is a break of six years in an otherwise steady increase, and the rate of increase is slightly slower after the break. These are of course average speeds round a close circuit, and are therefore less than the records for straight flight. Straight-flight records, however, show the same interruption for the years of the War and the year of exhaustion following it.

The Schneider Cup trophy for a seaplane race was first competed for in 1913, and was finally retained by England after being won in 1929 for the third year in succession. The winning speed in 1913 was forty-seven miles per hour. The winner had, however, been compelled by the judges to repeat the last lap after he had landed, and his true speed was about sixty-one. The

winning speeds show an annual rise of approximately twenty-five miles per hour throughout the whole period, with a break of five and a half years.

Fig. 2 shows clearly this break in the curves of speed occasioned by the War. It may be argued that the greatest development was naturally in military aircraft, yet, of British military aircraft, the highest speed was increased during the War only from 105 to 140 miles per hour.

No matter what record is selected for analysis—altitude, endurance, distance in one flight, or speed—the War years appear either as a period of reduced progress or as simply time lost.

Yet this period was one of feverish activity, both in building airplanes and motors and in applied research in aeronautics. This research, however, which was conducted on a vast scale in practically every country, was largely empirical in nature. Wind tunnels were hastily erected and large experimental staffs were assembled. Yet the pressure to deal with the immediate day-to-day requirements kept the research workers' minds concentrated in grooves, and there was no serious advance in the understanding of aerodynamic science.

The airplanes they produced were assemblies of bits which were tested independently without much regard for the fact that, when these bits were placed in close juxtaposition, the passing air was forced to traverse the most uneven passages. It became an established habit of thought that the drag of an assembly was generally greater than the sum of the drags of the parts assembled, and the problem involved was shelved by giving the additional drag the name "interference."

The idea of the airplane as a single body, which must part the air and allow the two streams to rejoin with the least possible inconvenience, had to wait for a decade after the War before it could be born. The application of this idea has resulted in the almost universal substitution of the monoplane for the biplane and in the recent advance in speed which has falsified all the prognostications that the limit of speed had been nearly approached. The biplane survived as military aircraft long after it had been almost universally discarded for civil purposes. With-

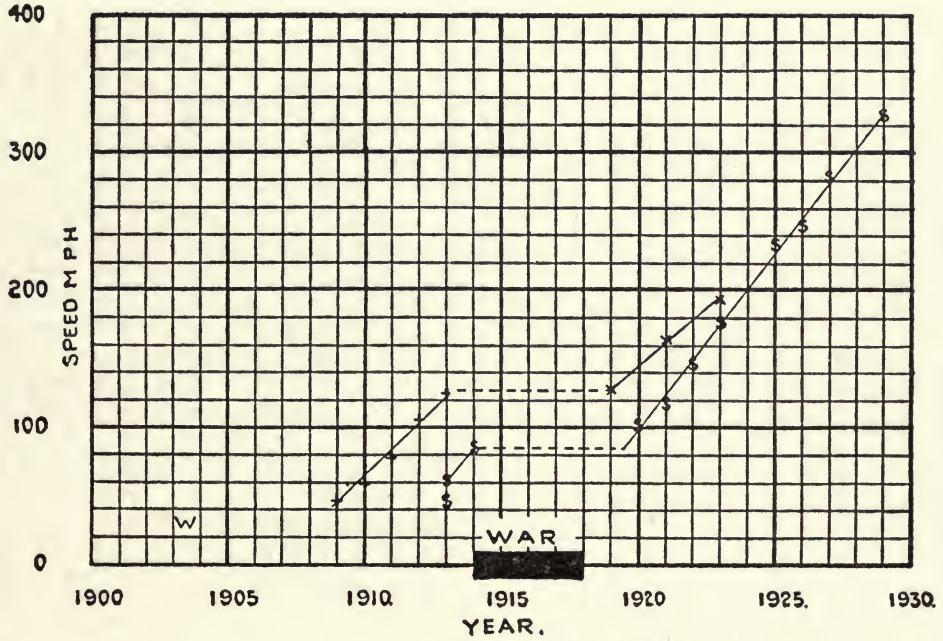


FIG 2

Curve marked "S" shows speed for seaplanes in Schneider Trophy race.
Curve marked + shows speed for landplanes in Gordon Bennett race and the Aerial Derby.
W shows speed for first flight by the Wright brothers.

out the impetus which the War gave to this type, it may be surmised that the modern monoplane would have been evolved about ten years earlier.

Only gradually, after the War, did pure research assert itself and establish a mathematical theory of aerodynamics and an understanding of the physics of streamlining. Only in the last eight years has the technical advance of airplane design resumed the rapid tempo of the pioneering years before the War, in spite of the vastly greater funds devoted to research and development. Such was the deadening effect of war on technique.

Development there certainly was in the War years. Motors grew in size and reliability. Machine guns were mounted. For some time a premium was placed on the "pusher" type with the airscrew behind the pilot, as this type permitted the machine gun to be fired in the most useful direction—straight ahead. The tractor type soon regained its predominance, when at first steel plates were attached to the airscrew blades to deflect bullets which would otherwise have shattered the blades, and later "interrupter gear" was fitted to lock the mechanism of the gun for the brief intervals while each blade passed the line of fire.

The military uses of airplanes were rapidly discovered and developed. Airplanes quickly dominated the unwieldy airships which lacked the maneuverability to avoid them. Airships were driven to fly by night, and then their sheds were bombed on the ground. The German High Command had reason to be pleased that they had not banked solely on Zeppelins.

Smaller airships, or "blimps," as they were called, proved, however, very effective at sea, where they seldom encountered airplanes, and where their ability to locate and attack submarines was invaluable.

Instead of being restricted to their original function of scouting and reconnaissance, airplanes were developed into powerful weapons of offense which could be used not only against the opposing army and its communications, but also against the civilian population and particularly important centers of industry or supply.

As bombing developed, airplanes rapidly became larger, so

as to carry heavy loads of bombs for a considerable distance behind the enemy lines. Bomb-racks and bomb-sights were developed, and as the attacks became more and more indiscriminate against extensive targets like London, the height from which the bombs were dropped was progressively increased to evade the defense of guns and fighter airplanes. The next chapter will show in some detail how the technique of aerial war on civilian populations developed during the 1914-18 period.

CHAPTER VIII

WHEN THE BOMBS FELL—1914-18

THE USE OF THE airplane and airship was gradually developed during the 1914-18 War. The air raids carried out inside this period on both sides supply the best available data on what air war really can be like. The figures of the number of planes, bombs dropped, and casualties caused have now been analyzed by several writers in various ways. Only certain essential points will be emphasized and discussed here. The raids may in general be divided into three types:

(1) "Tip-and-run" affairs, mainly one or two airplanes on East- or South-coast towns in England. These caused few casualties, but much annoyance, especially to the defending aircraft.

(2) Large-scale raids using mainly airships over Central and Northern England.

(3) Large-scale raids over London using airships and airplanes.

The first visit was at Christmas, 1914, and the last on August 5-6, 1918. The period divides easily into two sections. From December, 1914, to November, 1916, the main air weapon was the airship, while in the period January, 1917, to August, 1918, the new *Gotha* and *Giant* bombing airplanes were the basic types used. The main data of these two periods are given in the following tables.

TABLE I

Air Raids: December, 1914, to November, 1916

	Air-ships	Planes
Raids with Bombing..	42	19
Number of Machines.	160	26
Bombs:		
Number dropped ..	5,004	233
Weight in tons ...	154	2

Results	Air-ships	Planes
Killed	501	20
Injured	1,224	67
Total	1,725	87
Defense Machines used	346	
Total Damage	£1,421,916	

TABLE II

Air Raids: January, 1917, to August, 1918

	Air-ships	Planes
Raids with Bombing..	9	33
Number of Machines.	19	150
Bombs:		
Number dropped ..	802	2,539
Weight in tons ..	42	71

Results	Air-ships	Planes
Killed	56	837
Injured	134	1,991
Total	190	2,828
Defense Machines used	1,690	
Total Damage	£1,540,195	

The figures in these tables are based on the figures in the *Official History of the War,* volumes on "The War in the Air," by H. A. Jones.

Some of the airships listed as destroyed were lost in storms, not in military action. There is only one other supplement to these figures. The figures given record only the German machines arriving in England, a total of 355, while Germany sent out 101 more machines. Thus 78 per cent of the machines sent out arrived, and only 10 per cent of arrivals are recorded as being destroyed. Most of those destroyed were airships; the proportion of airplanes destroyed was only 3 per cent.

The figures in the table clearly show how the effectiveness of air attack increased during the War. It must be remembered that the raids on England were expensive to the German naval and military commands in material, men, and time. It has been argued that the small damage caused did not justify such expenditure. When the ratio of attacking to defending aircraft had to be changed from approximately 1:2 in the first period to

1:9 in the second, the progressive effectiveness of the airplane bombers over the airships is made clear. To this must be added the men, guns, sound localizers, searchlight equipment, and coastal listening-in posts which had to be maintained at full strength, even after the last raid in August. In 1918, London air defenses alone comprised 414 airplanes, 480 guns, 700 searchlights and 15,000 men. The material and men tied up in this defense would seem to be ample justification for the raids. But again we must add the amount of munitions expended in aircraft barrage work.

This is best illustrated by the data given for the last major air raid in May, 1918. Thirty-two *Gotha* and three *Giant* planes seem to have crossed the coast, of which nineteen attacked London for three hours. In spite of all the defenses described, 226 individuals were killed or injured and one thousand buildings damaged. The total monetary loss was estimated at £130,000. The defense claimed that anti-aircraft fire destroyed three planes, three were shot down by defense aircraft, one landed with engine trouble, another crashed in Belgium, and three more were reported to have crashed in their home aerodromes. Thus in all, eleven planes out of thirty-five attackers were destroyed. It is suggested that anti-aircraft fire prevented the remaining raiders from attacking London, but places in Essex and Kent were also bombed. This was looked on as a defense victory, but eighty-four first-class defense planes took the air, and the aircraft guns fired over thirty thousand shells. The planes involved in the attack had a speed of only eighty miles per hour. A defense success of this type can only mean that the loss of eleven planes to Germany at that time was sufficient to prevent her sending more planes to attack London. This was, in fact, the last important raid on England. The real reason seems to be that the situation on the Western Front demanded all the available German military resources. Also, the German military and naval staffs, like the Allied, still looked on the air raids as a side show.

Two other very important military results must be considered —namely, the direct effect of the air raids on munition produc-

tion, and their effect on the general population's "will to war." Neither the British, French, nor German General Staffs realized clearly that, while the War of 1914-18 was a war dependent on mass munition production, the airplane could be used directly to interfere with the enemy's basic munitions supplies. Had they done so, then Germany would not have concentrated her airplane attacks on a London equipped with the best available anti-aircraft defenses, when part of the vital English munition-producing area was but poorly defended against aerial attack. Nor would England have waited until June, 1918, to form the Independent Air Force.

1. EFFECT ON MUNITION PRODUCTION

The airship raids in 1915 and 1916 are calculated to have reduced the quantity of munition output by about 17 per cent, and to have decreased the quality as well. Woolwich Arsenal, in the London area, was never hit, but its output in September, 1917, was reduced 10 per cent by six air raids. In January, 1916, a false report of a Zeppelin raid stopped munition factories in Nottingham, Bath, Gloucester, and Worcester. In the same year munition workers on night work insisted that air-raid alarms be given in time to allow them to disperse. Transport was also paralyzed over a very wide area. To some extent the development of a more efficient and reliable air-warning system prevented much similar confusion in the transport industry.

The results of the Independent Air Force's bombing of Germany were equally striking. This force had a maximum of only 100 machines, which visited 106 towns in five months. In all, 700 raids were made, 330 against railways, 209 against aerodromes, 113 against factories, steel and chemical works, 48 against barracks, etc. Of the first, second, and last sections, 80 per cent of the objectives were military (tactical) and not industrial (strategic). Yet the output of munitions was greatly reduced. Transport was interrupted. The inhabitants fled from the area.

Only a few detailed figures seem to be available. During August, 1918, one shell factory which was never bombed re-

ceived fifty-three false alarms, and its output was reduced by three thousand tons. The German military were compelled to withdraw twenty air squadrons to the Rhineland area.

To defend Mannheim-Ludwigshafen from July, 1917, to October, 1918, a German squadron made fifty-four ascents. In forty-seven of these, involving 237 airplanes, the enemy planes were not encountered over German territory. In the remaining seven flights, involving sixty-three airplanes, engagements occurred in which eight enemy planes were shot down. Only once did the engagement occur on the enemy's approach and therefore prevent him from bombing his objective. The chemical works in this area were estimated to have lost two hours' production per raid, while the total casualties are reported at twenty-three killed and sixty-two wounded. The material damage was very great; the total loss, direct and indirect, was estimated at 4,000,000 marks.

Here again defense demanded about four times the number of the attacking machines, and these machines had to be withdrawn from the front line at a very critical period. Yet this use of the air attack was regarded as of secondary importance by a military command which had 30,782 machines supplied to it in 1918 alone. The effect of using even one-tenth of that supply against a vital munition supply area is now clearly recognized, but in 1918 it was neglected.

2. EFFECT ON MORALE

The drone of the airplane, the rattle of the anti-aircraft guns, the crash of the bombs, were heard by hundreds of thousands of nerve-racked people, people who had been on their guard night after night, people running for refuge into underground stations or cellars, sleeping with their clothes on, trying to protect themselves from something which came from the sky, crashing down on their heads, a mass of defenseless people without even the psychological satisfaction of being able to strike back, to fire something into the air, a mass untrained and undisciplined for defense, men and women crying out for protection not for

themselves so much as for their children, their aged, and their sick and invalid relations. All this is well known.

But what is forgotten is the mass scale on which these effects were experienced. In 1917 it was estimated that some 300,000 people spent their nights in underground railway stations, and another 500,000 slept in cellars. The mistaking of a maroon raid warning for bomb explosions caused a stampede into Bishopsgate Station. This resulted in a death toll of fourteen and another fourteen injured, mainly women and children. In Paris a similar air-raid panic caused sixty-six deaths in a Métro station.

The special nature of air attack is shown by a comparison of the results of airplane attacks in 1917 and 1918. In eight raids between May 25 and August 22, 1917, twenty tons of bombs killed 401 and wounded 983 persons. All these were daylight raids. In twenty raids between September, 1917, and May, 1918, fifty tons of bombs killed 435 and wounded 980. On the casualties basis the latter raids were only half as successful as the first. But the latter were all night raids. The psychological effect and strain created more than compensated for the relatively fewer casualties per bomb ton. This effect—the terror by night—has only too often been underestimated by technical military writers. Yet it was the protests resulting from night raids that compelled the Government to take the defense of London seriously. These same protests, curiously enough, seem to have been the final force in establishing the Independent Air Force already referred to. This force had been advocated from 1915 onward, but the military control of the new aerial weapon chained it down rigidly to its allotted place in pre-airplane military tactics.

A study of British casualties (Table III—page 104) from various war forces compared with air-raid casualties is of interest.

Therefore aerial attack was successful in producing the highest ratio of killed to wounded. These casualties were not all caused by bomb explosions. In some raids 50 per cent of the casualties were due to anti-aircraft defense shells. Normally such casualties represented about 20-25 per cent of the losses in the later period.

TABLE III

Casualties

	Percentages		
	Killed and Died	Wounded	Missing and Prisoners
Cavalry	23.33	66.35	10.32
Infantry	19.96	64.23	14.81
Tank Corps	12.58	70.24	17.18
Air Raid (1): (Airship period, 1914-1916)	29.1	70.9	....
Air Raid (2): (Airplane period, 1917-1918)	30.0	70.0	....

On several occasions the Germans dropped incendiary bombs, which are not casualty-producers. These bombs were, in general, very inefficient, and the new efficient German "electron" bomb was not used, because the possibility of a German success at the time of its development was recognized as being too improbable.

Owing to the success of the Independent Air Force, plans were made for a really first-class aerial bombardment of the Rhineland, and also for an attack on Berlin. It is reported that Lewisite, the most effective (but unused) poison gas of the Allies, was to have been used in the attack on Berlin in the spring of 1919.

The further importance of the casualties caused in the civil population is that the "information spread" of such casualties is far greater than that of a similar number in the actual front line. The information in a populated area is spread with great rapidity and with an immense amount of distortion. The mass responses given in England to aerial attack are of considerable interest. Each area bombed produced at once a special local crop of spy stories. In Hull in January, 1915, a raid on the unprotected town caused sixty-four casualties. Rioting broke out, and all shops with even German-sounding names were attacked. In the same town, during another raid in March, 1916, a Royal Flying Corps truck was damaged and its personnel mobbed. In May, 1917, at Hythe, after a raid, the people attacked the local aerodrome, stoned the mechanics, and attempted to destroy the hangars, because of the lack of defense. In both the Tyneside

and Hull areas thousands of people from the congested districts left the towns at night to sleep in the open fields.

Each especially effective air raid called forth a new press campaign. The first precautions were the restrictions on lights in houses and on vehicles. After experiencing an air raid, the zealous special constables made it dangerous to light a pipe or cigarette in the open. In January, 1915, a Lord Mayor's deputation obtained an extension of the searchlight and artillery defenses of London. These were mainly manned by civilian volunteers. A few airplane patrols were established—mainly in coastal districts. In September, 1915, the first co-ordinated defense command was given to Sir Percy Scott, but he was not granted the planes he wanted. In February, 1916, the defense passed to the War Office with increased armaments and planes.

During the airplane raids' period in May-June, 1916, with a hundred killed on the East coast and 162 killed in daylight raids, the public protests caused a doubling of the strength of the Royal Flying Corps and drastic reorganization of the War Office defense plans. But the next daylight raid, with its fifty-four killed, caused an even more extensive reorganization of the London defenses under Brigadier-General Ashmore. The effective night raids of September, 1917, caused more press protests against the Department of Air Service. An official investigation took place. The new balloon aprons were set up. But the raids continued with increasing frequency. Munition work at Woolwich was seriously affected, and—even more important—mass panic seemed to be getting worse. A stricter press censorship on air-raid casualties was imposed, and the Independent Air Force was established to retaliate on the Rhineland towns. The anti-aircraft defenses had to be continually increased as well. Finally, pressure on the Western Front brought the air raids to an end.

Throughout the whole period it was civilian pressure which demanded and got increased defensive measures. The War Office had to learn that their primary function—the destruction of the enemy's fighting forces—did not absolve them from the duty of protecting their own population at home. It is ironical

that the demand of the civilian population for reprisals made the development of the Independent Air Force a possibility, and forced the military leaders to free the air arm from their restrictions on its use. This new strategic arm was thus freed to become the basic factor in modern military development—a factor designed to be used directly against those who demanded its development.

This review of the air raids on London helps us to see more clearly the problems of defense. During the War period, 1914-18, the defense against aircraft was always behind the attacking force. While the defense was increasingly successful, it could attain its limited success only by allocating ever increasing numbers of men and of munitions to the defense of London and other centers. The success gained was only a success against an enemy who regarded aerial attack as a sideshow. If a serious and prolonged aerial bombardment on a definite industrial objective had been carried out, then the defense might well have failed in its object. Against an enemy fighting the last stage of war in which its major military plans had proved unsuccessful, the defense was sufficient to make badly organized raids on indeterminate objectives unprofitable.

Part III

TWENTY YEARS OF COMMERCIAL AND MILITARY AERONAUTICAL "PROGRESS"

The great development of technology between 1919 and 1939 is reflected in the great triumphs of aeronautics to be described and summarized in Part III. The great commercial and scientific development of the period has had, however, one basic purpose—to provide efficient airplanes for military purposes.

The theory of air war is discussed against a background of the records from the Abyssinian and Spanish Wars. The failure of progress in international relations has made technological aeronautical progress a thing to dread rather than glory in. However, the real progress in this new method of transport for the general good is also outlined. What the aeronautical technicians could do if they were free to use their ideas for the benefit of mankind instead of for destruction is described. What has been done by the long-distance fliers across the Pacific and Atlantic Oceans and in the Arctic is reported.

CHAPTER IX

THE INTERLUDE OF PEACE

In the aftermath of the first European War—the "War to End War"—the opinion was general that there would not be another major war for at least a quarter of a century. Many really believed the war-to-end-war theory and looked forward to an endless prospect of peace regulated by the League of Nations.

In the Old World, however, there was a general unsettlement—a revolutionary ferment that at one time looked as though it might spread throughout Central Europe. This was particularly true in Germany, where matters were prevented from reaching a climax by the coming to power of the Social Democratic Party. Even in Britain the organized protests that stopped the military intervention in Russia against the Soviets were indicative of a new, unexpected, and even startling mood among the working class. In this Old World, the Soviet Union seems to many to be the vanguard of a new civilization based on peace. In fact, the history of the post-War years can scarcely be understood unless it be realized that the fear of revolution had largely superseded the fear of war in the minds of the governing classes of the world.

The part which airplanes can play in the civil war of revolution had not yet been established. Consequently the military aspects of aviation receded into the background in all countries at the conclusion of the War. Those interested in, or dependent on, aviation were compelled to try to adapt the airplane to the needs of peace. Government money was no longer pouring into the industry. Aviation found itself compelled to struggle for its mere existence. Individual firms were in danger of extinction, and many did go into bankruptcy; yet the industry as a whole

was never in such danger, for all governments were compelled to keep at least a nucleus of the industry in a healthy condition lest international war might once again occupy the stage.

The government research establishments were kept going, but generally with reduced staffs. In addition, industries had to be given some support from public funds. Subsidizing civil aviation was an obvious method which put a cloak of respectability over the proceedings by suggesting that the motive was purely to encourage a new industry. Various other methods were developed by the different governments for supplementing the flow of public money. In England the system of paying a large price for experimental planes produced to Air Ministry specifications was adopted. Bids were obtained on the specifications, and generally from three to five firms were selected for each order. After completion, the experimental planes were tested and one was selected for a small production order. The fortunes of the firms swung to and fro with the placing of the orders, but sufficient discretion was always used to keep the skeleton of a war industry in being. If the designing ability of one firm led to a preponderance of their designs being accepted for production, then arrangements were made for other firms to manufacture under license some of the successful designs. For example, the prospectus of Hawker Aircraft (1933) says:

> The British Air Ministry has acquired, under a royalty agreement, the manufacturing rights of the *Hawker Hart* type aircraft, and this machine is in quantity production by Vickers (Aviation) Ltd. and Sir W. Armstrong Whitworth Aircraft Ltd., to the orders of the Air Ministry.

The general policy was at that time based on the assumption that war need not be contemplated for a period of at least ten years. Thus to maintain a large air force, equipped with material which would be out of date before it was required, would have been grossly uneconomic. Rather should design be kept up to date by rapid substitution and by a fairly liberal expenditure on research and development, while production was spread over a comparatively large number of firms which could be expanded should the need become apparent. At the same time civil

aviation was to be encouraged by subsidies. A measure of control was undertaken to minimize the accident rate and to create confidence among the potential passengers.

Nevertheless, such was the lack of vision of the British Government of the time, that it was not until March, 1921, that the need for a subsidy for air transport was recognized, as a result of parliamentary and press agitation following the bankruptcy of Aircraft Transport and Travel Ltd. and the suspension of operations by Handley-Page Transport Ltd., leaving the French in unchallenged possession of the cross-Channel services. The subsidy policy vacillated until March, 1924, when Imperial Airways Ltd., with a guaranteed monopoly of subsidy for a number of years, was formed to amalgamate the four then existing companies.

The policy still, however, lacked an essential provision. Civil aviation was clearly not going to expand sufficiently rapidly to ensure the supply of the required number of pilots for a future war. Thus a system of short-term commissions for the Royal Air Force was introduced. Many young pilots who were unable to obtain permanent commissions were bitterly resentful when they were fired out into the cold world with its now chronic unemployment; yet only in this way could a sufficient standing reserve of pilots be established.

Official encouragement of flying clubs provided an alternative method of building up a reserve of pilots. The London Flying Club was established by Mr. Graham-White, one of the enthusiastic English pioneers, but it was not until 1925 that a system of government-aided flying clubs was established. Since that date private flying has increased to considerable dimensions and, owing to the subsidy, the cost to the individual of being trained to obtain a certificate of proficiency has been reduced to about £30. These arrangements, together with the development of the Auxiliary Air Force, have ensured that the human material for a rapid expansion shall not be lacking.

In spite of official encouragement and financial assistance to the flying clubs, private flying has not increased to such an

extent as to rival motoring. The reason is not far to seek. The motorcar was able to use the roads of a previous form of transport and, before the establishment of the modern system of gas stations, the motorist could always carry spare tins of gasoline. When the early private car-owner wished to visit friends, the roads were there, and perhaps a coach-house or shed to accommodate the machine. The private airplane-owner, invited for the week end by friends in the country, has generally no landing field to use. He must examine maps and waste time and money in telephone consultations to find a suitable field and make arrangements for permission to use it and to have it marked so that he can identify it from the air.

The subsidized airlines provide their own ground organization, emergency landing grounds, weather-reporting service, and wireless communication with the pilots in flight. By such means regularity of service has been maintained together with a commendably low accident rate. As these facilities are extended, and as improved systems of aerodrome lighting and improved instruments for flying in bad weather are devised, the reliability of airline operation is steadily improving.

The private owner is still, however, gravely handicapped by the lack of ground facilities. In the early days, when he flew for the sake of flying and not because he had a destination to reach, a forced landing in the grounds of a large house was a not unpleasant adventure. The householder could generally be relied upon to evince a kindly interest in the strange new toy and to extend his hospitality. Such an attitude cannot now be expected when dealing with the aerial "tripper." Even farmers have a right to complain if private plane owners develop a habit of popping down on their best-looking fields.

In Germany, where the authorities have not been expecting a long period of peace, the organization of sports flying has been much more thorough. All over Germany today the young are being trained to fly. Most villages have their flying clubs, and the training is free. Early training is given in gliders, and the more advanced pupils are trained in light planes. Since the

preparations for an air force have become open, thousands of these embryo war pilots are being intensively trained in military planes. It is difficult to obtain precise information on the numbers which are being trained, but it is reported that the number of pilots killed in accidents is higher today than at any time during the last War.

1. LONG-DISTANCE DEVELOPMENTS: THE PIONEERS

During the twenty-one years which have elapsed since the last War tremendous strides have been made in the technique of airplanes. The spirit of adventure, spurred on by large monetary prizes, has led to spectacular conquests of distance and to the growth of a long list of casualties.

Immediately after the War the *Daily Mail* renewed an offer, first made in 1913, of a prize of £10,000 for the first non-stop flight across the Atlantic. Many believed that such an offer was nothing more than a *beau geste* for advertising purposes, and that there was no risk of the money having to be paid. Nevertheless in May, 1919, Mr. H. G. Hawker, with Commander Mackenzie-Grieve as his navigator, set out from Newfoundland in a *Sopwith* biplane and got within 750 miles of the Irish coast before he was forced down by mechanical failure. Fortunately he was able to find a small steamer, beside which he abandoned his machine; they were both picked up unhurt. As the steamer had no wireless, their friends suffered an anxious week during which there was no news of the fliers.

In the following month, on June 14, 1919, Captain John Alcock and Lieutenant Arthur Whitten-Brown repeated the effort in a twin-motored heavy bomber, the *Vickers Vimy*. With a strong following wind they reached Ireland in sixteen and a half hours, averaging 117 miles per hour. After taking off, they had discarded their undercarriage in order to reduce the drag of the machine and to increase its range; thus they had to land the plane on its belly at the end of their hazardous flight, a feat which was not accomplished without the machine turning over on its nose in a soft field. Among other things, they risked

being forced down by an accumulation of ice if they had encountered the cold fogs of the North Atlantic, a risk which was little known at the time, but which has probably accounted for the loss of several crews which have failed to complete this crossing. Suitable instruments for "blind" flying were not available at the time, with the result that Alcock got into a "spin" while flying in cloud in mid-Atlantic and only just succeeded in regaining control after the sea had spun into his range of vision. They earned the £10,000 and the knighthoods which were conferred upon them. Nevertheless, their performance was in the nature of a stunt. They were not equipped for such a journey, and they may be said to have gallantly started the problem of transatlantic flight.

In July, 1919, the Atlantic crossing was made from east to west by the British airship *R.34* under the command of Major G. H. Scott. This airship was one of two copies of a German Zeppelin, the *L.33*, which had been forced down and captured in a raid on England in 1916. They were built for the purpose of raiding Berlin, but the *R.34* was not completed until after the Armistice had been signed. The Atlantic crossing, however, showed that a higher speed and a greater reserve of fuel were required, for the ship was forced out of her way by bad weather between Newfoundland and Long Island and she barely completed her journey before her fuel was exhausted.

The arrival of the *R.34* provided the American spectators with a typical example of British phlegm. When the airship appeared over the landing field, the spectators were horrified to see a human body falling from the control car. Presently, however, a parachute was unfurled and gently deposited Major Pritchard in their midst. The Major announced that he had come down to supervise the landing; he then took charge of the ground party and gave the necessary orders for handling the ship until she was safely moored.

The return journey, with a following wind, was uneventful—as such journeys must be if regular passengers are to be enticed.

Before the end of 1919 another spectacular flight was accomplished in a *Vickers Vimy* to demonstrate the reliability which

had been developed for bombers under the stress of war. The Australian Government had offered a prize of £10,000 for a flight from England to Australia to be accomplished in not more than thirty days. Two brothers, Ross Smith and Keith Smith, set out on November 12, 1919, to win this prize. Many have now flown this route, and it is difficult to recapture the thrill of the first of these epic flights. Deserts, jungles, and long sea stretches presented formidable hazards. Tropical heat and tropical storms were a test of the endurance of both the machine and the men, but in spite of all, the *Vimy* ran with the regularity of a scheduled train service, and completed the journey with two days in hand. The airplane had proved its ability to navigate the habitable portions of the globe.

2. LONG-DISTANCE DEVELOPMENT: COMMERCIAL TRANSPORT

Airways quickly sprang into existence all over the continent of Europe. At first the wartime pilots were employed to give "flips" to the more venturesome members of the public, by which means a somewhat precarious source of revenue was tapped. Government subsidies, however, quickly became the mainspring of development, and the modern network of airways began to develop. From the first these lines catered for passengers as well as mail, and in Germany—such was the rapid success of the Deutsche Lufthansa, which now operates more than fifty lines—flying quickly became a normal mode of travel. Germany was debarred by the terms of the peace treaty from having a military air force, but the utmost energy was thrown into the development of commercial aviation.

In the United States of America an attempt was made immediately after the War to popularize flying for both business and pleasure. One of the largest airplane-manufacturing companies equipped a large number of flying fields and invited the patronage of the public for flights in wartime machines. No government subsidy was provided, and the fares charged were too high for the venture to succeed.

In three years, however, the Post Office Department had established a transcontinental combined air and rail service from

New York to San Francisco. The mail was flown by day to Chicago, transferred to rail for a night journey, and flown the remainder of the distance on the following day. In 1924 the first night-flying service in the world was established, on the central section between Chicago and Cheyenne, thus linking New York with San Francisco by an all-air route.

The early history of air transportation, especially in the United States, has been submitted to a careful analysis by Dr. E. P. Warner * in the James Jackson Cabot Professorship lectures at Norwich University. The transference of attitudes toward established methods of mail transportation to new methods is strikingly illustrated in this study. It is important as an illustration of how the crude transference of social traditions can retard a new technological method.

The most important indirect subsidy to American aviation in the period 1917-27 was the United States Post Office grants for flying mail. The romantic appeal of sending letters by air mail was mobilized by the United States Post Office and the rosy predictions of what aviation could accomplish were boosted by the uncritical zeal of the aviation press. One might say that it became necessary to save aviation from its friends.

To these romantic promises was added the attitude of the Postmasters General who transferred their own ideas of Post Office service. They demanded a service under all weather conditions, which "will not be disarranged by storm, sleet or snow." Apparently they based their demands upon reports that bombing squadrons in France had operated without regard for weather. Even an early "Corrigan," who flew in the wrong direction after he had first tried to take off without any fuel, failed to enlighten them on the limitations of technical development. The Post Office decided that

> The Department control is the only possible way to operate a service of this kind. The responsibility for the flying must be centered in the Department, and not left to the discretion of the pilot or a number of pilots. This re-

*E. P. Warner, *The Early History of Air Transportation* (Norwich University, 1938).

sponsibility is taken by the Department on the strength of the weather and field reports before it. In no other way can an aerial mail service, requiring dependability of service, be operated.

To make matters worse, the Post Office, comparing its officials to army air commanding officers, insisted on using analogies from war experience. The pilots struck. Inside two days a "settlement" was arrived at which included the suggestion that "if the pilots still refuse, the [local field] manager himself will take a plane and go aloft, thus demonstrating to the pilots that the weather is safe."

There is no group of men with a higher general morale than air-line pilots. This type of treatment so affected the pilots that operating efficiency for the last nine months of 1920 and the early part of 1921 was seriously affected. Dr. Warner demonstrates that there was a sound technical basis for the pilots' attitude:

> In any case there is no doubt that the fatality rate during this period was high, and it was not coming down as rapidly as might have been expected. In the calendar year 1919, there were 8.67 pilot fatalities for every 1,000,000 miles flown; and in 1920 there were 7.62. In no year since that time has the fatality rate ever been even one-half that high.

These attitudes might be laughed at if they were not in part responsible for the killing of human beings. They are not confined to American practice. Very similar problems occurred in the development of the British Imperial Airways. The recent reorganization of that body after a Parliamentary inquiry shows quite clearly that both pilots and radio operators have serious grounds for complaint.

In these early days the ground organization was quite inadequate for such an undertaking, and most of the original pilots were killed in a series of sensational crashes which, more than anything else, delayed the development of commercial flying in the States. Flying through fog-bound mountain ranges in hail, rain, and snow, these ex-war pilots earned a justifiable reputation for dauntless courage, and by their deaths they

created a first-class political scandal. Their pioneer work, however, proved invaluable, for they gradually established the need for the modern elaborate organization to ensure safety in air transport. Gyroscopic instruments had to be provided to enable the pilots to hold the planes on a level keel and to fly straight when they could see nothing of ground or sky. Weather-reporting stations along the whole route had to be provided, so that a pilot might know, before setting out on any stage, that he had some chance of landing at the other end.

Following legislation in 1926, whereby air navigation was brought under federal control and a civil aviation branch was set up in the Department of Commerce, progress became rapid. Subsidies were established by a system of air-mail contracts; technical supervision and route organization were provided; and in other ways air transport was nursed and encouraged.

Soon a network of radio tracks was provided, by the aid of which a pilot could find his way in the thickest weather. These radio tracks, which are also known as equi-signal beacons, consist of two overlapping radio-fields giving an equal signal strength on their line of symmetry. On one side of this line one signal predominates, on the other side the other signal predominates. For recognition one signal generally consists of a series of dots and the other of a series of dashes. On the line of symmetry, defining the required track, the two signals key together to produce a continuous note. When the pilot deviates from this track the predominance of either the dots or the dashes tells him on which side of the track he is placed.

A competitive form of radio-navigating device, known as a radio-compass, has since been produced. This device gives the pilot a visual indication of the heading of the station on which the receiver is tuned. The indicator consists of a pointer which is central when the plane is headed straight toward the station; if the pilot heads his plane to either side of the required course, the pointer indicates the necessary correction. This device possesses the advantage that any station, broadcasting or otherwise, which can be tuned in and recognized, may be used as a "homing beacon." Also by taking bearings on two or more stations in

turn, a navigator is able to fix his position with fair precision on a map.

In England, Imperial Airways have stuck to an earlier and more primitive system in which the direction-finding is effected on the ground and the navigator's position is communicated to him verbally. The procedure is for the navigator or pilot to ask Croydon for his position. He then sends out a signal which is simultaneously received at three ground-stations, each of which determines the bearing of the transmitter. These bearings are then plotted on a map and the position of intersection of the lines is noted. The control station then calls up the airplane and states the position and the time at which the observations were made. Only a few minutes are required for the whole operation. Recently, however, more modern methods have been adopted.

The advantages of the radio-compass were demonstrated in Wiley Post's second sensational flight round the world. In this flight he tuned in broadcast stations in succession and was able, in consequence, to navigate in all weathers with little trouble.

He was also aided in the flight by an automatic pilot. Such devices have now been produced in the U. S. A., England, and Germany. In each case gyroscopes are used to detect the smallest deviation of the plane from the required altitude and, by means of servomotors, to apply the necessary control movements to restore the altitude. The English automatic pilot was used by Squadron-Leader Gayford in his long-range record flight from England in which he just failed to reach the Cape.

Clearly the long-distance airplane of the future will be flown by an automatic pilot coupled to a radio-compass, so that, once the required station has been tuned in, the machine will run like a train on its track. Already this coupling of the automatic pilot and the radio-compass is being effected experimentally in the U. S. A. and in Germany.

Thus technical progress is continually being made, and flying is gradually developing into a normal and accepted form of transport. Progress was noticeably slow for a few years after the War. To the war-weary peoples, airplanes were primarily associated with the War, and the governments had not yet

realized the extent to which the airplane would dominate the next War.

Gradually, however, a new generation emerged for which the War was little more than a bit of history and the airplane was as normal as the motorcar. Thus the miracle of one generation becomes the furniture of the next.

Sensational flights have become so commonplace that they no longer arouse a world-wide thrill. Some people in America, by refueling in the air from another airplane, stayed aloft for seventeen days—or was it eighteen? It may be important as a means of fueling a bomber after it has taken off loaded to capacity with bombs, but for the man-in-the-street it is on a par with the flagpole-sitters of about the same period. Flights to Australia in a few hours less than the last fellow's time arouse little interest. Lindbergh was news in 1927 when he flew, solo, from New York to Paris in a single flight; Bert Hinkler was news in 1928 when he flew to Australia in fifteen and a half days; Amy Johnson also was news when she beat Hinkler's time while still in her teens; but it required an air race to Australia to arouse a lively interest in such flights in 1934. In 1938 only a Corrigan is real news while the excellent technical achievement of Hughes in breaking the record for around-the-world flight was given far less publicity than the achievement deserved.

3. RESEARCH DEVELOPMENTS

The Australia race, which was won by Black and Scott in a *De Haviland Comet,* marked a revolution in British airplane design. Ever since the War there had been a struggle for ascendancy between the biplane and the monoplane. The biplane, on account of the mutual support given by the two-strutted and wire-braced wings, offered the advantage of a lighter structure and, under the conditions of the War, it had gained the ascendancy; strength to withstand the stresses of violent maneuvers had been a first consideration. The monoplane, once it had discarded external bracing, could be made aerodynamically clean, and therefore offered the advantage of higher speed, but the extra structural weight required appeared to offset this ad-

vantage in an over-all appreciation of design. For the first decade after the War, design was impeded by a vicious circle. Attempts to reduce air resistance, by such devices as retractable undercarriages, proved uneconomic in view of the extra weight involved because, when this item of drag had been removed, the drag of the rest of the airplane was so high that little advantage was obtained. It was not until the art of streamlining had improved to the point where the drag of the undercarriage contributed a serious proportion of the total, that the extra weight of the retracting gear was justified. So, with the extra drag of the struts and wires of the biplane, the monoplane had to be made so "clean" that this saving was a serious proportion of the remaining drag. When that stage was reached, it suddenly became profitable to whittle down the drag of undercarriages, engine installations, poor surfacing, bad-fitting panels, leaks at the joints, and a hundred and one other details, at whatever cost in weight and labor of construction. Thus a fresh impetus was given to applied aerodynamics and the biplane method of construction became obsolete.

America, with almost unlimited funds for research, provided herself with the most expensive equipment, including a wind tunnel in which the actual airplanes, not models, could be tested. She soon led the world. Dr. Warner, in the second lecture* in the series mentioned before (page 115), has discussed the period (1927-1933) of intensive research very fully. He attributes America's leadership to the thorough detail work carried on at Langley Field, Virginia, by Weick and his associates for the National Advisory Committee for Aeronautics.

The German designers, however, were equally successful without these elaborate facilities for empirical research. They built their technique on a well-founded aeronautical science in which they had long been predominant. The writer is inclined to award them first place for the production of the *Heinkel "70"* in 1931. This machine was a single-motored monoplane, capable of carrying five persons, built ostensibly for passenger and mail

*E. P. Warner, *Technical Development and Its Effect on Air Transportation* (Norwich University, 1938).

transport. Realizing that roughness of even a few thousandths of an inch is, for the high-speed plane, the counterpart of barnacles on a ship, the German designers employed a surface as smooth as the paneling of a high-grade motorcar. The streamlining was so good that the total drag of the plane was little more than the skin friction of the air on the perfect surface. The aerodynamic cleanness of the *Lockheed Vega* with its N. A. C. A. cowl and of the *Heinkel "70"* leaves them the almost unchanged prototypes of the designs of today.

The production of the *Heinkel "70"* made the biplane obsolete. England, however, had to wait until the *Comet*—designed after a close study of American and German technique for the specific purpose of winning the race to Australia—had proved dramatically the advantages of the new technique before she realized that "flying birdcages," as the Americans unkindly called them, were out of date.

Britain's might is based on coal and steel. These formed the basis of the industrial system in which she has dominated the world. They reached their highest peak in the coal-fired battleship by which she has dominated. Thus Britain bases her policy on the battleship and has only grudgingly consented to interest herself in this newfangled art of flying. She is now desperately trying to make up the leeway by learning the art of building stream-lined airplanes and equipping herself with a real air force at the same time. Given time and the diversion of the necessary funds from the purpose of building battleships, she may yet produce the finest air force in the world.

The interlude of peace has permitted many purely pacific uses of airplanes to develop. Thus aerial photography has become an established technique. The use of these photographs for advertising purposes may perhaps be regarded as an ephemeral phenomenon, belonging to an over-competitive social organization. The more legitimate social uses of aerial photography, however, include general survey work, the planning of towns, of railways, of irrigation and drainage schemes, and numerous other purposes. Where great accuracy in mapping is required, a preliminary ground survey is used to provide a framework of

check points. In this survey work, the British design of automatic pilot has proved invaluable, on account of the extreme accuracy with which the required courses can be flown by its aid, and on account of the freedom from pitching, rolling, and yawing, whereby the photographs may be accurately spaced and free from the distortion caused by a tilted camera.

In Canada, the airplane has been extensively used for the control of forest fires and for making surveys and inventories of the forests, in addition to the survey of her vast unmapped expanses. During the forestfire seasons, airplanes are continuously patrolling the important areas, and outbreaks of fire are instantly reported to the fire-fighting stations. In some cases, when the fires are inaccessible by land, parties and apparatus are transported by air. By these means, millions of acres of valuable forests have been saved.

In many undeveloped countries, where facilities for land transport are lacking or gravely deficient, airplanes have been used for transporting doctors and nurses and also for conveying cases of dangerous illness to hospital. In the U. S. S. R., this medical service has recently been extended by the training of doctors and nurses in parachute-jumping, in order that they may reach districts where landing fields are not available. Recently this type of service has been used in the Hebrides, Orkney, and Shetland Islands of Great Britain for emergency cases.

To bring swift relief to flooded or earthquake-stricken areas, the airplane and flying boat are invaluable. The great advantage of this form of transport is that it can deliver essential supplies either direct or by parachute. In the United States, Canada, Chile, China, and the U. S. S. R. the airplane has been used extensively to bring succor to the distressed. In many disasters the air forces of two or more nations have co-operated in their relief work. But even today, fog and extremely bad weather conditions can prevent or delay the service rendered.

For agriculture the airplane has also begun to play an important part. Thus, in the U. S. S. R., crops are sown by distributing the seeds over large areas by airplanes. In both the U. S. S. R. and the U. S. A. locusts and other pests are being attacked by

dusting the required insecticides from specially equipped planes. In this field of crop-dusting it has been found that a single plane can do the work of forty cart-dusting machines.

4. THE AIRSHIP CARRIES ON

Throughout the whole of this period there has been a bitter antagonism between the protagonists of the airship and the supporters of the airplane. Germany, which had the most experience in the field of airship design and which had, by means of the early Zeppelins, established the first genuine commercial air service in 1912, lost practically the whole of her airship organization under the terms of the Treaty of Versailles. For some time the U. S. A. was the only country that devoted serious attention to airship development, possibly because of her virtual monopoly of helium gas by which the fire risk, associated with the use of hydrogen as a lifting agent, is averted.

The series of post-War disasters involving the British *R.38* in 1921, the French *Dixmude* in 1923, and the American *Shenandoah* in 1925 provided the advocates of heavier-than-air types with a strong case for arguing that airships were the playthings of storms.

In 1924 Britain was stirred up by the advocates of airships to make another attack on the problem of the airship for the purpose of developing her Empire communications. It was argued that previous structural failures were primarily due to the airships having been too long for their depth, the result being a weak beam when a violent up-current was encountered. Two new ships were accordingly laid down with a much greater depth than had previously been provided. Wind-tunnel researches suggested that this shape presented less head resistance for a given enclosed volume of gas than did the cigar-shaped Zeppelins which had developed during the War, owing to the limitations of height of the hangars. The Airship Guarantee Company, formed specially for the purpose, designed the *R.100;* the Air Ministry officials designed the *R.101.*

Great hopes were based upon these ships, only to be dashed to the ground with the *R.101,* in October, 1930, on her first

Empire flight to India. After this disaster the British Empire decided to leave the design of airships to others. American enthusiasm was dampened by the loss of the *Akron* in 1933, followed by the loss of the *Macon* two years later.

Germany had, however, again entered the field, and the success of her *Graf Zeppelin* had done much to restore public confidence in this type of aircraft. The *Hindenburg* was launched to support the *Graf Zeppelin* in a regular North Atlantic service, and to show that, over long sea distances at least, the airship could hold her own. Dr. Eckener stoutly maintained that airships were safe in the hands of experienced navigators.

That airships still possessed a serious handicap from their relatively low speed, had been shown, however, by a North Atlantic crossing of the *Hindenburg*, in which, owing to adverse winds, seventy-eight and a half hours were occupied by the journey from Frankfort on Main to Lakehurst, New Jersey. The *Hindenburg* was the fastest airship that had been built, and was capable of eighty miles per hour average speed; yet for part of this trip her speed was reduced to twenty miles per hour. Dr. Eckener has admitted that weather conditions in the North Atlantic make it impossible to maintain an airship service on its route with the same regularity as across the South Atlantic.

At Lakehurst on May 6, 1937, the *Hindenburg* arrived with thirty-nine passengers, fifty-two crew, and her usual twelve tons of freight. The airship was twelve hours overdue from adverse weather conditions, and it cruised about for an hour until the weather cleared for a mooring to be attempted. The landing-ropes were dropped and the passengers waved to their friends two hundred feet below. Suddenly a flash with a sharp explosion occurred. The airship rapidly burst into flames, falling so swiftly to the ground that one member of the aerodrome landing crew was killed. A few individuals were blown clear of the ship by the explosion, several jumped clear, and others were rescued from the blazing ship. In all, twelve passengers and twenty-two crew were killed or died from their injuries. Captain Lehmann, second in experience to Dr. Eckener himself, was

one of the latter. Only three causes of the disaster were suggested: sabotage, static electricity, or damage caused by a broken propeller. The first suggestion has been discounted, while the official report of the United States Government Inquiry leaves little doubt that static electricity and the hydrogen gas leaks were the factors which combined to cause the disaster. The German Government has withdrawn the *Graf Zeppelin* from service, at least until such a time as she can be filled with helium.

Meanwhile the exponents of heavier-than-air craft have proceeded to demonstrate that the airplane can carry loads comparable to the airship. The German *Dornier D.O-X,* built in 1929, carries from seventy-five to a hundred passengers at a cruising speed of 110 miles per hour, compared with fifty passengers and eighty miles per hour for the ill-fated *Hindenburg.* However, the *Hindenburg* could carry twelve tons of freight, and her fifty tons of oil fuel gave her a cruising distance of seven thousand miles. The U. S. S. R. then produced a land plane, the *Maxim Gorki,* with an even greater load capacity. This machine, which was equipped with a printing-press and a traveling cinema, was intended primarily for propaganda purposes, by bringing a practical demonstration of the advantages of modern technique to the notice of the inhabitants of the outlying districts of the Soviet Union. The *Maxim Gorki* was destroyed in a most unfortunate accident in 1935, when a small single-seater military machine, which was escorting it on a demonstration flight, collided with it. Undaunted, however, the Soviet authorities proceeded to lay down sixteen more sister ships, with larger motors and a much higher expected speed.

The United States has not lagged behind in this development. The Pan American Airways, in 1935, was able to establish its first route into the Pacific Ocean. This route was gradually extended down to New Zealand. The *Sikorsky Clippers* have an excellent record of service on this and other routes. Igor Sikorsky, in an autobiography, *The Story of the Winged-S,* points out that his ships are the result of a pooling of research techniques and flying experience which cannot be credited to

any one man or group of men. The design is the result of all known aeronautical experience inside the margins where the experts differ and the actual producer makes his own decision.

5. THE SOVIET REPUBLICS CONQUER THE ARCTIC

The possibility of establishing a transarctic air route was shown by the Soviet fliers Chkalov, Baidukov, and Belyakov in the Soviet-built *A.N.T. 25*, when they flew from Moscow to Portland, Oregon. Their plane was in the air sixty-three hours, covering a distance of about 5,400 miles. They were out of touch with wireless signals for twenty-two hours, owing to magnetic disturbance. Eventually they picked up the American wireless beacons.

On July 13, 1937, the Soviet pilots Gronov, Gumachev, and Danilin left Moscow and landed at San Jacinto, California, on July 15, after being in the air for sixty-one hours seven minutes. The International Aeronautical Federation has officially recognized this flight as a world record. The distance, put at 6,305.7 miles, replaces the older record of the Frenchmen Codos and Rossi, who flew 5,657 miles from New York to Syria in 1933.

The next Soviet flight was not successful. On August 12, the Soviet ace Levanevski, with six companions, left Moscow with a four-motored monoplane. The thirty-four-ton plane had a full commercial load of furs, caviar, and mail. They passed over the North Pole at twenty thousand feet on schedule, and completed 2,400 miles in eighteen and a half hours. During three-quarters of the distance heavy clouds made blind flying necessary. Soon the wireless messages indicated that the plane must come down. All attempts to locate the wrecked plane failed.

In 1937 the Soviet Union won new laurels by sending four planes to land a party and their equipment near the North Pole. This party of four scientists set up camp on the North Pole ice sheet and carried out scientific observations for a one-year period. Their main object was to study meteorological conditions for a new air route across the North Pole between the U. S. S. R. and North America. The complete success of their scientific achievement has tended to obscure the aeronautical efficiency

which made their work possible. L. K. Brontman,* who flew with the party to the North Pole in *USSR N-171* on March 22, 1937, and returned to the mainland in the same plane on June 15, 1937, has published a complete record of the expedition.

The expedition's air squadron consisted of four four-motored *A.N.T.*-type monoplanes and one two-motored scout *N-166* monoplane. The four large planes carried a landing party of thirty-five men and eleven tons of equipment for the four scientists who remained to complete their scientific observations. Behind the flight lay a detailed study of all earlier polar work, including the Soviet Union's own extensive records; the development of the Soviet polar radio stations; the work carried out by Academician Schmidt and his associates in the Soviet Northern Sea Route Commission; the aviation work directed by Michael Vodopianov, chief pilot of the expedition; and one year's intensive planning and testing of every detail of the route, the planes, and the scientific cargo. The first hop, from Moscow to Archangel, a distance of 670 miles, was completed in five hours. At Archangel runners were substituted for wheels and all machines were completely overhauled. Each machine took off from Archangel with a total flying weight of twenty-two and a half tons and arrived at Narian-Mar in two hours and fifty minutes with an average speed of 160 miles per hour.

Then came the first major test—one thousand miles as the crow flies from Narian-Mar to Rudolf Island, across the ice-free Barents Sea in *land* planes. The two-motored monoplane *N-166* was used as a scouting machine to check on the weather and flying conditions, supplementing the squadron's own radios which collected weather reports from all the Soviet meteorological stations. The radios also enabled two-way communications to be maintained between all the planes. The load carried made a straight hop impossible. After four hours' flying, the squadron landed at Malochkin Straits, Novarja Zernlya, inside the Arctic Circle. Here they were trapped for three days by an

* L. K. Brontman, *On the Top of the World,* edited by Academician O. J. Schmidt (Covici-Friede, N. Y., 1938).

eighty-mile-an-hour blizzard, which smashed the rudder of one of their planes. On April 19, after the necessary repairs, the squadron landed on an ice-field aerodrome at Rudolf Island in the Franz Josef Land Archipelago—Latitude 82° North. Two auxiliary scouting planes for short-distance observation flights were waiting here. On May 5, Golovin, the chief scout pilot, took the *N-166* over the Pole and reported by wireless:

> Latitude 90 stop Pole under us stop but covered thick layer cloud stop failed pierce through stop laid return course stop Golovin

Golovin's gasoline supply barely held out. He was in the air eleven hours on a route of over 1,200 miles.

Continued bad weather enforced some delay, but on May 21, Vodopianov took off for the North Pole in the flagship *N-170* with fourteen men and over eight tons of equipment aboard. Radio communication stopped after ten hours at about Latitude 90° North. Ten hours later the following message came through from the expedition's own wireless transmitter which had been erected at the Pole:

> 88 Kolia ["love and kisses" in the private code of wireless operators] stop all alive plane intact stop Simon's generator burnt out and my batteries run down stop if connection breaks off call us midnight stop will give official message

On schedule came the first official message from the North Pole:

> At 11 A.M. airplane *USSR N-170* piloted by Vodopianov Babushkin Spirin, senior mechanic Bassein, flew over North Pole stop to make sure flew a little farther stop then Vodopianov came down from 5,000 feet to 600 comma breaking through dense cloud began looking for floe for landing and setting up scientific station stop at 11:35 Vodopianov made brilliant landing stop unfortunately while sending message that Pole reached sudden short circuit occurred stop radio transformer burnt through comma wireless communication ceased comma could only now be renewed after establishment of radio transformer on new

polar station stop ice floe on which we are stationed lies about 20 kilometers beyond Pole in that direction and a little west of the Rudolf meridian stop will ascertain exact position stop ice floe quite suitable for scientific station remaining in drift at center of polar basin stop possible make fine aerodrome here to take other planes with station cargo stop we realize that by breaking connection we involuntarily caused you much anxiety very sorry stop hearty greetings stop please report to Party and Government that first part of mission fulfilled stop Schmidt chief of expedition

On May 25 the North Pole radioed the three planes at Rudolf Island, "Marvelous weather, sun, cloudless sky, recommend you fly." In spite of fog at the field the fliers decided to take off and meet at the edge of the fog bank.

Each machine weighed over twenty-four tons, the margin of safety was cut down to the bone. We all realized that the smallest air pocket might lead to very serious consequences. The tractors hauled the planes to the starting line. The first to take off was Molokov. The distance was lost in fog, and the plane ran into the unknown. Nothing could be seen ahead. We felt that we must soon reach the edge of the hill. If the machine did not gather speed in time it would fall into the sea. All the engines ran at full power. Our speed rose slowly, lazily, unwillingly. But all the same it rose. Taxiing along, the plane finally rose only 600 feet short of the precipice. Without circling, the chief pilot steered the plane straight north. The machine rolled slightly.

In half an hour the second ship (Alexeiev) joined the first (Molokov) at the edge of the cloud bank. After an hour, the third (Mazarak) had not appeared and was instructed to follow the others to the Pole. Actually he was ahead of the others. The formation flight had started.

At 6 P.M., after seven hours' flying, Molokov landed his plane on the North Pole's landing field. At 10 P.M. a message from Alexeiev was received, saying he had landed at a different point inside the polar area in order not to waste gasoline in trying to

locate the camp. Eleven days later Mazarak arrived at the camp, having established radio contact with it several days earlier. He, too, had landed at the Pole, about six hours after leaving Rudolf Island, at a point some sixty miles from the Vodopianov camp. He was on an ice floe that made a take-off difficult.

At last the thirty-five men and a dog were in camp at the top of the world—a world with which they were in constant communication by radio.

On June 5, the plans for the return flight went into effect. At 3:42 A.M. the four ships of the squadron were on their way in formation back to Rudolf Island. The flagship landed at 8:15 A.M. with two other planes following it. Alexeiev had landed his plane, according to plan, at Latitude 83° 37′, on a suitable ice floe, with only sixty gallons of gasoline in the tanks. While he waited for the others to bring him gas, this ice floe drifted forty-six miles to the north in three days. On June 8, the weather improved and Golovin took him 250 gallons of gasoline. Thirty minutes after leaving Alexeiev's ice floe, Golovin landed at Rudolf Island. A short time afterwards, Alexeiev landed the last plane back at the base. The job of setting up a scientific camp at the North Pole had been completed.

Two scout planes were left at Rudolf Island, ready to fly to the polar camp should the need arise. The remaining four planes made ready for the remainder of their return flight. Flying in the Arctic Circle is not carefree sport. The return journey proved to be as difficult as the journey out. The men decided to fly direct to Archangel. The flight was almost completely blind, in cloud, at about 4,500 feet. The mainland was blanketed in fog; the squadron was compelled to fly at only 150 feet. Suddenly the aerodrome appeared, covered with only a narrow strip of snow. Spring had set in on the mainland. The planes with their runners could make a landing only on snow. They made it without a hitch. Alexeiev, the last to land, had only eighteen inches clearance between the other planes and the stony, snow-free ground. The layer of snow was only one inch thick!

From Archangel to Moscow was merely an airman's holiday for these men.

The account graphically illustrates the true social importance of aviation. It shows what scientific planning, technological development, and social discipline can do. It also shows, however, that there must be a broad base for such achievements. It was not 35 men nor 3,500 men who organized and established a scientific camp at the North Pole; it was the people of the U. S. S. R. who sent those members of its own community to carry on scientific research at the top of the world. The same people against whom Lord with thousands of others had waged war until 1920 were able after only ten years of industrial development to carry out successfully the greatest scientific expedition the world has yet seen. The story summarized has its own moral—what the individualistic, commercialized, scientific civilization of the last fifty years has been able to accomplish is only a dim preview of what a socially organized scientific civilization can accomplish in the future.

Equally as important as the organization and the efficiency of the flying mechanisms are the types of men who flew the planes. For an accurate picture of them the reader is referred to Brontman's book. The social discipline which controlled the whole work of the expedition may be best illustrated by one quotation from the record of the return flight from Archangel to Moscow:

> The squadron flew westward in Indian file. Then Alexeiev suddenly pressed forward but was immediately put in his place. In our earphones we heard Shevelev's precise voice: "Hallo, hallo, flagship calling. Calling Molokov machine. Where are you? In front of us or behind us?"
>
> "Hallo, hallo, flagship. Molokov machine calling. We are behind you. The machine in front to the right is Alexeiev's!"
>
> "Hallo, hallo, flagship calling. Calling Alexeiev machine. Why are you flying in contravention of instructions? Why have you passed us? Please return to your place immediately."

"Hallo, flagship. Alexeiev machine calling. Your orders to return to our position received. Will comply."

It was the unhesitating carrying out of the plans made, after the fullest democratic discussion, that, in the writer's opinion, was the most important single factor of the whole experiment. It is this complete unity and welding together of numerous scientific and personal factors by this social discipline, accepted not by dictatorial compulsion, but by democratic discussion, which made for the complete success of the enterprise.

The wider implications of the development of Soviet aviation may be illustrated by one last quotation:

One English newspaper wirelessed this question to O. Schmidt: To whom in his opinion did the North Pole belong? The inquiry was the subject of a lengthy debate in the tents of the camp. Schmidt laughingly summed up our discussion in these terms (though he did not broadcast his resumé to the world at large):

"The English say that the sea belongs to the nation which has the strongest navy. We can say that the North Pole belongs to the nation which has the strongest air fleet."

Even in our scientific age there is many a true word spoken in jest. So far, the Soviet Air Force has no rival to their implied claim. Furthermore they have dramatically demonstrated how successful the airplane can be under the most adverse conditions.

6. THE CONQUEST OF THE ATLANTICS

France has tackled the problem of the South Atlantic crossing. Here the weather conditions are more favorable than on the North Atlantic, and intermediate islands can be used as refueling stations.

The airplane's challenge to the North Atlantic has begun. An American-Canadian-English-Irish Company with full government support from all four nations has undertaken the organization of experimental transatlantic flights with the prospects of a regular passenger service in a few months' time. At Foynes on the Shannon River and at Botswood, Newfoundland, two special flying-boat bases have been constructed with short-wave

wireless stations, so that directional wireless signals, wireless telephony, and meteorological reports can be given to the flying boats throughout their journey across the Atlantic. Captain A. S. Wilcockson in the Imperial Airways twenty-ton aluminum flying boat *Caledonia* left Foynes on July 5, 1937, with his crew of four for his 1,993-mile run to Newfoundland. He knew he was facing a thirty-mile-per-hour headwind. At the same time the American Sikorsky flying boat, *Pan American Clipper*, with Captain Gray and his crew of six, left Botswood for Foynes.

The weather was bad, but the *Caledonia's* speed was better than expected, and she maintained her schedule of 140 miles per hour. On the other side of the Atlantic the *Pan American Clipper* had arrived at Foynes a quarter of an hour before the *Caledonia's* landing at Botswood. Both ships had encountered fog, but their wireless control from their bases had proved completely successful. As well as this, they were in communication with transatlantic liners.

Throughout the summer, seven double transatlantic flights were made. The results are shown in the following table.

TABLE IV

North Atlantic Crossing

July to September 1937

To Ireland

July 5:	*Pan American Clipper*	12 hrs. 34 mins.
July 15:	*Caledonia*	12 hrs. 7 mins.
July 29:	*Clipper*	12 hrs. 47 mins.
Aug. 8:	*Cambria*	11 hrs. 57 mins.
Aug. 20:	*Caledonia*	11 hrs. 33 mins.
Sept. 23:	*Caledonia*	11 hrs. 38 mins.
Sept. 27:	*Cambria*	10 hrs. 33 mins.

From Ireland

July 5:	*Caledonia*	15 hrs. 9 mins.
July 15:	*Clipper*	16 hrs. 24 mins.
July 29:	*Cambria*	17 hrs. 48 mins.
Aug. 6:	*Clipper III*	17 hrs. 32 mins.
Aug. 15:	*Caledonia*	16 hrs. 32 mins.
Aug. 27:	*Cambria*	14 hrs. 24 mins.
Sept. 13:	*Caledonia*	15 hrs. 33 mins.

The Imperial Airways account of the fastest flight in this series on September 27, 1937, reads as follows:

> The *Cambria* flew on a Great Circle course and averaged approximately 190 miles per hour for the crossing. She flew for most of the way at 10,000 feet where, in accordance with weather forecasts, more favorable winds were encountered. The weather was mainly fair but the *Cambria* met several intermittent rainstorms which greatly reduced visibility.

In spite of the technical success of these trials, the European situation has delayed the starting of regular transatlantic service. At present this service has only two American Clipper ships available. One of these ships, the *Yankee Clipper* has just completed its final trial flight (April 1939). But weather conditions seem to make the Azores route at present preferable to the direct North Atlantic crossing.

The airplane had challenged the airship on her own ground and won the first round. It will be for the future to decide whether the helium-filled airship or the large-size flying boat or the airplane will furnish the best *commercial* transportation for a transatlantic route.

CHAPTER X

TECHNICAL POSSIBILITIES

THE PROGRESSIVE DEVELOPMENT OF improved means of transport has for centuries been breaking down the parochial outlook of man. Aviation is carrying on the process. But all development is at present dependent on subsidy. How aviation might develop if technical factors were to control its progress is an interesting speculation.

Such a development is not, however, yet in sight, for the present growth of aviation is a forced mushroom growth, dependent for its very existence on the manure of government subsidies, provided for purely military purposes. This is illus-

trated by the report, *Economics of Air Transport in Europe,* issued in 1935 by the Air Transport Co-operation Committee of the League of Nations. From an analysis of the sources of revenue of the main network of permanent air routes in Europe for the years 1930-33, it is shown that nearly 70 per cent of the total revenue was provided by subsidy. The figures for 1933 were not completely analyzed, but they appear to show a slight advance toward financial autonomy. The increase in operating speeds which is now taking place must lead to a large increase in operating costs and a rise in the proportion of revenue borne by governmental subsidies. Yet the drive for further advance in operating speed goes on relentlessly, because the country with the fastest civil airplanes possesses an overwhelming advantage in war.

Leaving these military-financial considerations aside for the present, a study of purely technical factors will help to clarify the contrast between the technician's dream and the politician's reality.

High speed of air transport is uneconomic because, other things being equal, the rate of expenditure of power is proportional to the cube of the flight speed. The duration of the flight to cover a specified distance varies, of course, inversely as the speed. Nevertheless the result is that the power cost per ton-mile varies as the square of the speed. Too low a speed is again uneconomic, since adverse winds then lead to a disproportionate increase of flying time, with the further complication of dislocation of time tables. In so far, however, as higher speeds are achieved by reduction of air resistance or drag, instead of by increased power, the optimum speed of operation increases.

Airplanes are now approaching a state of streamlining in which the drag is little more than the skin friction of the exposed surface—a vast improvement on the technique of a few years ago. Further improvement in the economic operating speed therefore seems to depend upon a reduction of the amount of surface in relation to the load carried. This may be brought about by structural improvements, whereby the useful load becomes a greater proportion of the total load, or by an increase

in the weight per square foot of wing area of the loaded airplane. The latter expedient increases the landing speed and therefore tends to increase the accident risk. Such devices as landing-flaps, which increase the lift and therefore decrease the landing speed, and variable wings, which may be reduced in area when the plane is at a safe height, contribute materially to the required increase in loading without increase of landing speed; but a satisfactory mechanical solution of the variable wing has yet to be found.

There is one other avenue by which economic speed may be advanced, and that is flying at a very high altitude where the reduced density of the air leads to a reduction of the power required to maintain a specified speed. Unfortunately rarefied air starves both the engine and the passengers of the oxygen which they require. The air can, however, be compressed by pumps and fed to both engine and passengers. Superchargers, by which the full power of an airplane can be maintained up to about fifteen thousand feet, have already been developed, but there are considerable technical difficulties in the way of extending their operation to the rarefied atmosphere at, say, fifty thousand feet altitude, where the gain would be really worth while. This, and the difficulty of providing a sufficiently light airtight cabin to stand the air pressure required by the passengers, is barring progress in this direction.

It is probable that future developments will someday lead to economic flight at speeds far higher than are contemplated today. Nevertheless for some time to come it may be expected that airplanes will, for peaceful purposes, operate at speeds of only about 150 miles per hour, with an expenditure of power which can compete with other methods of transport. Many will think that this estimate is fantastically low, in view of the speeds achieved today by air-transport lines. The answer is, of course, the subsidy. The subsidy controls the type of airplane to be developed—it must have military value and military value means high speed.

As man develops more leisure by the full application of modern technique to the service of his needs, and provided the world's

stock of fuels does not show alarming signs of depletion, purely sporting attempts at high-speed flight may be expected. For the same reason that a few men devote their energies to climbing Mount Everest or visiting the Poles, without any obvious economic motive, many men will devote part of their time to record-breaking exploits in the air. It is difficult to set a limit to the speeds which may be attained in such circumstances. The jet-reaction engine has been mooted by many reputable physicists. Means of decreasing the drag of surfaces below the assumed limit of skin friction are conjectural possibilities. If development should occur along these lines, speeds may be expected to increase to the neighborhood of the velocity of sound —that is, 1,100 feet per second or 750 miles per hour. Indeed, speeds not far short of this are already practicable by existing methods. The limit of the speed of sound is mentioned because, above this speed, the compressibility of the air leads to a marked increase of the resistance to the motion of a body through it. It is of interest to note that, at such a speed, an airplane could encircle the earth in thirty-three hours. Thus, by following the sun, the journey could be made between sunrise and sunset, with time to spare for landing to refuel! Such an exploit may sound fantastic. Twenty years ago it would have appeared as fantastic to suggest that the American continent could be spanned by an airplane between sunrise and sunset, yet this has now been achieved.

It may be asked whether the inherent risks of flying will not prevent its wide adoption as a means of transport. Unfortunately, as soon as one risk has been reduced by years of research work, new risks are introduced by more daring employment of airplanes. Increase of loading, in the interests of speed, introduces more risk as improvements of control reduce it. High speed increases the risk of dangerous stresses caused by handling or by large air eddies; it also introduces a new risk of structural vibrations, or "flutter," analogous to the vibrations of the reed in a musical instrument. The facility to fly in cloud increases the risk of flying into a hillside in low cloud or fog, also the risk of collision. These effects mask the enormous strides which

have in fact been made toward eliminating the risks of flying.

There can be little doubt that air lines will become as safe as other means of transport. This can be achieved, however, only with the most elaborate and expensive ground organization for providing emergency landing grounds, and reliable weather information transmitted by radio to the pilots. The organization must be such that the traffic is controlled in fog with the same thoroughness as railway traffic. The abandonment of spectacular speeds will also contribute to the required safety.

Air transport may therefore be expected to develop into the normal mode for distances greater than, say, a hundred miles. The abandonment of nationalism, with its attendant inconveniences of passports, customs, and exchange restrictions, will permit a free flow of visitors from one country to another. The airship, so vulnerable in war, may become the most delightful method of travel. Vast airships, providing an accommodation comparable to that of an ocean liner and free from the distressing noises and jolts of land-borne vehicles, may traverse continents and oceans.

Apart from the regular long-distance air lines, flying will develop as an exhilarating sport. For this purpose probably the motorless glider will hold the pride of place. Sports owe their appeal to the opportunities they offer for the development of skill and to the thrill of uncertainty provided by chance. Motorless gliding satisfies these requirements in full measure, in the search for rising currents of air on the slopes of hills and around and inside clouds. In addition, the glider pilot senses to the full the poetry and beauty of motion and feels the fulfillment of man's age-long ambition to soar with the birds. Such a sport cannot fail to attract the youth of all ages and to provide relief from the monotony of an over-mechanized age.

There will also be the problem of the man-powered flying machine. If the motorless glider can remain aloft for hours on end and cover hundreds of miles, clearly a small expenditure of power, provided by the muscles of the bird-man, can tide over some of the periods when rising currents are absent. Propulsion

will probably be provided by wing-flapping, as the pioneers of flight envisaged; such a method will detract nothing from the qualities of the glider, whereas a propeller would add unnecessary air resistance when not in use. As the technique improves, the skilled and athletic bird-man will progressively conquer the vagaries of the air currents and be able to remain aloft at will. Then man will truly have conquered the air and have fulfilled the dream of countless ages. Man will no longer have cause to envy the albatross.

Unfortunately little work is being done on the problem of flapping flight. Naturalists continue to study the flight of birds and make suggestions that research should be directed to the problems of bird flight. Meanwhile the aerodynamic laboratories of the world are fully loaded with more practical problems. Funds for aerodynamic research are provided by governments which must, in defense of their own nationals, provide better fighting planes and faster bombers to beat the other fellow's better fighter. So the perfection of swifter and more efficient death moves on not steadily but with an ever increasing acceleration.

Technical speculations are the prerogative of the technician and scientist. The independent scientist at work for the sheer joy of discovery has practically disappeared. The growth of technique itself has made the teamwork of experts essential for modern scientific progress. Technical experiments cost money, and money comes only from governments or competitive industry. They have an unhappy lot, these research workers and technicians. Their training and employment develop a critical attitude of mind. They cannot refrain from researching into their own function. They would like to find that they are serving humanity; they find instead that they are contributing their little quotas to the perfection of improved engines of human destruction. The pacifist devising better bombs is truly a pitiable person. As a rule the research worker is narrow-minded and lacking in knowledge of economics or politics. He cannot discover the forces which compel him to prostitute his ability to

the service of war for the pay of a policeman. The world appears to him as perverse, and he has generally no inkling where to turn to escape from his thralldom.

Recent years, however, have shown a marked development in the scientist's awakening to his responsibilities. In his 1936 presidential address to the Mathematical and Physical Science section of the British Association for the Advancement of Science, Professor Allan Ferguson spoke as follows:

> Never in the history of mankind have more powerful weapons for good and for evil been placed in the hands of the community as a direct result of the growth of scientific knowledge; and never has it been more necessary for the scientist to develop some awareness of the effects of his activities on the well-being of that community of which he himself is a responsible member.
>
> We are most of us ready enough to discuss the "Impact of Science on Society," so long as we restrict ourselves to an enumeration of the benefits which science has bestowed upon mankind; and on occasion we may make a rather snobbish distinction between cultural and vocational values. But we have to remember actively that there are dysgenic applications of scientific knowledge, and if the scientist claims, as he rightly does, that place in the counsels of the nation which the importance of his work warrants, he must cease his worship of what Professor Hogben calls the "Idol of Purity," must be prepared to discuss all the social implications of his work and to educate himself, as well as his less fortunate brethren trained in the humanity schools, in a knowledge of these implications.

The scientist and the technician protest; still aviation develops as the most potent engine of destruction yet devised, instead of the means of satisfying man's cravings. It is significant that it was in disarmed Germany that the art of gliding was born and developed as far as it has gone. Civil aviation must continue to develop with a view to its conversion to military uses in case of need. Speed and still greater speed must ever be sought in order that the civil fleets may, when loaded with gas and incendiary

bombs, be able to join with the bombers in destroying an enemy's cities.

CHAPTER XI

WHEN THE BOMBS FALL AGAIN

WHAT HAPPENED IN THE air raids of the 1914-18 period belongs to history. The outline of recent technical progress shows how outmoded those attacks would be today. It is essential to try to estimate the use to which the aerial arm may be put in another large-scale war. Old types of weapons have been adapted and new ones developed for aerial attack and defense. The theoretical implication of mock aerial warfare and the undeclared wars of 1918-39 have given a new orientation to the writings of military experts. All these new technical devices and the results of these theoretical studies will in the next war operate against the enemy populations, whether military or industrial.

1. AERIAL ATTACK AND DEFENSE

The first development of the military air arm proper led to the division into fighter and bomber types of aircraft. Defense was aided by the fact that the speed of the fighters was considerably greater than that of the bombers. The bombers relied for their protection upon the weight of machine-gun fire which they could bring to bear upon a fighter. Thus the bombers had to operate in formation so that all their guns could be used simultaneously. They also had to sacrifice a little more speed by providing alternative gun positions to enable them to resist attack from any direction. The modern monoplane type of high-speed bomber has its gun position so built into the machine design that the defects of the older type have been largely eliminated.

The fighters, possessing the initiative, were able to concentrate on the forward field of fire, which could be provided by

fixed machine guns. Nevertheless, to redress the balance of gun-power, they too had to adopt the tactic of fighting in formation.

This struggle for ascendancy between the bombers and the fighters was never settled owing to the outbreak of peace. It seemed then that the fighters would require vast superiority of numbers to ensure success, since a large proportion of them would fail to make contact with the raiders during the short time occupied by the raid.

Since the War, however, the speed of airplanes has increased to such an extent that it is doubtful whether the experience then gained in aerial warfare can provide any guidance. In the light of modern knowledge there is no obvious reason why the bomber should not be as fast as anything that can fly. As the size of airplanes increases, they can approximate ever closer to the flying-wing, free from excrescences; thus mere size offers an advantage in speed. The defending fighters cannot compete in size with the bombers, on account of the necessity of their being produced in vast numbers if they are to be of any use. It is, indeed, doubtful whether they would be of any avail against bombers operating at speeds of about three hundred miles per hour. At such a speed a raiding airplane could reach London within about ten minutes of crossing the coast.

Moreover, it cannot be assumed that an attack would be limited, as in the last War, to a single squadron whose position and movement could be continuously followed. It is probable that an attack, intended primarily to demoralize the industrial production of a large city, would be carried out by successive waves of squadrons, following one another in such close succession that no useful information as to their movements could be either collected or conveyed to the fighter squadrons in the air. In such circumstances, and with the bombers moving five miles in a minute, contacts between the defending and the raiding planes would be more or less accidental. Even if the fighters still possessed a small advantage in speed, a long chase would be involved after the enemy had been sighted, and for such a chase

the necessarily small fuel load of the fighters would be inadequate.

Modern high-speed commercial airplanes could obviously be used to supplement the fleets of bomber aircraft, since they could be readily adapted to carry either incendiary bombs or gas containers, the two most effective weapons for use against cities. It would probably be unnecessary to equip them for gun defense, since they could be interspersed among the regular bombers and the new type attack bombers.

Hence today the general ratios for military air forces are: bombers 60 per cent, pursuit and combat planes 30-35 per cent, and auxiliary aviation 5-10 per cent.

The conclusion to which the military authorities of all countries appear to have come is that the only effective reply to airplane attacks on their civil populations is counter-bombing. This may take three forms. As a true measure of defense, the counter-bombing may be directed against the enemy air bases, on the theory that the enemy bombers can most easily be destroyed on the ground. The second form is attack on munitions works, docks, railway junctions, and large industrial centers to prevent the movement of troops and the production of munitions. This attack is indirectly a reprisal on the industrial population and also indirectly a defense measure. The third form is reprisals against the enemy population—a measure which cannot, by any stretch of the imagination, be described as defensive. Since, in war, a vast number of emergency aerodromes would be brought into use in order to confuse the enemy, it would generally be difficult to destroy the bombing fleets on the ground, and much of the effort of the counter-bombing operations would be wasted in an effort to do so. Thus, as has been remarked by many, including Earl Baldwin, the bomber must get through, and the only remedy is retaliation.

The effective range of the modern bomber has increased from five hundred miles in 1919 to between one thousand and fifteen hundred in 1937. For long distances the bomb load carried must be reduced and special methods of launching the machines with

the maximum fuel load or of refueling in the air have to be adopted.

2. THE BOMBER'S MESSAGE

Research work has done much to perfect the high-explosive bomb and to devise efficient incendiary and gas bombs. The modern type of incendiary bomb was not used in the 1914-18 period, while poison gas has not yet been used against an industrial or urban population. The British Air Force has developed the use of time-delayed bombs which can explode in periods of from two to twenty-four hours after their discharge. This type of bomb must add considerably to the difficulties of an air-raid defense organization. All types and sizes of bombs have been developed from two-and-a-half-pound incendiaries to a four-thousand-pound experimental, high-explosive bomb. Special aerial torpedoes have also been designed for attacks on battleships.

The conventions drawn up to prohibit the use of poison gas are universally regarded as valueless. The Italian success with the spraying of poison gas in Abyssinia shows how effective gas is against an unprotected rural population. The incendiary bomb has also proved to be effective and efficient both in Abyssinia and in Spain. There has been considerable discussion about the relative dangers of gas bombs and high-explosive bombs. The British Air Raid Precautions Department has emphasized its viewpoint that the gas bomb is possibly less difficult to combat than the high-explosive bomb. This discussion has the serious drawback of giving a false perspective to an aerial attack. Defensive measures have to be taken against an attack using first high-explosive bombs and incendiaries and following up with either gas bombs or gas spraying.

The high-explosive opens up the area for a gas attack. The bomb which exploded in Warrington Crescent, London, in March, 1918, destroyed four houses and damaged four hundred more, breaking every pane of glass in them. The size of this bomb is in dispute, the estimates ranging from 660 pounds to 2,000 pounds. The lower figure is probably correct. At the end

of the War the British used 1,650-pound bombs with great effect in the Rhineland. The effect of this type of explosion on the efficiency of gas-proofed rooms over a wide area can well be imagined. A gas attack on an area systematically opened up in this way by explosives is the method which modern experts forecast.

The methods of defense are still the same as in 1918; fighter planes, antiaircraft guns, searchlight batteries, sound localizers, balloon aprons, and wireless and telephone communication. All these methods have been technically improved, but all are subject to very definite limitations. All must be extended to cover a much greater area than in 1914-18. The general consensus of opinion about the combined effect of these measures is that they may account for a small percentage of the attacking force and that they will definitely affect the accuracy of an attack upon specific objectives. They cannot defeat, but they may limit and lessen the destruction of an air attack.

In the past, all land warfare has been a "war of fronts"; in the future, air war will make it a "war of areas." In a war of areas the function of the aerial arms is to destroy not only the enemy's military, but also his industrial organization, his transport system, and his basic supplies of raw materials and food, so that he is compelled to sue for peace. If these are the tactics of air war, then the question of the direct use of the aerial arm against the civilian population is answered. An attack launched against industrial, shipping, and food centers must affect the people living in these centers. The military command will regret that it is compelled to bomb residential civilian areas, but the necessity demands it.

A powerful air fleet can be produced in about three years and, having been produced, it renders all previous air fleets obsolete, on account of their inferior speed. In assessing air strength the term "first-line air strength" is frequently employed. It is based on the military strategy of a long war, in which it is of paramount importance that the fighting forces should be continuously replaced as they are destroyed or exhausted. For this purpose, it seems to be necessary to hold in

reserve about three times the force that can be engaged at any time, and to provide for the replacement of these reserves as they are exhausted. These factors applied particularly to aircraft in the last War, which dragged on for more than four years and in which the wastage of planes was enormous. It has accordingly become customary to reckon first-line strength of airplanes at about a quarter of the available number of planes. In a naval engagement these considerations do not apply; if the enemy fleet can be destroyed, command of the sea will have been secured and no reserves will be required. Thus it is possible to throw the whole of your naval strength into a single engagement, if by doing so you can secure a victory.

3. THE WAR-OF-AREAS THEORY OF ATTACK

It is by no means certain that, in a war of areas, the same will not apply to air forces. If the aggressor possessed, at the beginning of the war, a preponderant advantage in air strength, he might choose to make a bid for command of the air by a single decisive engagement. Such a strategy would demand that the attack should be directed, in the first place, against the air bases of the enemy in order to minimize the weight of the retaliatory attack. Thus the decisive factor in the next major war may well be the number of up-to-date bombing planes which can take the air on the first day of the war.

Concealment of air bases may become a primary consideration; it would be no use relying on a small number of known aerodromes upon which the enemy could concentrate in his first attack. The bombing planes would require to be scattered over a vast number of well-camouflaged flying fields. A government may prepare hundreds of such flying fields. Underground hangars can and are being constructed. Large underground hangars, however, may turn out to be deathtraps, if their exits are bottled up by well-aimed bombs. Any skilled observer who flies over a country can, moreover, detect scores of flying fields, placed on the borders of woods in which the hangars are cunningly concealed.

In air war, in which both sides confine themselves to trying to destroy each other's planes on the ground, neither side possesses any advantage in regard to the range at which the bombers have to operate. In a war of areas, however, this question of range will become important. The load which a bomber can carry must include fuel as well as bombs. Thus the greater the range at which it is operating, the smaller the load of bombs it can carry. British Air Commodore Charlton has discussed these geographical factors very fully. The location of industrial centers may put one air force at a decided disadvantage because, to strike at inland industrial centers, it may have to fly through an enemy country in which defense aircraft can be maintained. When, therefore, the offensive is directed against the industrial population and against the centers of supply, the weight of the attack will depend upon the distance of these centers from the enemy aerodromes as well as the position of the defense aerodromes.

This factor of the distance of important centers from possible enemy air bases introduces a new consideration into the relative strength of the various powers. Of all the great powers, only the United States and the U. S. S. R. can feel safe from a devastating attack by air. Although ranges of about six thousand miles are possible today for planes designed for record-breaking flights, the striking range of the modern bomber is only about one thousand miles. The bomber must be able to make the return journey, it must carry a useful load of bombs; it must be able to take off from a small field rather than a specially prepared runway which could be bombed by the enemy. Taking all these factors into consideration, striking ranges of about seventeen hundred miles are possible with small loads of bombs, of about one thousand miles with moderate loads, while at ranges of less than, say, four hundred miles, the bomb load can be enormous. Moreover, when the striking range is only about two hundred miles, the return journey can be made in about two hours. Thus several journeys can be made by the same plane in the same day. A glance at the map reveals that London

is the most vulnerable capital in Europe. It is within a hundred miles of France, within two hundred miles of the Low Countries, and within three hundred miles of Germany.

It is very difficult to give a factual statement of the bomb load which can be carried by a modern air fleet. In England during 1914-18 some 180 planes dropped only seventy-three tons of bombs. The following two accounts give the best available description of the magnitude of the bomb loads carried by modern air units. A detailed technical description of the aircraft in the first report is given because the ratio of bomber to fighter planes is one important factor in determining total bomb load.

On September 21, 1937, during the parade of the American Legion through New York, the American Army sent over the city one hundred of its most modern aircraft for two day- and one night-formation flights. The formation consisted of thirty-six two-seater *Northrop* fighters, six *Boeing B17* four-motored "flying fortresses," believed to be the most formidable bombers in the world, eighteen *Martin B10* bombers, eighteen *Consolidated* two-seater pursuit planes, eighteen *Boeing P26* pursuit planes, and four miscellaneous general-purpose photographic and transport planes. The planes took off and landed in formation at Mitchel Field under wireless directions. During the parade they were throttled down to a speed of 150 miles per hour, but on a return journey the *Boeing* flying fortresses were extended to 240 miles per hour. All planes completed their three flights of one and a half hours each without incident. The American Army authorities stated that, during the three flights, the bombing and attacking planes could have carried 300,000 pounds of bombs—considerably more than the total weight dropped by the American air force in all their raids on German objectives during the World War.

It will be noticed that only twenty-four bombers were included in this formation. What a major air force can carry is illustrated by the next account. M. Khirpin, Assistant Commander-in-Chief of the Soviet Air Force, in a speech in November, 1936, is reported as saying:

During the World War a total of 17,500 tons of bombs fell in France, Great Britain, and Russia. The same amount could now be carried in five flights of the Soviet bombing squadron.

These figures illustrate the scale at which an aerial bombardment could take place, using high-explosive, incendiary, and gas bombs on any given objective or area.

This raises the question whether it would be possible to attack on the same day with several thousand planes. It would require the use of, say, two hundred aerodromes within striking range of the objective. This would present no difficulty to an enemy that had spent a year or so preparing the necessary flying fields. The required number of pilots could easily be trained in a year or so. It is doubtful, however, whether the skill or the morale of these hastily trained pilots would suffice for an attack under cover of darkness or of cloud. Collisions would add to the strain on the morale of the pilots. It is therefore more likely that such an attack would be made in clear daylight, when the planes could operate in squadron formation. In these circumstances only the leaders need be highly trained; the rest would follow like sheep. Well-trained machine-gunners would also be required to ward off attacks from defending fighter planes. They would not, however, have much to do if the country attacked had not taken the precaution of providing itself with thousands of fighter planes of the very latest design.

Until quite recently flying in cloud was a rare and difficult feat. Instruments are, however, now available which make cloud-flying perfectly safe, apart from the risk of collision. Automatic pilots, steering mechanically by means of gyroscopes, can also be used for cloud-flying. With a knowledge of the wind, gained earlier in the flight, the last hundred miles could be flown blind with sufficient accuracy to find a large city; if necessary, bearings could be taken by radio to check up the position. Thus the attack could be delivered without the defense so much as seeing the raiding bombers. Risk of collisions would, however, probably restrict attacks in cloud, or at night, to a few hundred planes at a time.

It must not be forgotten that airships such as the *Graf Zeppelin* could also be used for attacks in cloud. Thus harassing raids would be carried out continuously, by day and by night, to supplement the main raids in clear weather.

No country has, as yet, found the means of defending its cities from devastation by air attacks. Wire nets may be suspended from kite balloons, but this is of no avail against planes flying high, since the balloons cannot rise above about thirteen thousand feet owing to the weight of the wires. Even in cloud the protection offered by balloons is more moral than physical, as was demonstrated in the last War.

4. ABYSSINIA, SPAIN, AND CHINA REPORT "PROGRESS"

The discussion has been confined, so far, to the use of aircraft in a war against a densely populated industrial country. Thinly populated extensive areas, such as Siberia or Mongolia, would present a very different problem. Here the ground must be occupied by land forces, since the purpose of the war would be conquest rather than the destruction of the fighting morale of an imperial rival. Mobile land forces would therefore play the leading part in a Far Eastern war. The airplane would, as in the last War, be mainly ancillary. It would be used largely for reconnaissance, for harassing concentrations of troops, and for transporting supplies. These uses of planes have been illustrated in the Italian campaign in Abyssinia and by Franco in the Spanish civil war. If, however, both sides were equipped equally with planes, there would be a struggle for supremacy of the air, and the two-seater fighter would play a dominant rôle. The Chinese air force, for example, has compelled the Japanese to move their air bases from approximately forty to fifty miles from the front lines to four hundred miles in the rear.

In open warfare, airplanes could also play an important part in increasing the mobility of the land forces. Provisions could be hastily transported to troops in inaccessible regions. Troops could also be transported in troop-carriers. The U. S. S. R., faced with the prospect of such a war, has further developed the use of planes for transporting troops. In their 1935 maneuvers, they

demonstrated the possibility of dropping battalions of men, complete with rifles and machine guns. They have also transported light tanks slung beneath airplanes. Followed up by their heavier tanks carrying field guns, such a force could prove decisive by seizing a strategic point on the enemy's lines of communication.

It is as yet difficult to draw very definite conclusions about air war from the experiences in Spain. As evidence of this, the reader is referred to the numerous articles which have appeared in journals, magazines, and newspapers in which not only the conclusions, but even the facts are at variance. The reports have not been sifted and are undoubtedly colored by both bias and sensationalism. Moreover, the operations have generally been on a small scale as compared with those a major war will produce.

The case of Guernica, a small city in the Basque country which was bombed out of existence in May, 1937, is perhaps an exception. Since there was apparently no military purpose in this action, it is probable that it was a field experiment designed to obtain data on the quantities of material and the number of aircraft required to destroy a defenseless prescribed urban area. At the same time, it was practicable to test the efficacy of machine-gunning against panic-stricken civilians and to measure the turning-round time of the bombing aircraft.

Another important analysis has been made by J. Langdon-Davies* of a series of thirteen air raids on Barcelona starting March 16 and ending March 18, 1938. At that time, Barcelona had developed a seemingly adequate system of air-raid protection. Air-raid shelters had been provided, modern sound-detector systems had been installed, antiaircraft and defense combat squadrons were available, and, finally, the citizens of Barcelona had become accustomed to air raids and were efficient in the use of the precautions and shelters provided. Air-raid defense had become a successful routine operation. Of course, the bombing did involve casualties, but no such casualties as to create a serious danger to morale.

* J. Langdon-Davies, *Air-Raid* (Routledge, London, 1938).

On March 16, at 10:08 P.M., bomb explosions were heard. People not injured made for shelters. Fifteen or twenty seconds later sirens sounded air-raid warnings.

After another fifteen seconds, antiaircraft was heard, probably an airplane engine noise of the retreating planes; twenty minutes later antiaircraft barrage fire stopped. Soon, "All Is Clear" was sounded. March 17, 12:05-12:06 A.M., the same procedure was repeated. It occurred again at 1:36-1:38; 7:36-7:38; 10:26-10:28 A.M.; 1:58-2:00; 10:18-10:20 P.M. March 18, 1:14-1:16; 4:03-4:05; 7:00-7:02; 9:30-9:32 A.M.; 1:11-1:13; 3:00-3:02 P.M. In all, thirteen raids were made. Langdon-Davies analyzes the total time of forty hours into three periods: (1) thirteen periods of two minutes each, with actual bombing, (2) nine hours and seven minutes of fear without danger, (3) thirty hours and forty-two minutes free from danger, but with a growing feeling of strain. In all, only two hundred large-size high-explosive bombs were dropped. Only five planes seem to have been used for the raids. The bombs, generally about thirteen, seem to have been all released at the same time, generally exploding within a radius of about a thousand yards. The casualties were estimated at three thousand killed, five thousand hospital cases, and twenty thousand minor injuries.

Langdon-Davies suggests that the raiding planes used a technique which he has called the "silent approach." These planes ascend from their base to an actual height of thirty thousand feet and, having shut off their motors, glide toward their objective at an angle of one in thirty, maintaining a gliding speed of 120 miles an hour. This would give a distance of approximately one hundred miles with a loss in height of ten thousand feet. Langdon-Davies estimates that the electro-magnetic detectors and the localizers used at Barcelona were able to detect an airplane motor at fifty miles. In no case does it seem to be definitely established that the planes were detected before the bombs were dropped. This explanation seems to be a possible one. Three factors seem to limit it: (1) the suggested angle of glide is very low, especially at the altitude of thirty thousand feet, (2) a glide must cause propellers to hum, so a device for

locking the propeller would seem to be essential to avoid detection of this hum, (3) even with modern systems of lubrication, jacketing, and auxiliary heating, it would seem to be difficult to keep the motor from freezing at this height without occasionally running it.

However, these factors may have been overcome.

The outstanding result of the raid was the degree of panic created by the bombing without warning, combined with the suspense in waiting for the next raid. The carefully compiled data on the psychological effects of these raids will be discussed in the chapter on morale. After the thirteenth raid the method was not repeated. Langdon-Davies' suggestion that the whole affair was an experiment to test the value of this technique is probably quite correct. It confirms the view of the writer and other individuals that Guernica was a similar experiment.

In the writer's opinion, most of the misinterpretation of the Spanish developments arises from a confusion of the basic factors that underlay the war. The Spanish War had three different, though interlocking, trends. First, the military revolt against the Republican Government and the military war resulting from the revolt. Second, the "political" war by which Italy and, to a lesser extent, Germany used the Spanish situation to extend Italian influence in the Mediterranean. The political war partially accounts for Franco's delay in the capture of Barcelona. Third, the experimental war by which both Italian and German air units and military technicians collected important data on the use of military tactics as well as trained their personnel in actual warfare.

The use of the airplane has been subordinated to all these other factors. While the intensity of the air war launched in Spain seems to have been heavier than aerial bombardments in the 1914-18 War, major large-scale air war was not launched. The maximum number of machines available seems to have been of the order of eight hundred for the Rebels and six hundred for the Government. The quality, as well as quantity of the Rebel aircraft, personnel, and ground staff was definitely superior to the Government's equipment. That is because the Italians and

Germans controlled this technical section of the Rebel armies.

It is difficult to overestimate the value of training under fighting conditions. Mussolini has stated clearly and openly that his own army in Europe has had this essential experience in two wars—Abyssinian and Spanish. The value of this training is testified to by Liddell Hart, who wrote recently of military maneuvers:

> On these battlefields without bullets and shells, many things are done which would be impossible under actual fire—without their impossibility even being perceived.

The betrayal of the Spanish people by the governments of the world's democracies, with the exception of the Soviet Government, has been the betrayal not only of the Spanish people, but of their own peoples. This betrayal may well give the fascist powers a very important initial advantage if a major European war does take place. This repudiation by the other democracies of their responsibility to the Spanish democracy makes the statement published in *Pravda* by M. Loktianov of considerable importance. This statement outlines the lessons Soviet military aviation learned from its study of the Spanish and Chinese Wars in 1938:

> This year world aviation has drawn many lessons and conclusions from war in Spain and China.
>
> These lessons may be described as follows:
>
> Firstly, the wars in Spain and China have shown that it is not sufficient to possess thousands of planes. High altitude and speed planes are also necessary. Air forces whose planes can fly highest and fastest will have the upper hand in battle.
>
> Secondly, air battles in Spain and China have shown that objects of air attacks will be not only at the battle front, but also far in the rear. The interior of such countries as for example Britain, Germany, Poland, and France will not be immune from air attacks in view of the geographical conditions.
>
> Thirdly, airplanes will have to fly both day and night, and under all sorts of meteorological conditions. Conse-

quently contemporary military aviation must possess high altitude airplanes, first-class stunt pilots, sharpshooters, courageous and intrepid men.

Military aviation must possess the most up-to-date planes and must steadily improve their fighting qualities. It is precisely such military aviation, with high speed, capable of flight at high altitudes and possessing a wide radius of operations, that the Soviet people have created.

To this may be added one other point; many Spanish Government aviators, including Lord, state that although the German *Heinkel* planes were much faster than the 1934 *Curtiss* and *Boeing* pursuit planes, which had been modified and improved by the Soviet Government before being sent to Spain, these fast planes were not as good fighters as the remodeled American planes because the latter maneuver much better. In view of Fokker's methods in 1918 and the results obtained from them (page 57) this point is of considerable importance. It also emphasizes the value of data obtained under actual fighting conditions.

When the bombs fall again in a major imperial war, the extent of death and destruction they will cause is difficult to forecast accurately. But our civilization can rest content that the best technical brains in all countries will do a thorough job. The extent of devastation caused will be their great memorial.

Part IV

MORALE AND THE HOME FRONT

The development of air war demands from all countries the building up of the home front. The factors which are felt to control the nations' "will to fight" must be studied and reinforced by the systematic method of propaganda. The peoples of the world do not want another war. Therefore these systematic preparations must be made so that they can be directed to support the next war. The war must be disguised as a war for the preservation of the ideals of the people—Freedom and Democracy in the case of the democracies; against the Communist and Jew in the case of the fascist states.

The danger to real democracy is twofold. It must resist fascist aggression from the outside. It must watch that in resisting external fascist aggression, it does not become a fascist state at home. It must see to it that the army, with the great expansion of its power in a war, does not suppress democratic rights.

This army-political relationship lies at the very base of the maintenance of civilian morale. The factors which seem to be behind this morale will be discussed in this section. The discussion will be illustrated by recent data from the Spanish and other wars. The fascist, democratic and socialist methods of organizing this morale will be described and contrasted.

CHAPTER XII

THE NATIONALISTIC BASIS OF MORALE

It is a commonplace of military history that each major war is entirely different from the preceding ones. When the next major war occurs in Europe, it will not belie the saying; for the airplane must radically alter both the technique and the ethic of war when highly industrialized communities are engaged on opposite sides.

All nations start their next war where the last war left off. The conditions under which a nation enters a war are of basic importance for the consideration of national morale. In this very complex situation, three integrating factors of national morale may be isolated for the purpose of discussion: fighting tradition, prestige, and economic development. There is one method by which these factors are maintained at their best level, namely, propaganda. In common usage, the term propaganda is applied only to the dissemination of an unpopular political theory, often by ethically reprehensible means. This is only one small part of propaganda and is not the way in which the term is used in this book. Propaganda* aims at influencing group behavior by presenting material in the most convincing way to the majority of the group. It aims at causing the group to act in the way suggested by the propagandist. The material used may be true or false. The objective advocated may be good or bad. The attitude created may aim at controlling human ac-

*The reader is referred to the numerous books on this subject. One of the most important is by L. W. Doob, *Propaganda: Its Psychology and Technique* (Holt, N. Y., 1935). The Institute for Propaganda Analysis, Inc. (130 Morningside Drive, New York), publishes a monthly bulletin which gives a scientifically written analysis of a very wide range of propaganda methods in the social, industrial, and political fields. The writer is indebted to the Institute for permission to use the bulletins.

tivity ranging from buying a particular article to a life or death situation in front-line trenches. Propaganda is only a mechanism to accomplish a predetermined end. From this point of view, all normative processes, such as education, use or should use propaganda techniques.

1. FIGHTING TRADITION

Fighting tradition is based on the military history of the nation. In 1914 Germany entered a war with the best European military tradition of the period. Since 1933, Germany has organized her interpretation of the 1914-18 War to show that her armies were really not defeated from the military viewpoint, but were rather betrayed by subversive influences behind the lines. In this way, the National Socialist Party aims at re-establishing the successful fighting tradition of the pre-1918 period. Italy has a much more difficult job to convince the world that she has a fighting tradition. The conquest of Abyssinia raised Italian prestige by wiping out the defeat of the Italians at Adowa in 1896. The Italian collapse in Spain at Guadalajara revealed that the fighting tradition was still not very deep in the Italian soldier outside the Fascist Party members. The Napoleonic success and the mystical theory of *Attuaquez* has given France a fighting tradition of the first order. It cost her 664,000 dead in a sixteen months' period up to December 1, 1915, as against 683,000 for the remaining thirty-five months from then to November 11, 1918. But the fighting tradition still lives. England, except during the terrible period of Haig's command at Passchendaele in 1917, when the English lost 400,000 men between July 31 and November 6, has based her fighting tradition on her ability to sustain a long-drawn-out war. The pressure exerted by her naval power brought her armies victory over enemies who were compelled to fight when and where England wanted to fight. The fighting tradition of grim determination rather than brilliant soldiering is the basis of English military prestige. The new Soviet State has based its fighting tradition on a series of very successful campaigns against military interven-

tionist armies on her own territory. The United States, while never having been really tested, has a fighting tradition of brave soldiering, efficient naval policing, and planned industrial organization. The Civil War campaigns have been recognized as an example of brilliant soldiering. Japan has, next to England, the most successful fighting tradition in the world. In 1904 Japan disposed of a major opponent; today she is successfully carrying out the most aggressive colonial war policy the world has yet seen. Her major danger is the stability of her economic structure. In this, Japan differs radically from England.

All these historical traditions can be applied only to the nations as a whole. They mean simply that military groups and military policies have a different influence in these various countries. This influence, however, molds the attitude of the nation as well as the attitudes of other nations to it. From the point of view of the man-in-the-street, all war is today hated. No large mass of people wants war. The Scandinavian countries seem to have been successful in really expressing this universal attitude. But their success rests mainly on accidental geographical and economic development rather than on any essential difference of policy. Their way is not yet the way of mankind. It is the rest of the world and especially some, if not all, of the countries named, which will have to bear the suffering and strain of the coming air war.

2. NATIONAL PRESTIGE AND ECONOMIC DEVELOPMENT

It is necessary, under modern conditions, to distinguish between two classes of war. Wars conducted at long distances from home, in outlying parts of a colonial empire, raise problems, in the aerial wing, of a new and special nature. These depend not only on the relation between the home government and the colonial peoples, but also on the relation between the home government and other rival governments equally anxious to possess control over colonies.

Colonial wars are waged between a highly organized industrial power on the one hand, and a more or less primitive, econom-

ically undeveloped people on the other hand. The cause of such wars is the need for an extension of the controlled markets of the highly industrialized state.

These wars are waged primarily by powers which are in danger of defeat in the ordinary financial and economic war which is the norm of capitalism in this age of plenty. The state concerned finds it increasingly difficult to dispose of its industrial output. In its struggle to reduce costs to compete with its rivals, must it not cut down wages? Nothing can give relief except the transfer abroad of the surplus on credit. It cannot be transferred for gold, because the more successful rival states can corner gold more easily. Transfer abroad of credit requires that the individuals who control the credit shall have confidence that the foreign loans are good investments. This confidence they can no longer have unless their state has military control of the area to which the loans are to be made. Thus the problem with which the state is faced is to find an undeveloped market which can be annexed to its growing empire.

Unfortunately, as the number of fully industrialized states playing this game increases, the supply of undeveloped markets decreases—Abyssinia was the last of such unclaimed markets in Africa; all the rest had been parceled out. This factor superimposes an imperial rivalry upon the commercial rivalry between the fully industrialized states. Prestige then assumes importance. Prestige is the other fellow's opinion of your fighting power. The state with the greatest prestige possesses a preponderant advantage in its pursuit of markets, and its rivals, unable to acquire new undeveloped markets, suffer the worst pressure of the periodic economic depressions.

Under economic pressure the specter of revolution haunts the hard-pressed owning classes of the losing states. They must burst their economic bonds by acquiring imperial markets or watch the tide of revolution rising to overwhelm them. If they are fortunately placed, they may indulge in a nice little colonial war without treading sufficiently on the corns of the Great Powers, or they may have such a strategic position that the

Great Powers cannot easily intervene. Such was the position of Japan when she started to absorb China.

A state which has lost "face" in the financial economic sphere is generally controlled in its imperial ventures by the Great Powers. Its internal position requires that the owning classes must then set to work to destroy the fighting organizations of their own working classes in order to gain a breathing space. But this breathing space is of little avail unless they can also organize their fighting forces until they possess sufficient prestige to take a hand in the game of grabbing markets. Japan has organized steadily for a great imperial effort. Italy took about thirteen years to go through this stage of development. Nazi Germany, with her much greater industrial resources, seems to have completed the process in about five years.

The policy, when successfully carried out, results in the state presenting the world with such a display of military force that its prestige sails up to somewhere near top place. The state is then in a position to grab what undeveloped markets it chooses, provided it does not run foul of a power with greater prestige and a greater military establishment to support it, and also provided its rivals do not present it with a united front, organized under a system of alliances. Such alliances are, however, united in nothing but name. These systems of alliances in the post-War world are often concealed under some general overt policy, as, for example, the Japanese-German-Italian Anti-Communist Pact.

The military gamblers must play with high and expensive stakes, but the prize is both a new lease of colonial expansion and an escape from the threat of social revolution. Their working class can share to a small extent in the distribution of the spoil. This is no longer enough. The fascist state must also build up a new morale around the slogans of its "official philosophical" basis. As will be shown later in this chapter, this "philosophy" arises from the requirements of morale, whereas in a healthy civilization morale will arise spontaneously from its industrial philosophy.

The economic relief of one state, by the acquisition of con-

trolled markets, can be obtained only at the expense of its rivals. In the shifting balances of power, a difference of opinion as to prestige may ensue. The result is the second class of modern war, the clash between nearly equally matched, highly armed imperial states. The threatening upheaval is of such a magnitude that the interests of all industrialized states are involved, and they throw in their weight on one side or the other, either in an endeavor to establish an unchallengeable prestige on the one side, or in the vain hope of securing the favor of the winner. The fascist state providing the driving force in this struggle for power must aim, therefore, at overwhelming military strength to scare off the potential allies of its challenged rival, and also it must attempt to divide its opponents by every trick known to diplomacy. Complete success may lead to such prestige that no major war ensues for a period. The more likely event is an acceptance of the challenge, the balance of power being secured by a formidable alliance to offset the advantage of initiative possessed by the challenger. It is in the increased advantage of initiative which it confers that the airplane dominates the world situation of today.

3. INDUSTRIAL PREPAREDNESS

The speed of development of airplane design has been increasing so rapidly that the airplanes have been out of date as soon as they are fully in service. For a major war against a well-prepared adversary, each power must assemble its force when it recognizes that the need is arising. At least three years is required for this process—and perhaps longer. The small hand-made wooden planes of the last War could be manufactured all over a country by hundreds of small firms. The powerful metal bomber of today lends itself to the methods of production of the Ford factories.

Expensive press tools may be laid down to stamp out the sheet-metal parts. Automatic lathes, performing simultaneously several machining operations, can turn out the machined parts like sausages. Stitch-riveting and spot-welding can be employed for joining parts. Assembly can take place on the belt, with

overhead conveyers bringing a continuous succession of each of the parts to their appointed positions on the assembly line, from the end of which comes a steady stream of the completed articles. The factory becomes a semi-automatic repetitive machine, in which the human labor is reduced to simple unskilled operations repeated rhythmically throughout the working shift. Three shifts of eight hours can keep the production machine working throughout the twenty-four hours, with short breaks for checking the settings of the automatic machines.

The motorcar or the airplane, to be produced by such a process, must be specially designed with this end in view. The factory must be laid out with a view to design. Much careful research and planning must precede the production process. Special machine tools must be procured. Once production has begun, however, the output is terrific and out of all proportion to the manpower employed. About three years is the period of gestation.

An intending aggressor state can prepare all the details in secret for such a process and at the selected moment begin to assemble the necessary plants. In about two years the full production rate should be reached, and at the end of another year the number of airplanes assembled should be adequate. Provision must be made to have the necessary number of pilots trained. Partial training can be given beforehand through sports flying clubs; after a further short period of training on the new airplanes, the most formidable striking force can be ready for use.

Mr. S. Paul Johnston,* editor of *Aviation,* who recently completed a tour of airplane factories in England, Germany, Italy, France, and other countries, was able to compare the 1938 aviation production with that of his earlier visit in 1936. Describing one of the most up-to-date German factories at Oranienburg, Germany, he wrote:

* S. P. Johnston, "Box Score—An Appraisal of European Air Power," *Aviation,* Vol. 38, January, 1939 (McGraw-Hill, New York). S. P. Johnston, "Marching as to War—Student Training Programs Here and Abroad," *Aviation,* Vol. 38, February, 1939. S. P. Johnston, "Hitler Wasn't Bluffing," *The Saturday Evening Post,* Vol. 211, February 18, 1939. See also H. Bouché, *"Les Forces aéronautiques en Europe." L'Illustration,* No. 4994, Paris, November, 1938.

Its various departments are housed separately in brick, steel and glass buildings, each well camouflaged, each provided with elaborate *Luft-schutz* (air-raid) shelters and equipment. The several manufacturing units are scattered over a large area of ground to minimize bomb damage. The entire plant was built in less than a year and went into production about May, 1938. When I saw it late in November, it was turning out nothing but *Heinkel 111* bombers, fitted with two Junkers Jumo 211 fuel-injection type 12-cylinder, inverted-Vee, liquid-cooled engines. At a guess, on one eight-hour shift per day, and operating without pressure, it was probably turning out 10 to 12 machines per week. By turning on the heat it is not unreasonable that Oranienburg might be able to turn out close to 40 per week.

Johnston estimated that Germany produced six thousand machines in 1938. In the writer's opinion, this estimate is probably too low. In any case, if Germany wanted to, her airplane production could easily rise to twelve hundred planes per month without industrial expansion outside her present aeronautical industry. These figures illustrate that the world is now in the pre-air-war production period.

There is another method of mass production which can also be applied to the modern airplane and which is only slightly less effective than the Ford process. This process is practised in the English Morris car factories. Components are produced in specialized factories and transported to the assembly plant. This process is more flexible and can be more readily improvised for war purposes by an industrial state with adequate workshop facilities. A careful survey of the industrial equipment, having regard to the claims of all three of the fighting forces, must, however, precede the inauguration of production on a war basis.

This method was employed in England during the 1914-18 War. In 1918 plane production had reached 4,000 planes per month. In 1917, Lord Weir calculated that 100 British squadrons of 18 planes each at the Front, required a monthly production rate of 1,000 planes per month. The French estimated that

2,400 air frames and 4,000 engines per month were required to maintain 4,000 aircraft at the Front. The German output was about 2,000 planes per month. In 1918 Germany produced over 14,000 planes and 16,500 aero-motors. The British wastage of planes was approximately 80 per cent and the Front-line planes were held to require a reserve of 500 per cent. The total British production in 1918 was over 30,000 planes.

4. MASS PRODUCTION AND MASS MURDER

These figures have been widely used for discussion of the plane production necessary for the next air war. Many writers have not realized the limitations of these figures. The question at once arises: Why the enormous size of the British plane production as compared with France and Germany? This cannot be explained away by saying that the British supplied planes for all the outlined fronts and for the American armies. On the Western Front in 1918, approximately 3,000 German planes were dealing with 3,000 French and 3,300 British machines. The real reason seems to be in the superior fighting tactics of the German Air Force. The development of these tactics by Boelcke, Richthofen, and the German Air Force Staff has already been described (page 24). This conclusion is confirmed by Brigadier-General P. R. C. Groves,* who was Director of Flying Operation at the Air Ministry during 1918. In March, 1918, Groves showed that 51 per cent of the pilots leaving for France had totally inadequate training. Major-General Sir Frederick Sykes, Chief of the Air Staff, supported Groves in his attempt to get this murder of pilots stopped, but their influence was not sufficient to control the Air Ministry policy. So the murder went on. The terrible air losses are all the more amazing when it is realized that the British planes were superior to the German machines during 1917 and afterwards. This was especially true of the *Sopwith "Pup," Sopwith Triplane,* and the *Bristol* fighters. To illustrate the German fighting superiority, two references will be given. Groves writes:

> . . . our flying corps was out-matched early in 1917 and

*P. R. C. Groves, *Behind the Smoke Screen* (Faber, London, 1934).

suffered enormous losses at the hands of a numerically inferior foe. This is clearly established in the account of the air operations centering upon the battle of Arras in the latest Volume (No. III) of *The War in the Air.* On the opening day of that offensive (April 9, 1917) there were, according to the official air historian, "Forty-one squadrons with the four British Armies (the First, Third, Fifth and Fourth) along the Front stretching approximately between Lille and Peronne. They had on charge on the day 754 airplanes of which 385 were single-seated fighters or fighter-reconnaissance aircraft. With the two German Armies—the Sixth and First—opposed to them, were 264 airplanes, of which 114 were single-seater fighters or protective airplanes."

Despite our immense numerical superiority the Germans gained and maintained mastery in the air, and inflicted fantastic losses upon the R. F. C. "In no other month throughout the War," says the official historian, "was the Royal Flying Corps so hard pressed, never were the casualties suffered so heavy."

The last volume of the British *Official History of the War,* "War in the Air," gives full details of a raid in May, 1918, by Squadron No. 99. Twelve machines took off to bomb the Rhineland; three returned with engine trouble. Out of the remaining nine, seven were shot down and only two returned safely. "Most of the pilots who had recently joined the squadron were from England with little experience of flying in formation." The fact that the British morale could withstand this systematic policy of murder is the greatest tribute that can be made to that morale.

Inevitably the superior machine and numerical strength of the British Air Force told its tale. It was aided by the death of Richthofen. Soon after his death, Goering became leader of his *Staffel.* Goering had the British attitude of fighting it out—not that of Boelcke and Richthofen of fighting as soldiers to kill, not to be killed. In August, 1918, Goering led his *Staffel* of fifty

machines into action against the British Air Force. After four days of fighting the *Staffel* was reduced to eleven machines. But Goering went up again to lose four more machines. The tradition of Boelcke and Richthofen to avoid or break off a fight against superior odds was lost and with it went the last hope of German air superiority.

These facts of senseless destruction, not only of human life but of one of the most expensive units of military mechanism, made the British figure completely abnormal (unless, of course, the same stupid tactics are repeated in another war). The dramatic increase in motor life and efficiency, the increased structural strength of the all-metal monoplane, the new instruments for safe flying—all combine to reduce the plane loss in another air war. The increased load, speed, and flying range of the modern plane mean an increase of military effectiveness. Modern methods of mass production mean that the replacement of losses is more easy than in 1918. All these factors indicate that the maintenance of a first-line strength of four thousand machines is a much simpler problem than in 1918. The only other factor is that other nations have an equal possibility of expansion and development if they have an efficient industrial system and if the enemy air raid cannot stop industrial production.

The history of aerial warfare makes it evident that equipment is not the whole or even the major factor. In the 1914-18 War, the German air training and tactics gave it its undoubted superiority. It was aided by good general staff work and its great industrial machine. This industrial machine enabled Fokker and other designers to develop their plans to the full. Of equal importance was the quality of fighting leadership. Goering's tactics proved a complete failure in spite of the successful tradition and careful training he had received from Richthofen. The actual orders Goering received have never been published, but even if they were to fight it out at all cost, both Boelcke and Richthofen had established their right to control fighting tactics even against general staff orders. Goering's fighting tactics fit in so well with the later development of personality that it is likely

it was quite unnecessary to give such orders to him. He acted as he would be expected to act, and his actions brought a clean-cut defeat. The leadership of a fighting air force is as important today as it was in 1918. Victory in aerial warfare can only be won or lost in air fighting. It is not possible to predict it on the basis of efficient equipment and mechanizations alone. The mechanism cannot replace the human beings who control it. Here the factor of military morale is of great importance.

CHAPTER XIII

MILITARY MORALE AND ITS MAINTENANCE

THE STORY OF BOELCKE, A. N. Other, Lord, and Fokker is not the story of how Germans, Britishers, Americans, or Dutchmen behave in war and in aviation. Instead, it is simply four case histories which combine to describe how war affected four men and which illustrate certain important factors in aerial warfare. These four men, like others of their kind, openly admit terrific strain. To the strain of flying which Fokker graphically described, the remaining three added the strain of actual aerial combat.

1. THE MORALE OF THE WAR PILOTS

These four case histories reveal how strain starts and grows. The pilots' attitude is not constant but changing in response to the strain of the war. The strain is not confined to fighting alone. In aerial warfare there was the added strain of flying. Fokker has told how this strain of flying early machines affected him not only in the past, but even today. The same effect is reported by other air pioneers. As the war went on, the reliability of the machines improved, but the strain on the pilots increased. This strain was not simple, but complex. In it at least five factors can be distinguished. First, the fear of being shot down, and especially of flames. Second, the dislike of war and realization

of the futility of killing. Third, the effect of even a remote personal contact. Fourth, the effect of military training and the acceptance of a definite philosophy. Fifth, marked difference in the individual response. All these specific factors in the actual fighting situation are related to the various personality characteristics which go to make up a man's physical and mental capability of being an efficient soldier. Secondary information from Culpin, Fokker, Crozier, and Goering shows the same characteristics as the three war aviators described in detail. Goering's case is of special interest. There is no doubt of Goering's personal bravery. He, however, developed the use of drugs and was in various Swedish hospitals and mental homes in 1925 and 1926. Whether his bravery, his drug-taking, and his sadistic tendencies are a result of the War or whether the War only gave an adequate situation for their full expression, it is impossible to determine. The fact that he had to resort to drug-taking is definite evidence that his personality did succumb to strains imposed upon it.

2. THE VALUE OF ACTION

One of the most important factors in avoidance of strain in aerial fighting, machine-gunning, or bombing is "distance" of the airman from the results of his actions. The records given show very clearly the effect of breaking down this isolation. Once the consequence of his actions is visually presented to the airman, the strain increases with remarkable force. Numerous records are available of airmen with distinguished records in aerial warfare fainting or vomiting at the sight which had become routine for infantry. The fact that their operations usually involved *action* with little waiting was also a very important factor in avoiding strain. Fighting against equally-equipped opponents, constant action in the air, isolation from the results of his action, the great prestige of being an ace—all these aided the building up of defense mechanisms against the possibility of death. The discipline of the regular army soldier or sailor was an important auxiliary factor. But none of these influences was sufficient to suppress the ever growing fear of death and the

steady hatred of war with its senseless mass killing. The negative morale factor of the court martial was difficult if not impossible to apply to pilots. The case of Rats (page 34) is typical of the difficulty in proving that an airman's nerves were gone. In most cases, no court martial was necessary. An airman with a broken morale was fairly sure to be an easy victim for a fighting enemy. His only way out was a forced landing and imprisonment in enemy territory. In the British Army all captured officers automatically had to face a court martial on their return. In most cases, it was a mere formality but still the threat was always there.

The modern use of the airplane as an offensive weapon rather than as an observation unit has deprived the fighting pilot of one of his old defense mechanisms—the romantic war in the air. The romantic war was built up in the camaraderie of the last war. Captured enemy pilots were entertained at the Air Force mess. When Boelcke died, the British Air Force dropped a wreath behind the German lines with a letter addressed "To the German Flying Corps" with a message reading: "To the memory of Captain Boelcke, our brave and chivalrous opponent. From the English Royal Flying Corps." Similar incidents were very numerous on both sides and on all fronts.

But no one loved the bomber. It is remarkable that practically all the available records are those of the fighting pilot. The writer has been unable to trace any diary material from pilots in bombing squadrons. Boelcke's dislike of bombing seems to have been almost universal in all armies in the last war. Bombing of the type described by Lord was carried out by Allied and German airmen on all fronts against the Red Army. Here the justification was the Red hordes who strangely oppressed the Russian people and prevented them from joining the White Army. In these wars, as in Spain, the childish romanticism of the 1914-18 War was missing. Civil war and fascist war are a serious business. Since the bomber is the long-range gunner of the next war, the bombing pilot has only one duty to carry out in exact detail—his orders—to unload his bombs on the given objective. This objective must in the majority of cases involve bombing civilians

—women, children, and workers. What will this do to the pilot? The records of the last war show that this type of work increases mental tension. Men do not like it. The isolation of the bombing pilot cannot be complete. The danger of revolt and mutiny is increased. This danger is clearly realized by all military authorities.

3. TRAINING THE BOMBER'S PILOT

The danger is offset in various ways. Air forces are based on volunteers, not conscripts. Young pilots are preferred. Their interest in the splendid mechanism they are to fly is systematically built up and exploited. Bombing is part of an exciting routine. After a few years, these pilots go on the air force reserves. When they are recalled the old habit patterns are expected to re-assert themselves and moral attitudes are to be submerged. The training is always designed with a maximum emphasis on contempt for risk and death. The theory is that the more dangerous the job is, the less moral thinking it will involve.

The official justification for the disastrous offensive policy of the British Air Force was that the offensive action helped to keep up the morale of pilots and observers. By establishing a tradition of fighting to the death, with a stiff upper lip, morale was to be maintained. The World War has shown how dangerous and tragic that policy was. The same factor is being used today in the training methods not only of the fascist powers, but also of the democracies. To suppress in the military personnel all systematic thinking on the meaning of war, to emphasize the action, the bravery, the stoical acceptance of death—this is the basic policy behind which modern air morale is being created in many countries. This systematic suppression of intelligence instead of its development and employment, because of the old tradition of a meaningless discipline and of military morale, may prove once again in the next war as tragically expensive as in the last.

4. THE MORALE OF THE SOLDIER

The 1914-18 War was based on conscript armies. In all countries war pilots were volunteers; therefore, their morale had the best psychological foundation. The three war pilots whose records

have been discussed had the highest morale and very high technical skill. Their morale had a positive basis. All armies go to war with a positive morale. All armies, however, are prepared to re-inforce this positive morale with an organized negative morale.

This negative morale is expressed by the provost marshal and his military police. For alleged cowardice or desertion, every soldier knows he must face a court martial. In the British Army, if a court martial finds either of these two charges true against a soldier in the fighting line, then the penalty is death. If this sentence is confirmed by the Commander-in-Chief, the soldier is executed before the battalion on parade. Brigadier-General F. P. Crozier has given us a graphic description of this ceremonial execution of one of his own men:*

> I saw the execution; and the whole battalion heard it on parade, a wall screening the victim from the men's view. Death, despite all precautions, was not instantaneous. Owing to nerves, the firing-party fired wide. It was an event that had been anticipated.
>
> Later, the Divisional Commander wrote congratulating the battalion on its "soldierly bearing in the face of great strain." Execution cannot be carried out by a bad battalion lacking in morale.
>
> Before Crockett † took his first drink he had seen the Chaplain, written his letters, and made his peace with God. In the eyes of God, of course, he had committed no specific sin demanding repentance; therefore the Chaplain's task was easy. But in the eyes of the military authorities Crockett was an outcast.
>
> To us, what was he? He was only poor Crockett. And we never made up our minds for whom we were sorrier—him, or ourselves. For such is war.

Thus did the British reinforce all the other mechanisms by which it built up morale.

* F. P. Crozier, *The Men I Killed* (Joseph, London, 1937).

† The fictitious name of a man whom General Crozier knew throughout his army career. He deserted from the front-line trenches during the night.

The positive morale of an army is supported by all the traditional records and the living pageantry of the past.

General Crozier has described the morale-producing effect of the ceremonial of the "Trooping of the Colors":

> The Trooping of the Colors is an immense moral stimulus. The Guards do it better and more frequently than others, and because of that, and because of the fact that their daily responsibilities concerning the safety of the Sovereign create the spirit of "Do or Die" within them, they fail less than others. Yet, even they have to do a bit of unrehearsed shooting out of hand on occasion.
>
> Indeed, it is very doubtful if the most highly-trained, long-service troops in the world would stand up to modern war for long—let alone for four years—if the shadow of the death penalty did not always loom in the distance and the fear of the consequences of misbehavior in face of the enemy was not constantly held in mind.

It is the combination of the two ceremonials—glory and disgrace—which builds up the military morale.

The ceremonial execution has its function in adding the negative morale of fear and disgrace to the positive morale of fighting and dying for an accepted ideal. The method, however, is only preparation for something else. In all wars, the time may come when a line must be held at all costs. In this case it is the duty of the officers in charge to shoot any deserters out of hand. One deserter may destroy the morale of a whole line—and the line must be held.

On April 11, 1918, Field Marshal Sir Douglas Haig, Commander-in-Chief of the British Army in France, issued his famous Special Order of the Day. The last paragraph read:

> There is no other course open to us but to fight it out. Every position must be held to the last man; there must be no retirement. With our backs to the wall and believing in the justice of our cause each one of us must fight on to the end. The safety of our homes and the freedom of mankind alike depend upon the conduct of each one of us at this critical moment.

The British *Official History of the War* quotes the following interpretation of the order, issued by a young Australian subaltern of the First Australian Division.

Special orders to No. . . . . .Section:

(1) This position will be held, and the section will remain here until relieved.

(2) The enemy cannot be allowed to interfere with this program.

(3) If the section cannot remain here alive it will remain here dead, but in any case it will remain here.

(4) Should any man through shell-shock or other cause attempt to surrender he will remain here dead.

(5) Should all guns be blown out, the section will use Mills grenades and other novelties.

(6) Finally, the position as stated will be held.

Brigadier-General Crozier comments on this as follows:

Was this young Australian subaltern perpetrating murder or not? Perhaps the Archbishop of York will be able to tell us. If he was committing murder, then the Special Order of the Day by Field-Marshal Commander-in-Chief was a direct incitement to murder—to the murder of one's comrades, of one's own brothers.

I was, alas, too old a hand at the game to require to be incited to murder—as is quite clear from this official record. I did my private shooting two days earlier, without higher orders, because I had been trained in the tradition and knew every rule of the game of war by heart. Of course my shooting is not referred to in the Official Diaries. It is not the thing to do, for a man to refer to himself as a murderer. There is a bald statement in the official narrative of those events. It reads:

> "Reinforced by the divisional engineers and pioneers, headquarters, under Brigadier-General Crozier, and brigade schools, the 119th, by 3:30 P.M., was holding a 4,000 yards line," . . . and so and on.

I owe it to the women and children of the present generation to tell the truth, the whole wretched truth, at the

same time begging them to remember that what men sow, shall they reap.

Here is the negative approach to the maintenance of morale. This is the way in which the man-in-the-uniform has to be dealt with in time of emergency. If the line is held, a victory is gained. If the line breaks, who is to tell the tale? The function of an army is to obey orders. If the orders are to hold the line, then it must be held. It is better that a few men should die than that a defeat be incurred. The military commander who cannot shoot his own men, when it is necessary to hold an essential position, is not an efficient commander. This is an ethic of war.

5. CIVILIAN AND MILITARY MORALE CONTRASTED

The mechanism by which military morale is maintained is now clear. It is essential to understand this mechanism in all its stark reality in order to grasp the problems of the maintenance of civilian morale in an air war.

Civilians are not volunteers like Boelcke, A. N. Other, and Lord. Civilians are not disciplined like these men or even like the conscript soldier of the 1914-18 War. Civilians are not physically selected as all soldiers were. Civilians mean women, children, sick and old, as well as fit men and women.

The military morale has no direct relationship to that of a normal community. Military success will, of course, help civilians to stand firm. But their morale is not a military morale. If they are not protected, the people will turn on the military (page 104). It has been reported to the writer, from a reliable but an unquotable source, that in spite of the great prestige of the German airmen in the eyes of the German people, when the Allied air raids on the Rhine were being systematically carried out in 1918, German pilots, if they appeared in uniform in certain Rhineland areas, were attacked. The people, in this case rightly, attributed the British air raids to the activities of their former heroes.

Evidence of morale, from the army experience, cannot be applied to civilian problems except in a negative manner. Fokker candidly admits he would not like to bear the strain of aerial

warfare. Where army morale collapses before a particular weapon, such as it did in the case of gas warfare, it seems likely that civilian morale will collapse even more quickly.

However, this military attitude to the maintenance of morale has important implications in the relationship of the military to the political control. The military mind which used the fear of the firing squad to counteract the fear of death in the firing line is always prone to use systematic destruction to destroy the morale of enemy civilians. The classical expression of this doctrine is the phrase "the enemy should be left with only his eyes to weep with."

More dangerous than these crudities of expression and action is the general attitude of the military high command to their own troops, to civilian political control, and to civilians in general. In this attitude lies one of the factors which may control the whole political development of a democratic people. The next war in which civilian morale will be directly attacked will tend to extend the power of military control over the civilian population. It therefore is essential to try to discover how efficient the military mind has been in dealing with the army's problem of morale. How successful it was in dealing with industrial and civilian problems in the 1914-18 War and also how the army can be controlled so that democracy may be preserved during and after the next war, are topics which will be discussed in the next chapter.

CHAPTER XIV

THE DEMOCRATIC CONTROL OF THE ARMY

UNTIL 1800, IN MOST European countries, army careers were the prerogative of the sons of the aristocracy and landed gentry, and the political function of the army was the defense of the state against other nations and the protection of the class interests of the officers at home. With the rise of the industrialists

and the breakdown of aristocracies, the position of the army changed, but the great liberal democracies never solved completely the problem of army control. In general they tried two lines of approach: first, democratization of the officer class; and second, financial control over the army estimates. There was no unity of constitutional practice in European countries; the majority of countries enforced some type of conscription while England, under the protection of her navy, relied on a professional army.

The revolutions in America and France created new attitudes toward the army. It was on the basis of this revolutionary drive that Napoleon carried out his first campaigns. His brilliant generalship enabled him to convert the army into an instrument for the expression of his personal aggrandizement. Through its power he was able to get in sight of European domination, but even the great personal loyalty he inspired was unable to promote the necessary morale and economic development which his military machine required.

The American Revolution produced a very different situation. Dr. Vagts describes the situation as follows:

> At the end of the Revolution, America presented the scene of a society without a monarch, without a privileged aristocracy to monopolize the offices of the army, without a state church to bless the banners of war. That was a menacing challenge to the European military system and the political system which it enclosed.

But the situation so created was almost too much for the young republic. It was only at the end of Washington's political career that the problem of a standing army versus a militia force was solved for a time. The Constitution finally placed the army under the civilian control of the President, established a militia and the right of the people to keep and bear arms, and founded a system of military education expressly designed to prevent a privileged officer class. The American military system today still carries on many essentials of this early attitude. It was not until the Russian Revolution that the complete democratization of the army of a great power was finally accomplished.

When in an air war, the civilian population is under direct attack, the closer the relationship of army to the civilian population, the stronger will be the integration of military and civilian morale. The attitude of the army to democratic control is best reflected in the psychology of the high command.

1. THE PSYCHOLOGY OF THE HIGH COMMAND

The account of aerial warfare has brought out clearly that fighting brains like Boelcke and Richthofen and numerous others are most important to the successful maintenance of the Light Brigade attitude of

> Theirs not to make reply,
> Theirs not to reason why,
> Theirs but to do and die.

Behind this suppression of intelligent thinking lies the factor of the social struggle. To have a thinking army means to discuss and analyze not only tactics and strategy, but also the causes of war; to study and read carefully records such as those of the Nye Committee on the policy of munition makers; to discuss the ethical problems of killing and its relation to murder. All these and similar problems are not the sort of thing the professional soldier of either the fascist or democratic nations has either the ability to handle or the psychological training to face up to. Any attempt to break down the mysterious isolation of a general staff from the rank and file and even from their army corps commanders will bring down all the authoritative thunder that the All-High Command enjoys with Jupiter himself. One other fatal defect in any plan to modernize military attitude is that the rank and file might become human beings, not just military units.

Foch, Haig, Falkenhayn, Ludendorff, and all army commanders do not conceive of an army or army corps as groups of men, but as solid units to be used by a commander. Foch has most aptly expressed the viewpoint:

> An army is to a commander what a sword is to a soldier; it is only worth anything in so far as it receives from him a certain impulsion.

Therefore the army is based on organized units, the activity of which can be accurately predicted. The army can destroy similar organized units under the direction of the commander. The essential part is the commander who demands from the state an adequate army with which to write his genius on the pages of history. In 1914-18 it was well and deeply written at Passchendaele, Verdun, Tannenburg, Gallipoli, Caporetto—in the blood of the men they commanded. This whole policy of High Command—its authority, its independence, and its refusal of democratic discussion—is serious for all democratic countries. In the changing attitudes and temper of the man-in-the-street, the relationship between the military authorities of a country and the civilian population will be a basic factor which may well control the whole morale of the civilian population and, therefore, of the country.

This placing of all the resources of the state under the control of the commander-in-chief is the end result of our civilization when war occurs. In this situation the great peril to democratic institutions arises. The clearest example of this dilemma has been shown in the final stage of the Spanish war when part of the military command under General Miaja repudiated the political policy of Prime Minister Dr. Negrin. This repudiation of the political control is always a possibility which is too often neglected in the discussion of the problem of democratic control. The methods used to control the army by both fascist and socialist states show other ways of handling this problem.

2. THE ARMY COMMAND AND THE POLITICAL CONTROL

One of the most important factors in the general morale is the relationship between the army high command and the political representatives of a democratic people. With the ready acceptance of the fascist ideology in certain military circles and the military success of Spanish Army fascists against the duly elected democratic Spanish Republican Government, the question is now of supreme importance for all democratic people. In theory, the army is the servant of the state. Its function is to carry out in a technical manner the orders given to it by the

elected government. In practice, all armies have been deeply involved in politics and the functioning of the army, as a purely technical instrument, has never really been attained. The degree of direct army influence on politics has varied from the military-controlled government of Japan to the attempted *coup d'état* of certain generals in the Soviet Union during 1936-37. This problem has been very fully discussed by all leading military theoreticians and by very few social scientists. Recently Dr. A. Vagts very ably surveyed military history in an attempt to outline this problem in its historical setting. For a general treatment of the subject the reader is referred to his book.* Here the concern is with the efficiency of a military-political relationship in two particular spheres. One is the swift and efficient prosecution of a war to attain the objective laid down by the democratic government. The other is the relationship of the people's attitude to the military as a factor in morale. The very thorough historical analysis of the 1914-18 War has clearly revealed the enormous weakness of the military high commands of all belligerent countries. It has also shown that the broader problems of strategy—the development of munitions supplies, and even the use of certain military weapons—were more readily solved by the civilian politician than by the army command. This is so well known that it need be illustrated by but three examples from the abundant material available.

In July, 1915, the British Civilian Ministry of Munitions was faced with numerous problems of planning what type and quantity of munitions were essential for war purposes. Sir Eric Geddes had the greatest difficulty in getting from Lord Kitchener the number of Lewis machine guns per battalion the army would require. The final memo from Kitchener read: "Essential 2 per battalion. If possible run to 4 per battalion and above 4 may be counted as a luxury." When Geddes asked Lloyd George, then Minister of Munitions, to countersign this order he was instructed to "Take Kitchener's maximum (four per battalion); square it: Multiply that result by two; and when

*A. Vagts, *A History of Militarism: Romance and Realities of a Profession* (Norton, N. Y., 1937).

you are in sight of that, double it again for luck." This crude estimate gave thirty-two machine guns per battalion with another thirty-two for margin when this production could be achieved. In actual fact, in November, 1914, the War Office demanded sixteen machine guns per battalion and at the end of the War the machine guns with a battalion and the reserve guns necessary to maintain this fighting equipment were eighty per battalion.

In 1915, Captain Fritz Haber was given permission by the German High Command to develop his plans for poison gas warfare. Heinz Liepmann* gives the following account of Professor Haber's statement on the use of poison gas in war:

> But on the day when the inventor officially communicated his finished plans for gas warfare to the leaders of the German Army, we learn from eyewitnesses that, to the consternation of these leaders, if not to their horror, Captain Haber delivered the following address:
>
> Gentlemen, I feel it my duty to warn you against adopting my schemes, or any scheme for gas warfare, if you think the war likely to continue for as much as three or four months longer. I utter this warning as emphatically as I can. We have now reached the end of the year 1914. If you, the leaders of this empire and of its army, believe that there is the slightest possibility of the war lasting longer than until the early summer of 1915, then you should on no account begin gas warfare. I know nothing whatever about the basic motives, the conduct, or the reserve forces of this war. You, gentlemen, are well informed upon these matters. I implore you to lay my words to heart. If there is even the remotest possibility that the war will last beyond the summer 1915, reject all schemes for gas warfare. If you disregard my warning, we shall be beaten by the use of our own weapen. Our enemies have a hundred times as much raw material as we, and, should the war last beyond the summer 1915, they will have time to overtake us in our stride, and to drench us with quantities of gas enormously greater than we shall ever be able to produce.

*H. Liepmann, *Poison in the Air* (Lippincott, Philadelphia, 1937).

It has never yet been divulged whether the German High Command felt convinced that a victory for their arms was imminent, or whether the authorities made light of Haber's warning. Anyhow, gas warfare began on April 22, 1915.

The German High Command not only neglected Haber's advice on strategy, but their tactical use of this weapon was so poor that the Allies were able to meet it successfully, and eventually, as Haber predicted, they were more successful in the use of gas than the Germans themselves.

The final illustration brings home very vividly the crux of the military-political relationship.

It was with the greatest difficulty that Sir Douglas Haig was able to persuade the British Cabinet to consent to his murderous offensive at Passchendaele in 1917. The documents now published show quite clearly that Haig misled the Cabinet in order to get their approval. The crowning deception occurred when the Prime Minister (Lloyd George) decided to visit the Front. Liddell Hart's * account of what happened and his comments are the best description of this almost incredible military duplicity:

> He [Lloyd George] was told by Haig and his Staff of the marked deterioration in the German prisoners. He was shown a "cage," and had to admit that they were a "weakly lot."
>
> How could any civilian Minister dare to put a stop to a campaign that, on such evidence, might be so near to producing the collapse of the enemy? "It was some years after the War that I ascertained, on authority which is unimpeachable, that on that occasion G. H. Q. rang up the Fifth Army and stated that the Prime Minister was coming down. . . . Instructions were given . . . to see that able-bodied prisoners were removed from the corps cages." † That surely is the crowning stroke of a long course of deceit. In the case of a trivial financial investment such deceit would be a criminal matter. Yet in this matter of

* Liddell Hart, *Through the Fog of War* (Random House, N. Y., 1938).
† Quotation from Lloyd George's Memoirs.

life and death to scores of thousands of their countrymen and to Britain herself it was perpetrated by officers who were honorable men—according to their lights.

There is something fundamentally wrong with a code of honor which permits such dishonesty—even from good motives. No one will question that Haig and his Staff were pursuing what they believed to be their country's good. But this conduct afforded yet another proof of the fallacy that the end justifies the means.

What matters now is not recrimination. No thoughtful student of humanity and history will desire to cast stones at their memory. He will value their virtues none the less for perceiving their weaknesses. But will the next generation learn the lesson, or will it merely confirm Hegel's observation that "We learn from history that we do not learn from history"?

The general failure of both the German and Allied High Commands shows quite clearly that the soldier outside his peculiar military sphere is almost certain to make a complete mess of the secondary problems related to the prosecution of a war. The military mind which worries perpetually over the problem of morale is quite unable to cope with the problem. It has shown itself to be inefficient in its treatment of all problems involving industrialization and propaganda. It is reckless in its use of manpower—the quickest way to destroy fighting tradition in any nation. It believes that the civilian is completely incompetent in all things pertaining to military matters. It faces another war in which a fighting nation will have to maintain not only the morale of its soldiers but the morale of a civilian population which will be under a direct attack from the air.

The great difficulty of the democratic politician is that he has always deemed it to be essential to build up the high command and especially the commander-in-chief by his propaganda machine. In both England and Germany official praise was given only to individual war heroes or to the commander-in-chief. This created very great difficulty when a particularly poor

commander had to be removed. In Germany, for instance, the removal of General von Falkenhayn was concealed for several weeks because of the certain shock to the German people. Sir Douglas Haig was practically unremovable. This is the dilemma of the democracies but it is also the dilemma of the dictatorships. What is not realized is that the dictatorship seems to have invented a method which solves this dilemma.

3. DICTATORSHIP OVER THE MILITARY

In all totalitarian countries the basic structure is not an individual but the party. In the use of this party structure a fundamental difference between the communist dictatorship and the fascist dictatorship develops. The fascist party disguises itself behind a person, the Communist Party expresses itself through a personality. All totalitarian parties run through the whole political structure but only the Communist Party seems to have developed a systematic method of dealing with the army. This method is the appointment of a political commissar who is directly responsible for the maintenance of morale and for seeing that the army command carries out efficiently the duties referred to it by the state. In May, 1937, the duties of the political commissars were extended by a Soviet decree setting up a tribunal of three members for each military district in which two members were civilians and only one a soldier (the commanding officer of the district). It was this measure, combined with the confession of Trotskyists and other groups, which revealed the military plot against the Soviet State. As a result of the investigation carried out by the tribunals, the trial of the so-called eight generals took place. M. N. Tukhachevsky, I. E. Yakov, I. P. Uborevitch, A. G. Kork, R. P. Eidemann, B. M. Feldman, V. M. Primakov, and V. K. Putna—all staff officers of the Soviet Army—were placed on trial before a military court martial on a series of charges. These charges were that they co-operated with the Rightist groups to overthrow the Soviet regime; that they had maintained contacts with the military intelligence of an unfriendly foreign state and had systematically given espionage information to this power; that

they had formed a military agreement with this state in which they would have its co-operation in setting up a military-capitalist regime in the Soviet Union. As with all court martials, the details of the trial have not been published, but the evidence from the other trial clearly indicates that the plot was made with the German Military Staff. The left-wing plotters under Bukharin had made arrangements to use this military group to gain power and then to eliminate them before the generals could establish themselves in a military dictatorship. The generals' political policy was a military and economic agreement with the German *Reichswehr*, even at the cost of territorial concessions. The generals were condemned to death and duly executed. In this way the developing socialist democracy was protected from a direct internal military attack. The recent events in Spain after the fall of Barcelona indicate how an army will treat its own elected government. These events show the value of the Soviet method of military control, in which the political commissars are known to all.

On the other hand, it is generally believed that the National Socialist Party in Germany has its own intelligence service in all the German state institutions including the *Reichswehr*. The Italian method is similar but is not so widespread or so effective as the German. The High Command of the picked Italian troops in Spain developed its internal espionage service as shown by the following army orders captured by the Spanish Republican Government at Guadalajara: *

SECOND VOLUNTEER BRIGADE *FIAMME NERE* HEADQUARTERS
Serial No. 2A/III. Confidential and personal
2nd Section, Intelligence.
Burgo de Osma, February 11, 1937, XV.
SUBJECT: POLITICAL SERVICE.
To the Officers Commanding Groups of
Banderas VI, VII, VIII and IX.

It is necessary to institute a political service for each group of *Banderas*.

*Extracts taken from the *Spanish White Book: The Italian Invasion of Spain,* published by the Spanish Embassy, Washington, 1937. Documents presented to the League of Nations Council in March, 1937, by J. Alvarez del Vayo.

This service should be staffed by a selected personnel, known to nobody, entirely reliable, and absolutely discreet.

Duties: To watch, listen, study individuals, and report everything. I have reason to believe that subversive cells are being formed in the district, and that *agents provocateurs* have been instructed to conduct defeatist propaganda among the troops.

Vigilance is necessary in order that everything may be known—what both soldiers and country people are thinking.

Accordingly, this personnel should frequent all canteens, inns, taverns, meeting-places, listen to what is said, etc.

Each Group Command will organize this service as it thinks fit, in order to be constantly aware of the pulse of its own men and the temper of the local people.

Never allow yourselves to be surprised, either by the enemy or by events.

I should be glad to be informed by letter addressed to me personally and confidentially, on the 15th and 30th of the month, of anything new that has taken place in this field.

General Commanding the Brigade:
(G. A. Coppi)
(Autograph signature:) A. G. Coppi

General A. G. Coppi on February 24, 1937, issued another order in which he stated:

> . . . It should also be remembered that, in the matter of rations the fighting men must be made to feel that nothing is being left undone by the personnel responsible for this highly important service; it should be remembered that the soldier fights partly *with his belly;* if the latter is well provided for, morale rises, and the utmost can be got out of such excellent soldiers as ours.

That famous dictum of Napoleon that an army fights on its stomach is as true today as when it was said.

On March 16, 1937, the Italian Division Commander, General Mancini, issued a long general order on the "Preparation of Morale to all Italian Divisional Commanders in Spain." The

following extract illustrates the type of rumors which were affecting the morale of his troops and which were probably collected by the espionage system which had been set up:

A—Various circumstances, with which you are acquainted, show that although the units are composed of troops with a high morale and ready to follow their leaders, etc., they are often lacking in dash and aggressiveness, and allow themselves to be impressed too easily by the vicissitudes of battle.

In view of the intrinsic quality of the troops, this is due in 90 per cent of the cases to the *command*, and especially to the subordinate leaders (of whom several are of little professional value, while others show apathy, passivity, and a utilitarian and pacifist attitude unworthy of Italian leaders of men in the year XV of the Fascist Era).

This state of affairs, which is already sufficiently regrettable in itself, might become a real danger if, in addition, there was a tendency to overestimate the value of the enemy, especially in the sense of crediting him with the ability to do with ease things which we ourselves cannot even attempt. . . .

Tell them that the "International Brigades," although composed of better fighters than the ordinary Spanish militiamen, are few in number, that their ranks were already depleted when they came against us (according to reliable documents, one of these units arrived with only 700 men), and that their numbers have been still further reduced by the great losses we have inflicted on them.

Moreover, these men are the same as, or brothers so to speak of, those whom our Fascist squads thoroughly thrashed on the roads of Italy. And, for lack of recruits abroad, some of these International units are partly made up of poor quality local militiamen.

The Russian tanks do not bear a charmed life. They are armed with guns, it is true, but their caterpillar wheels are most defective, they easily get stuck, and if we do not lose our heads, they can quickly be put out of action.

In our advance we captured ten, and hit and immobilized nine others in front of our lines. Obviously, they do not bear a charmed life!

Of our tanks, only four were hit, and these are still in our hands.

D—It should also be explained to the men, who have plenty of common sense and will readily understand, that when we are suffering under the rain the enemy is not sitting in a grand hotel, but is in the same plight as ourselves; if sometimes (an inevitable annoyance in war) the rations are late or do not arrive at all, the enemy is not dining at a restaurant but is fasting more than we are (as his communications are much worse and all the Red areas are short of food), etc.

Explain the reasons why in the early days—when the weather was appalling—the Red airplanes were able to fly and ours were not: The Reds have permanent aerodromes near Madrid from which they start below the clouds, while ours have to use improvised aerodromes situated of necessity on the other side of the mountains; hence, it is often impossible to take off owing to muddy ground and it is almost always impossible to cross the mountains flying blindly through the clouds. . . .

E—Commanders, by simple and elementary reasoning, should make it clear to their subordinates (and in some cases also to themselves) how absurd it is to attribute fantastic powers to the enemy: "Forces that attack in daytime without cover or artillery preparation or after only a few rounds; detachments that steal on us by night over unknown ground between the positions occupied by our troops and then advance several kilometers in order to cut off our regiments, etc."

Let us look at things seriously!

I ask, "Would any of you or your subordinates ever dream in similar circumstances of doing or ordering any of the things which you so lightly attribute to the enemy? Have any of you ever done it?"

These extracts show the type of rumor which is accepted as valid by trained troops under the strain of war. They also show that the Italian troops are still very far from being the first-class fighting men that fascism claims it can produce. It may be safely assumed that these attitudes in the Italian troops in Spain only reflect an even more pronounced anti-military attitude among the Italian people at home.

The contrast between the Soviet and fascist methods is clear. The Soviet system has developed a new open democratic method, while the fascist system resorts to concealed espionage. The organized political system of the Soviet has developed a method of political control which is much more acceptable to democratic methods than the fascist espionage system. The problem which the democracies must face is now clearly formulated.

4. DEMOCRATIC CONTROL OF THE ARMY

The democracies have only one method of control, namely, the maintenance of free speech. In a war situation, all countries must impose certain restrictions on individual action and must mobilize all the forces of the state for war purposes. In the 1914-18 War the limitations on free speech and discussion were extended beyond all former limits. This was true for all the belligerent countries. Had the state censorship in France been extended as far as many French patriots demanded, the rights of French deputies might have been so limited that they would have been unable to report the reaction of the French soldiers to the military policy in 1917. The mutiny in the French Army on May 3, which affected sixteen army corps, might have been so serious that the replacement of Nivelle by Pétain would not have solved the situation. The maintenance of free speech is the only way to prevent such occurrences.

The German Army during 1914-18 gradually extended its control over the political structure of the state. From 1917 onward Hindenburg and Ludendorff were given all the control they demanded, but they seemed to be surprised at the uprising of the German people against war in the last half of 1918.

The isolation of the German military autocracy from their own industrial and civil interests clearly reflected the High Command's lack of knowledge of what the German people were thinking. The German High Command was unable to face up to their military defeat. They sent no important member of the staff on November 7 to negotiate with Marshal Foch, General Weygand, and Admiral Wemyss. Erzberger, the leader of the German delegation, laid great stress on the revolutionary situation which had broken out in Germany. He asked the Allied Command to relieve military pressure so that order might be restored. Foch was surprised by these facts, but refused to yield to the German demands, saying, "You are suffering from a loser's sickness." Even in November, 1918, the German High Command began establishing the myth that the civilians had betrayed them. This theory came from a military staff all of whose allies had already been defeated—a staff that had lost almost 500,000 prisoners and 7,000 guns between July 18 and November 11, 1918. The hatred of their own defeat went with the assassination of Erzberger. The myth of Hindenburg and of "victory in the field" was therefore maintained for Hitler and the National Socialist Party to develop into the racial theory of German domination.

The conflict between civilian and military authority continues even today. But the failure of military control of industrial processes has been revealed and the apparent impossibility of the military mind to understand the problem of the civilian morale is evident. Can the military mind realize that in an air war all the problems which it has failed to handle will now be all-important? If it can do so, then perhaps it will allow the political structure to handle these problems and confine itself to its own sphere.

If the military command rejects this approach, then the probabilities are that the armies of the democracies will fail as the army of German imperialism failed in 1914-18. Which course will be taken? It depends on the faith the progressives of the nation have in their own democracy.

CHAPTER XV

THE HOME FRONT IS PREPARED

THE WAR MACHINE RUNS smoothly on. The military staffs are ready. Soldiers, sailors, and airmen are drilled and disciplined. Industry turns out its allotted quota of armaments and is prepared for further military production as soon as war is declared. But even this is not enough. People do not want war, but they must be prepared to expect war.

The destruction and horror of war must be made clear. The war memories of the masses must be awakened. Then, as the fear creates uneasiness, the masses must be mobilized behind a policy of rearmament. They must be trained out of their fear into a hope of salvation through war.

The morale to resist the strain of war must be created and organized. The purely military factors can easily be described in technical terms. What it may mean to a civilian population in terms of psychological strain and suffering can merely be conjectured. The effect of the war strain on an army can be compared with the strain on a civilian population only if the differences in these groups are taken into account.

Analyses of the casualties produced with various weapons in the 1914-18 War have shown that casualties produced by gas attack were less fatal than those produced by shellfire. These figures are based on data from the American Army, which came into the War equipped with efficient protection against gas attacks. They cannot be regarded as valid for a civilian population under bombardment by shells and by gas attack. Since, however, they are sometimes used to minimize the danger of a gas attack on a civilian population, it is important that the difference between an army and civilian groups be clearly understood.

1. CHARACTERISTICS OF MILITARY AND CIVILIAN GROUPS

In all armies the recruits are selected on the basis of physical fitness. The importance of this criterion is made clear when it is realized that from 50 to 70 per cent of applicants in different areas of England are rejected on this basis alone. Thus the army group contains individuals who are better fitted to stand the extra strain on the lungs which must be imposed by breathing through the filter system which is essential for any gas mask. Those individuals in the civilian population who suffer from any form of respiratory disease will find the use of a gas mask extremely difficult, and if any movement is involved they may find it impossible. During the 1914-18 War it was found that wearing a gas mask so lowered the efficiency of the individual that heavy manual work, such as moving munitions, became practically impossible. With modern types of gas masks this difficulty is not so serious.

A large proportion of army training is spent not only in learning simple operations, but also in making the performance of these simple operations practically automatic. The reasons for this are twofold. Large bodies of men can be maneuvered over large tracts of country to a reliable time schedule only if they have been systematically drilled in marching and if each particular specialized unit (*e.g.*, machine gunner, field kitchen, etc.) knows its correct position. Equally important is the value of such a training in maintaining discipline and morale in a really critical situation. A well-drilled group is also an emotionally disciplined group which can maintain effective action when an untrained or semi-trained group becomes disorganized, confused, and panic-stricken. To know how to carry out an operation does not mean that the operation will be effectively carried out in all situations.

On no operation, perhaps, was more time spent in making it automatic than on putting on a gas mask. To know how to put on the mask was not enough. Training in holding the breath before the mask is fitted is just as important as being able to fit the mask quickly and well. To add this extra routine to a

trained, disciplined body of men was easy enough. But the psychological effect of a gas attack was such that retraining in gas chambers at regular intervals was found to be essential. In these trained groups an individual from whom orders were unquestionably accepted was always present.

Ardent du Picq has revealed the real purpose of military training by saying that its object is not obedience but that "The purpose of discipline is to make men fight in spite of themselves."

The problem in a civilian population is very much more complex. Systematic training is difficult if not impossible to give. At best, the individual has learned how to fit a mask, but may not have practiced the operation sufficiently well to carry out the same operation under actual air-raid conditions. The operations involved are relatively simple, but they may have to be carried out in the dark or under conditions of very low illumination as well as in actual bombing situations. Even the first precaution of holding the breath may become a definite strain in these circumstances.

The discipline of belonging to a well-integrated group with a central nucleus of authority which can maintain the group organization and control its actions even in a critical and difficult situation cannot be developed at once. It is unlikely that the individuals will be in any organized group at the time. Instead they will probably have to act alone or in a family or residential group. Even if an air-raid warden or marshal is present, the age and sex variation inside the group will make formal discipline of the army type quite impossible. The greater the strain and the longer the strain is maintained the greater will be the liability to panic. In a situation in which training has been given by earlier warnings, there will be a constantly developing psychological tension which may destroy the value of the physical training given. When the individuals in a group are fatigued, the members become very suggestible and rumors are accepted as true which might otherwise be rejected. Panic can spread very rapidly through this group, and it may become uncontrollable.

2. POISON GAS

Gas attacks in the last War were extremely effective in the destruction of morale. This was due to severe casualties suffered before adequate protection was provided, and also to the nature of gas—an invisible, all-pervading weapon. Even after protection had been successfully worked out, gas still caused a marked psychological strain. Gas officers are well aware of the numerous minor complaints with regard to masks not fitting correctly, difficulty in breathing, gas burns being felt, and tension in the gas chamber during training or re-training. These complaints were symptoms of the strain, often unconscious, which the individuals suffered. For example, after experiencing heavy casualties in an attack in which gas had been used, the remainder of the company collapsed in a gas-training chamber in which only non-lethal fumes and not gas were being used. Thus poison gas is an ideal weapon to use against a civilian population if an attack on its morale as well as its industrial efficiency is intended.

The British Air Raid Precautions Department is advocating gas protection on the family or residential-group basis. The aim is to have one room in the house made gasproof, and thus avoid concentration of the population in large groups. These precautions are admitted to be ineffective against high-explosive or incendiary bombs. Incendiary bomb attacks require special treatment by isolation in a non-inflammable material such as sand. There is no protection from direct hits of high-explosive bombs, while their secondary effect will be to expose a large area to gas, since glass, roofs, and even walls will be shattered.

It is not the intention here to try to depict what may happen as the result of an air attack on any industrial center. There can be no doubt but that the results will be tragic and terrifying in the extreme. Even if the various precautions taken prove to be successful, the losses from direct hits, deaths of unavoidably unprotected individuals, damage to essential services, and loss of food by contamination will be terrible enough. In no case can they be expected to be as slight as they were in 1914-18.

3. MODERN POLITICAL SYSTEMS AND MORALE

It is often assumed that the world today is divided into two different political and social systems: namely, democracy and dictatorship. This division is so misleading that much modern discussion has been rendered almost meaningless. It is not even correct when applied to the United States, the British Empire, France, Germany, Italy, the Soviet Union, and Japan—the seven major great powers. It is easy to show that inside the so-called democratic countries what is considered an essential part of democracy in one is non-existent in the other. For instance, in Great Britain, France, and the United States, powerful groups exist which can limit and control important parts of the democratic process. Only two of the dictatorship countries, Germany and Italy, have essentially similar systems of dictatorship.

The problem of morale is closely interlinked with the type of political system inside a nation. The military dictatorships of Japan and Spain are similar to the fascist dictatorships of Italy and Germany. The democratic powers, England and France, are essentially similar to the United States in their treatment of minority groups. The socialist democracy of the Union of Soviet Socialist Republics is radically different from both systems. From the point of view of power politics the remaining states may be ignored.

It is often erroneously assumed that in the fascist state the dictatorship is equally effective over all the activities of its citizens and that its presence is obvious to and resented by a majority of the citizens in the state. In actual fact, only all political and certain economic functions are controlled. For a very large number of people there is no really essential change. Their abstract political rights have little meaning for the great mass of the population so long as there is no interference with their method of life or standard of living. The fascist dictatorship has been successful in giving political domination to one particular group which was representative of the dominating group of capitalist financial interests. In both Germany and

Italy the same financial group has always been in control, but the peril to its power became so great that an open dictatorship had to be substituted for a concealed control. Dictatorship, therefore, indicates that the old control was endangered by the new democratic forces in the state. It shows not the strength but the weakness of the political policy it represents. The dictating group has assumed that if the democratic process had been allowed to function, the group would have lost its control. When a dictatorship takes over, it must suppress all opposing political and economic groups which are opposed to its interest. The mass of the people will tend to accept this dictatorship, but if the dictatorship is unable to carry out a successful foreign policy and to maintain or increase the standard of living, the discontent created may be mobilized by the suppressed parties to bring down the dictatorship.

These fundamental factors create special problems of morale for all dictatorships. Modern dictatorships do not rest on individuals but on parties, which have their ramifications in all strata of the population. The party rulers are therefore able to get some measure of psychological reaction to the party policy. Because of the press censorship and general suppression, all serious strain is concealed from the public and serious discontent can spread without its extent being realized even by the dictator. The suppressed groups, in this situation, can carry out illegal activity and organize this discontent so that the revolutionary overthrow of the dictatorship becomes possible. Inside the democracies the amount of discontent with the political party in power is much better known and tends to be overestimated. The points of unity between the different apparently hostile political parties are often forgotten. When a crisis—such as entry into a war or extensive economic collapse—occurs, increased strain is imposed on all political systems. The reaction to this strain inside a dictatorship is strikingly different from that inside a democracy. The war strain increases the stress inside the dictatorship and lessens the stress inside the democracy. In a war situation, especially in the early period, there is a marked lessening of strain and an increase in political unifica-

tion in a democratic state. This factor is of considerable importance because it is very often forgotten in the pre-War period.

However, political unification in a democracy is not stable, and as the emotional effect of the entry into war wears off, it is gradually undermined. The groups inside the democracy which wish to stop the war because of direct damage to their own interests or sympathy with the ideology of the enemy or for pacifist reasons, are gradually welded together and exert growing influence as the war proceeds. The growth of anti-war feeling is also a function in the relative success or failure of the nation at war. In a stalemate war of the 1914-18 type with its increase in economic strain and heavy manpower losses, there is a constant interaction between the effects of the war in the front line and in the industrial areas behind it.

The groups which are pacifist or favorable to the enemy, or in ideological sympathy with him, combine together and begin to exert a systematic pressure to bring the war to an end. This combination is partly spontaneous and partly deliberate. It is one of the functions of the enemy's espionage system to aid and abet those influences in every way. This method was used very largely in the 1914-18 War. Germany hoped that the admission of Lenin and other Bolsheviki leaders into Russia would weaken Russia's fighting strength. The Allied propaganda in 1918 openly appealed to the German troops to revolt against their government and their officers. The leaflets distributed used revolutionary phraseology to stimulate this revolt. In the United States, the pro-German sympathizers carried out systematic propaganda among the dark-skinned populations, emphasizing their lynching and ill treatment in order to stir up trouble between them and the white population and to persuade these minorities that Germany would be more sympathetic to their claims. The organized basis for this type of work has been very extensively developed in recent years.* These forces will exert a steadily increasing influence if the war is long drawn out. If,

*J. L. Spivak in *Secret Armies: The New Technique of Nazi Warfare* (Modern Age Books, Inc., N. Y., 1939) has summarized some of these activities.

however, the war is successfully carried out both on the military front and on the propaganda front, then the effects of such groups may be trifling.

4. AIR WAR AND CIVILIAN MORALE IN SPAIN

The Spanish War has been a graphic illustration of the development of air war and the disintegration caused by hostile groups on the home front. In this war no large-scale air forces were involved. It is not possible to obtain accurate figures on the number of aircraft, but it is estimated that General Franco had between eight and nine hundred efficient military machines and the Spanish Government, from five to six hundred machines of which only a few were modern military machines, the remaining being militarized commercial aircraft. The bombing of Guernica in April, 1937, and of Barcelona left two thousand killed and five thousand seriously wounded. However, it was not until November, 1938, that a systematic large-scale air war was started.

Various observers had reported that the air attacks on the Spanish people had not produced any break in morale, in spite of the defective air defense which lacked adequate anti-aircraft guns and combat planes. These results were held to indicate the failure of aerial bombardment to affect civilian morale. Even today the significance of the Catalonian campaign is not fully understood. Mr. Claude G. Bowers, United States Ambassador to Spain until the fascist conquest, is reported in *The New York Times* as saying that the first effects of the air attacks

> on the civilian populations, of course, was to throw them into a state of terror. The amazing thing, however, is that in a very short time—a matter of weeks only—they became accustomed to it and hardened to it. While they remained on the lookout for planes so that they might take shelter, there was a very noticeable diminution of hysteria or fear that was first in evidence.
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> The apparent purpose of testing aviation as an instrument for the breaking down of the civilian population has probably resulted in some disillusionment. Judging by the

events in Spain, instead of breaking down the morale, the effect seemed to be very perceptibly a stiffening of the morale of the people—a rise in their resentment.

In November, 1938, General Franco published a list of 105 Catalonian towns which would be bombed unless the Spanish Government surrendered. In December the aerial bombardment started on some of these towns, only a few of which, such as Barcelona, had any air defense. Most towns, however, had some type of bombproof shelter system. Inside five days over thirty towns were bombed with a casualty list of approximately three hundred dead and one thousand wounded. At the time, it was calculated that the maximum number of planes which General Franco had available for this purpose was two hundred. However, the weakness of the Government air force enabled these planes to make numerous raids daily because their air bases could be maintained very near the front lines. Until December 23, air bombardment was systematically carried out, but on this day, as the main Insurgent offensive was launched, the air force now concentrated its attention on the Spanish Government military positions. As these positions were taken, the Insurgent air force continued to bomb very heavily the towns next in the line of retreat and also the refugees, both military and civilian, from these towns. As the military advance continued, the aerial bombardment of Barcelona itself increased. The official British Government air mission in Barcelona reported that some of these attacks were directed at the civilian population and not at harbor or similar military objectives. On January 18, the Spanish Government ordered all radios to be surrendered inside of four days. This was done to try to counteract the effect of the Insurgent propaganda on a hungry civilian population whose morale was beginning to break under the strain of over two years of war, with its constant record of defeat, carried on without any adequate outside aid and with the accumulative effects of aerial bombardment beginning to tell. During January 23-24, the aerial bombardment was increased in intensity so that air raids became practically continuous. In many of these raids, only legitimate military objectives were bombed, but the planes al-

ways flew over the civilian area before they bombed the harbor or the trenches. Observers reported that the fear and strain of hearing planes was worse than the actual bombing. On January 20, Barcelona had fallen. Constant bombing of refugees on the roads and in trains was systematically continued so that no respite was given either to the military or the civilian population. The result was that the broken morale could not be rebuilt, and remains of the Spanish Government Army with many of its civilian supporters had to find refuge in France. It is reported that when a few Spanish Government fighters crossed over the refugee columns to engage some Insurgent bombers, the panic-stricken refugees ran shrieking into the ditch on the roadside. Only those who were too weary to care marched on for the French border. This report parallels the panic created in the refugee Basque children's camp in England when some British Air Force airplanes flew near their camp.

Inside the Spanish Government lines, the Franco Fifth Column functioned constantly not so much in a military sense but as morale breakers. Its agents were able to mobilize the discontented extreme left-wing Socialists to revolt against the Catalonian Government, were able to spread rumors of betrayal and inefficiency, to use personal terror to influence individuals and to weaken the unity of the Republic's democratic front by emphasizing political differences. Without counterbalancing military successes for the armies of the Spanish Republic, these groups were most effective in accelerating the disintegration of morale.

As a result of his weight of military armament and the systematic use of his air force, General Franco was able to march his troops over a mountain country covered with snow at the rate of twenty miles a day and to break through elaborately prepared defensive positions held by troops with considerable training and fighting experience, but with inferior military equipment. The result obtained seems to be due in no small manner to the use of the air force. This campaign seems to have established beyond all doubt the effectiveness of an air war. While it is true that the defense force was inferior in military

equipment and deficient in aviation, the number of planes used by General Franco was only a small fraction of the number which will be used in a major European war. There is little hope that any method of defense can stop aerial attack. Lord Baldwin's famous phrase, "The bomber will always get through," is as valid today as when it was spoken a few years ago. The weight of the aerial bombardment must, therefore, be very much greater than even the worst that the Spanish people had to suffer. The Spanish War was a restricted war. Modern weapons, such as flame throwers and poison gas, were not used while incendiary bombs were used on only a few occasions—notably at Guernica. The reasons that these weapons were not used are peculiar to the Spanish War. There is no doubt that they will be used in another European war.

5. THE FASCIST TECHNIQUE

The pressure of these new developments on the public morale can, however, be prepared for in other ways, as is shown by the development of the fascist theory of war. This theory, somewhat obscured by his own mystical attitude, has been clearly postulated by General Ludendorff in *Der totale Krieg*. There are also numerous other expositions of a similar viewpoint by other fascist writers, both German and Italian. The basic structure for his "total" war is the spiritual solidarity of the people which will give them confidence of victory and power of resistance to the hardships of war and the action of the enemy. Ludendorff makes it quite clear that the enemy bomber will get through even though every bomb may not hit its mark. The air arm he regards as of decisive importance, for through its use a knockout blow may be delivered. This blow must be followed up rapidly by military and naval attacks. The function of the propaganda machine is to study how the people can be maintained in a state of mind favorable to the war during the battle period, which must be short, until victory is gained.

What central nucleus is available to the fascist propagandist for mobilizing mass emotion? Ludendorff sees the ideal nucleus to be in his *Feldherr*, a commander-in-chief who is also head

of the state. There must be only one command, one person who must appear to have absolute authority as head of the people with an absolute executive control of the armed forces of the nation as well. In the *Feldherr's* military staff the propaganda ministry comes first. The *Feldherr* is built up as the symbol of a racial, nationalistic unity. In this unity all the primitive hatred of the stranger, the unknown, the competitor, and the traditional enemy or enemies can be most effectively mobilized.

The danger of the Christian concept of life to this war program is made clear. Christianity was devised for a world republic. Its collectivized system without an emphasis on racial unity, with the destruction of the purely nationalistic outlook, the stressing of an individual, personal relationship to God, with an individualized heaven as its objective, does not give a satisfactory basis for the development of a "total" war situation. Therefore Christianity must go and be replaced by a religion which can give the essential spiritual unity on a racial basis, which the propaganda machine of the totalitarian state requires. Ludendorff looks with envy at Japan's achievement of this type of unity in Shintoism.

Two other points arise directly out of this book. The total war demands a pre-war peace time on the same basis as the war time itself. All economic development, whether in this peace period or in the war itself, must be governed by the requirements of the "total" war. Thus the whole function of the state is to be prepared for war by military development, economic preparedness, and above all by a psychological training, so that the spiritual solidarity of the people may be insured. These views of Ludendorff all spring from his experience of the revolt of the German people against the War in October-December, 1918. The whole aim of his writing is to insure that this weakness must be organized and planned against so that it may be avoided. He admits it can be avoided only if the war is a reasonably short one. This attitude has the support of Hitler, who stated that the collapse of the home front in Germany in the 1914-18 War did not take place, as the home front did not then exist.

This summary of the theoretical basis for a "total" war shows

with startling clearness the importance of psychological and propaganda factors in the preparations for, and during the course of, the next war. The facts already detailed of the effect of air war on the civilian and industrial populations make the organization of the psychological preparedness for war essential.

6. THE SOCIALIST TECHNIQUE

Yet in fascist countries the division between the dominant capitalistic dictators and the workers must create economic and political unrest. In fact, the country which will have the highest morale will be the country with the least economic inequality and class distinction. If its foreign policy has been directed to organize consistently for peace, then its citizens may be expected to have the best basis for a true morale. This type of development can become possible only in a state which has repudiated profit-making as its internal policy and economic imperialism as its foreign policy. It is significant that in international diplomacy since 1918 only the union of democratic states organized inside the Union of Soviet Socialist Republics has been able to carry out the policy outlined. The Soviet States have shown themselves pioneers in aerial development in many of its most important branches. Air-defense measures can be taken on a mass basis without interference from private interests and without differentiation between different classes in the community. Industry cannot make private profit out of defense or military preparations. This feeling of security and of co-operation for a common end without individual destruction or class differentiation provides the basis on which the citizens of the Soviet Union will rely to provide a sound morale in event of war.

On the technical side H. M. Hyde and G. R. F. Nuttall in their book, *Air Defence and the Civil Population,* have published an account of the Soviet organization. Civilian protection is under the control of the *Osoaviakin,* a semi-official voluntary organization with a membership of over fifteen millions. The subscription varies from twenty kopecks to ten rubles per year, and flying training, with gliding and parachute jumping, is available to its members. Mock air raids on a large scale are or-

ganized on towns. "All workers are expected to participate and are allowed time out of normal working hours for the purpose."

7. THE DEMOCRATIC TECHNIQUE

To meet an attack, the democracies must rely on the essential common response of all their divergent tendencies. These tendencies have already been discussed (page 189). Here the importance of being able to adjust to the new strains of an air war by maintaining freedom of speech will be considered. The very important problem of free speech on the home front in a war situation has been fully discussed by Dr. Z. Chafee.* He points out that the American Constitution expressly safeguards freedom of speech in a war situation. Dealing with its suppression, he writes:

> Before the late War, such suppression would generally have been supposed impossible. The tradition of open discussion was still strong among us. At the head of the Bill of Rights in our Constitution stood the words, "Congress shall make no law abridging the freedom of speech or of the press." This prohibition made no exception of war. As a United States judge put it, "The framers of the First Amendment knew that the right to criticize might weaken the support of the Government in time of war. They appreciated the value of a united public opinion at such a time. They were men who had experienced all those things in the War of the Revolution, and yet they knew too that the republic which they were founding could not live unless the right of free speech, of freedom of the press, was maintained at such a time. They balanced these considerations and then wrote the First Amendment."
>
> We can no longer cherish the delusion that this provision of the Constitution protects open discussion of the merits and methods of a war. We can predict with certainty what will happen in the next war from what happened in the last War, because exactly the same statute is in force.

* N. F. Hall, Z. Chafee, and M. O. Hudson, *The Next War* (Harvard Alumni Bulletin Press, 1925).

After discussing the added power of the dangerous Espionage Act of June, 1917, and showing that the older laws are quite adequate, he writes:

> The needlessness of such laws is shown by the experience of Massachusetts. We had in this state a large training camp and naval bases. Thousands of soldiers embarked from Boston for France. We had innumerable factories for the manufacture of munitions and other war supplies. We had in our midst a large foreign-born population, much of it unfriendly, by race at least, to the Allied cause, much of it possessing radical views. The United States District Attorney in Massachusetts refused to institute a single prosecution although much was said and written which would have been punished elsewhere. No record exists of a single bomb explosion, act of sabotage, or evasion of the draft, or desertion, which may be traced to such an unpunished utterance. There is not one bit of evidence that the cause of the War suffered in this State because of the adherence to liberal principles of this District Attorney, who has since been honored by elevation to the United States Circuit Court of Appeals.

Chafee is, however, compelled to admit that the view he takes has not been upheld by the United States Supreme Court. He therefore expects an even more vigorous suppression of public opinion in the next war. That more vigorous suppression will solve the problem is very improbable. The victims of this type of suppression are only too often quite harmless people whose views differ from those of the community on other questions, generally in the social field.

The discussion has shown that democracy has already got the essential mechanism by which it can learn how the strain and stress of war does affect the divergent groups inside it. If these strains are known, then it is the duty of the democracies' political leaders to see that the maximum possible amount of adjustments inside the basic principles of the democracy are made. If this is carried out adequately and if privilege and special

interests are not allowed to interfere with the conduct of the war, then the morale of democracy is likely to maintain itself under the severest military pressure. The problem of the different groups inside the democratic state with their somewhat divergent interests requires special consideration.

8. MORALE AND SOCIAL CLASSES

Hyde and Nuttall have commented on this problem as follows:

> But they [air raids in the 1914-18 War] did have the effect of weakening the public morale, especially among the poorer sections of the community, and this is a factor of the greatest importance when considering the aerial bombardment of the future.

All evidence goes to show that the morale was most weakened in areas with the greatest concentration of population. The dominant factors seem to be the lack of protection and the ease with which rumors could spread in these areas. The Official Air Historian, H. A. Jones, reports Sir William Robertson as writing after the daylight raid of July 7, 1917, that at the special Cabinet meeting in the afternoon "one would have thought that the whole world was coming to an end," so excited were the Cabinet members present. The war hysteria which attributed all panic to alien groups has also been shown to be quite untrue. The diaries of several soldiers, including pilots, also show that air raids were as effective against their morale when on leave as against that of the civilian population of the cities.

The United States of America faced peculiar problems in the maintenance of morale. The numerous different racial and national groups presented very special problems. In general the greater the number of heterogeneous groups in a country, the greater is the difficulty of maintaining morale in a war situation. The modern fascist methods of penetration already mentioned (page 197) mean that in another war, propaganda attempts to disintegrate the national morale will be even better organized than they were in the 1914-18 War. The type of propaganda then used by pro-German forces in this country has been fully

analyzed and discussed.* The German propagandists were definitely inferior to their Allied opponents. This is no longer true. The systematic development of the Nazi propaganda machine is one of the most impressive factors of the new Reich. Inside Germany and in German communities outside, Nazi propaganda has a striking record of achievement. Outside German communities it has been successful only with powerful pro-fascist groups. It has failed to sell Nazi principles to the great mass of people outside these pro-fascist groups.

Another problem is the ease with which rumor and action based on rumor can occur in the United States. Chafee gives the following summary of what actually happened in 1917-18:

> John Lord O'Brien, assistant to the Attorney General in the late War, tells some of the false stories of enemy activities within the United States:
>
> > A phantom ship sailed into our harbors with gold from the Bolsheviki with which to corrupt the country; another phantom ship was found carrying ammunition from one of our harbors to Germany; submarine captains landed on our coasts, went to the theater, and spread influenza germs; a new species of pigeon, thought to be German, was shot in Michigan; mysterious aeroplane floated over Kansas at night.
>
> An important German spy, landed on our coasts by submarine to disperse large funds and, caught spying in our camps, turned out to be a plumber from Baltimore. Spies caught on beaches signaling to submarines were subsequently released as honest men. One of them had been changing an incandescent light bulb in his hotel room.
>
> > There was no community in the country so small that it did not produce a complaint because of failure to intern or execute at least one German spy.
>
> There is no reason to suppose that there will be less propaganda or less hysteria in another war, and, as in the past war, most men will refuse to discuss the merits of the meth-

*H. D. Lasswell, *Propaganda Technique in the World War* (Knopf, N. Y., 1927); J. W. Dafoe, J. A. Sauerwein, E. Stern-Rubarth, R. H. Lutz, and H. D. Lasswell, *Public Opinion and World-Politics* (University of Chicago Press, 1933).

ods and objects of the war but will consider that a useless distraction from the fundamental purpose, "win the war."

9. MASS PANIC, 1939

A most recent example of what can happen is the reaction to the Orson Welles adaptation of H. G. Wells' story, *The War of the Worlds,* which was broadcast over the Columbia Broadcasting System from 8:00 to 9:00 P.M., Sunday, October 30, 1938. Mr. Welles adapted the story in a realistic dramatic form. Approximately the first twenty minutes of the broadcast was completely realistic in expression. It was composed of eye-witness reports, news bulletins, official statements, and army reports at actual places in New Jersey and outlying districts of the attack by the aerial invaders from Mars. The rest of the broadcast was a survivors' account of the destruction which had taken place in New York City and of bacterial action against which they had no resistance. The broadcast took place in a play series which was already well established; four formal announcements that it was the dramatization of a novel were given.

The following account of what occurred is summarized from *The New York Times* of October 31, 1938. Radio stations, police officers, and newspapers received an enormous number of telephone calls which asked either for the facts or for advice on the best thing to do in the supposed war situation. *The New York Times* switchboard reports 875 calls, and a Brooklyn paper, over 500 calls. The Manhattan Police Headquarters with 13 operators was swamped with calls and normal police work interfered with. Brooklyn police answered more than 300 calls. In Harlem the 123rd Street Police Station had thirty visitors; the 135th Street Station, twelve. The Newark and Jersey City police received thousands of calls. Crowds collected in certain areas in Harlem, Jersey City, and Newark, and in nine cases police cars were sent out to explain the situation. The war scare was nation-wide. Two geologists who set out from Princeton to find the meteor found a group of sightseers already at the reputed place. Reports of effects also came in from San Francisco, Chicago, St. Louis, Boston, Minneapolis, Birmingham, etc.

This case is not the first of the type. In January, 1926, Father Ronald Knox broadcast from the Edinburgh Studio of the British Broadcasting Company an imaginary story called *Broadcasting the Barricades*. He described a revolutionary uprising of the British unemployed. The B. B. C. and the newspapers were bombarded with queries, but the apology of the B. B. C. which was broadcast several times seems to have dealt effectively with the situation.

Both of these incidents occurred in prepared situations—the British incident occurred a few months before the British general strike, and the American incident after the Munich crisis. The main purpose of the American queries was what should the individual do in the coming poison-gas attack. The people who were affected were not those who listened to the whole broadcast, but those who heard only a section of it. At the time the broadcast was taking place, a routine research radio check of five thousand telephone calls was carried out to determine the radio audience for the various programs being broadcast.* The report shows that at this time the Charlie McCarthy variety program had approximately 82.5 per cent of the radio audience; 9 per cent of the listeners were dialed to miscellaneous local station programs; and only 8.5 per cent were listening to the Orson Welles program. The newspaper account shows quite clearly that the disturbance was caused not so much by the broadcast as by reports of the broadcast relayed to various groups in theaters, churches, and in the street by individuals who had heard only part of it—the characteristic mechanism of rumor-spreading.

The New York Times of November 6, 1936, reports that the United States Army Department was perturbed by a series of inquiries asking for more coastal defense and for details of the supposed "requisition" of hotels and private buildings as barracks. The origin of these rumors was traced to a speech by Major General J. K. Parsons in which he suggested that in the event of another war the army might commandeer hotels and train soldiers in the street.

**Hooper Radio Reports,* C. E. Hooper, Inc. (51 East 42nd Street, New York.)

These incidents all illustrate the basis on which rumor is built. This basis is a state of expectancy and slight alarm in which the true facts of the situation are disregarded and an alarmist distortion given to some relatively unimportant part of a real incident. The dangerous information is generally spread by secondhand interpretations of an original account. The early days of a war situation are the most fertile for the generation and growth of these rumors. The whole war period is always characterized by the spread of rumors because of the mental tension created. It is, however, characteristic that the early days and each special development produces especially luxurious growths of human interpretation of very simple incidents.

These situations are now used in an organized manner to aid enemy espionage and sabotage. R. W. Rowan* has pointed out that "spy scares" are a great advantage to well-trained and well-planted efficient enemy agents. Arrests of and attacks upon innocent but suspected foreigners, labor leaders, etc., give just the psychological situation in which sabotage becomes really effective. The practice of exaggeration of the country's early successes is also carried out by enemy agents because they know that the inevitable collapse of the hopes raised very effectively undermines morale. The overstatement of one's own losses so that the enemy exaggerates his own success was practiced with remarkable success by the British Intelligence after the Battle of Jutland. German rejoicing over a great naval victory inflated German prestige in the Scandinavian countries, but when this elation was found to be without foundation, the prestige of the German military machine received a blow from which it never recovered. The same result was created by Germany itself issuing grossly exaggerated accounts of the effectiveness of their air attacks on England.

10. PROPAGANDA AND MORALE

The next war with its distorted account of aerial successes and defeats will be an ideal situation for exploitation of these mechanisms. In event of the United States' support of the Eu-

*R. W. Rowan, *The Spy Menace* (Butterworth, London, 1934).

ropean democracies in a war against the fascist nations, one very interesting speculation arises. It would be quite possible for Germany to send a few specially-equipped airplanes to bomb certain civilian areas in the United States. These planes would have to be manned by suicide brigades or launched from concealed South American or merchant-ship depots. A few bombs would certainly create considerable panic in the areas attacked. No censorship could completely suppress all news of this panic. But the aftereffect even of a large-scale panic would probably be only to create a more widespread determination on the part of America to prosecute the war to the bitter end. It is, therefore, very unlikely that fascist Germany would resort to such tactics.

The lesson of this discussion is that it is essential for all democracies in a war situation to allow the maximum possible amount of full and free discussion, to publish accurate accounts of success and failure on the military and naval fronts, to define carefully their war aims, and to show that these war aims are really going to be carried out. If a democracy shirks any of these duties, it runs the risk of being undermined by the enemy propagandists who will be able to make full use of all suppressions and distortions which the democracy imposes. Lasswell sums up the propaganda value of a realistic idealist in his tribute to President Wilson as follows:

> If the great generalissimo on the military front was Foch, the great generalissimo on the propaganda front was Wilson. His monumental rhetoric, epitomizing the aspirations of all humanity in periods at once lucid and persuasive, was scattered far and wide over Germany. He declared war upon autocracies everywhere, and solemnly adhered to his distinction between the German people and the German rulers. His speeches were one prolonged instigation to revolt. He and Lenin were the champion revolutionists of the age. Throughout the entire war his pronouncements had won a substantial measure of confidence and respect in the minds of that minority of democratically-minded men, who longed to transform the pre-war Germany of class discrimination and special privilege. And when the clouds of

adversity darkened the sky in 1918, they were joined by immense numbers of their compatriots, pinched by privation and despair, anxiously searching the heavens for portents of a soft peace. They turned, not to Clemenceau—hard, relentless vulture, poised like an avenging conscience, to tear at the vitals of a fallen adversary; not to Lloyd George—nimble, unstable and uncertain; but to this mysterious figure in the White House, aloof from the ordinary passions of petty men, who spoke in elegiac prose of a better world, when wars should be no more and a brotherhood of democratic peoples should bury their heritage of ancestral rancor, and march toward a world of fellowship and reconciliation. It was to this man, mercilessly ridiculed and caricatured from one end of Germany to another through long years of hesitation and then of belligerency, that the Germans turned in their extremity.

May not democracy discover, like business, that perhaps after all "honesty is the better policy"? Whether the democracies can be honest will depend on the effectiveness with which they can deal with the fascist, imperialist, and capitalistic interests which lurk within their midst. These interests will have to decide whether they will throw their influence in with social reconstruction or with fascist suppression.

No democracy today can remain static; it must move either toward more economic democracy or toward more economic autocracy. The strain of an air war is accelerating the progress in either direction.

CHAPTER XVI

CONCLUSION

THE PURPOSE OF THIS book has been to show realistically not only what another war must mean, but also to indicate the forces which have created the present situation. Knowledge of

these forces is the first step toward action which can control and direct them.

Our story of aviation began with the legends of our primitive forefathers. Then came the period of speculation and scholastic discussion. Experimenters followed, but divorced from the theoretician they made little progress. Finally, theory and practice were co-ordinated in a scientific framework and a new science was born. The dream of the ancients has been fulfilled. Man conquered the air; but the dream is fast developing into a nightmare.

Science is constantly increasing man's control over nature. It is even creating a new, "unnatural" world of synthetic products specially developed to give man materials even more varied than nature provides. Such developments are in no sense independent of human beings and their desires. The story of the war pilots shows that these men are not immune to the fear of death or exempt from the strain of fighting. They suffer not only from the strain of external danger, but also from inner tension caused by increasing hatred of their role of mass-killers. With the development of the technique of air war the last romantic mask of the air fighter has disappeared. In the next war the man-in-the-bomber will become the long-range artillery man, using his tons of bombs against towns and merchant ships, as well as against soldiers, forts and warships. The man-in-the-bomber will not relish his allotted task.

Behind the bomber lies the work of the scientist, the expert, and the technician. These men, in their chemical and engineering laboratories, work ceaselessly to perfect the bombs and poison gases which their aircraft will carry. They know that they are creating not new benefits for mankind but methods for the more efficient destruction of their fellowmen. They, too, hate their task.

Production increases to mass production, but the abundance produced is soon followed by mass unemployment. We have the curious spectacle of nations burning and restricting the production of food while their unemployed starve; of diplomats discussing how many ships, tanks and airplanes shall be allotted to

fight the wars they have all "renounced"; of governments offering bonuses for large families while declaring their territories so overcrowded as to make colonies imperative. All this is strongly suggestive of a lunatic asylum.

It is foolish, however, to believe that there is some fundamental defect in the make-up of man which prevents him from living in peace and brotherhood with his fellows. His brain is sound. Intellectually he is quite capable of solving the problem of how to live in peace and how to provide abundance for all. His desires also are sound. His trouble is not insanity, but frustration. Let us look at the facts. In an expanding capitalist economy, when new markets are constantly being opened, the individual has a reasonable opportunity for livelihood and personal development. He has some justification for feeling that by increasing his personal wealth he is increasing the general wealth of society. However, when an economy no longer is expanding, and when powerful classes have begun to consolidate the general wealth into monopolies and to set up financial enclosures against the rest of society, the little man finds his activities restricted. He discovers that the means of production are in the hands of a few and that his labor is being exploited. But capital *must* expand; new markets *must* be found. So what happens? Powerful financial interests embark on a program of imperialism and attempt to seize the markets controlled by weaker nations. This can be accomplished (Munich notwithstanding) only by war. So against his will, and with nothing to gain from imperialist expansion, the common man is driven down the road to war.

Failure to realize the decisive influence exerted by social and economic forces leads to the superficial view that the evil of war is due to the dishonesty and cowardice of political leaders. It is frequently thought that if these men could only be made to realize how wicked they are, the drift to war would be arrested. A typical example of this approach is the following quotation from an address given by the late Field Marshal Lord Allenby at his installation as Lord Rector of Edinburgh University, April 28, 1936:

> Until lately [referring to the menace to noncombatants in the new aerial warfare], politicians and statesmen, who are the authors and initiators of war, could feel safe in their homes surrounded by their families. That happy security will no longer be theirs. The knowledge of this may perhaps bring to the statesman a warning of his responsibility. The choice lies with him. Will the hardness of his heart prevail? Must the narrowness of his outlook persist until he is schooled by poison gas and bomb? Or will he call to mind the pact renouncing war, as a solvent of differences—the pact signed by sixty nations, but now forgotten and discarded?

This is the veteran soldier laying the causes of war to the motives of political leaders. But neither statesmen nor soldiers drop from the skies as devils incarnate to brew the poison of war. Both are servants of a society which lives in a particular way. Does not the one plan to maintain the class power of the property owners at home and to peg out their claims abroad, while the other executes these plans by military force? Only when such men are employed by a different society, organized to give economic equality at home, and renouncing empire abroad, can they look each other and the world in the face and "call to mind the pact renouncing war." Then will men have created the conditions of peace.

All this represents a challenge to the peoples of the world. Science has not only created marvelous new machines and new methods of controlling nature; it has also created new problems in social and political development and set in motion conflicting forces which must eventually be resolved. For example, one of the main weapons for social advancement is the power, through propaganda, of directing human drives and interests. However, the propagandist, like the chemist and the engineer, is just another technician whose knowledge is subject to the same social forces controlling the soldier, the sailor and the airman. At present, these forces point toward war.

Men and women who want peace and security so that they can utilize science, art and culture for their own and their

children's happiness have power to make society take a new direction. To do this is the responsibility of every individual. The fruits of progress will go to those who mobilize their power to take them. It is the strength of the democratic process that it permits all methods of development to be discussed fully and freely until the most satisfactory method is found. In the World War this procedure proved its success in defeating the authoritarian militaristic method of the German ruling class. Unfortunately, it has failed to carry its success into the field of organizing peace. But the fault lies not in the democratic process but in sabotage and neglect of it.

The world is in transition and humanity is on the march. An older order is dying and a new one struggling to its feet. It is for the millions of people the world over to face the situation boldly and decide whether to support the old structure until it and they are destroyed by war, or to transform it in accordance with the ideals of friendliness, humanity and peace of the new. Today these two forces are battling for supremacy in a race against time. And the time is short.

If we would avoid war we must act now to convert the instruments of war into the instruments of peace. Otherwise, we face the prospect of civilization being destroyed Icaruslike by the very wings it fashioned. In the end war will not have accomplished its object—it will not have crushed the forces of social progress. The lusty youth of the new society will survive a world upheaval, no matter how horrible, to construct the free society in which economic as well as political democracy will lead man into honest living, brotherhood and peace, so that he may enjoy the fruits of his labor, among them his conquest of the air.

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