The U.S. Air Service in World War I

Volume IV

Postwar Review

Compiled and Edited by
Maurer Maurer

The Albert F. Simpson Historical Research Center
Maxwell AFB Alabama

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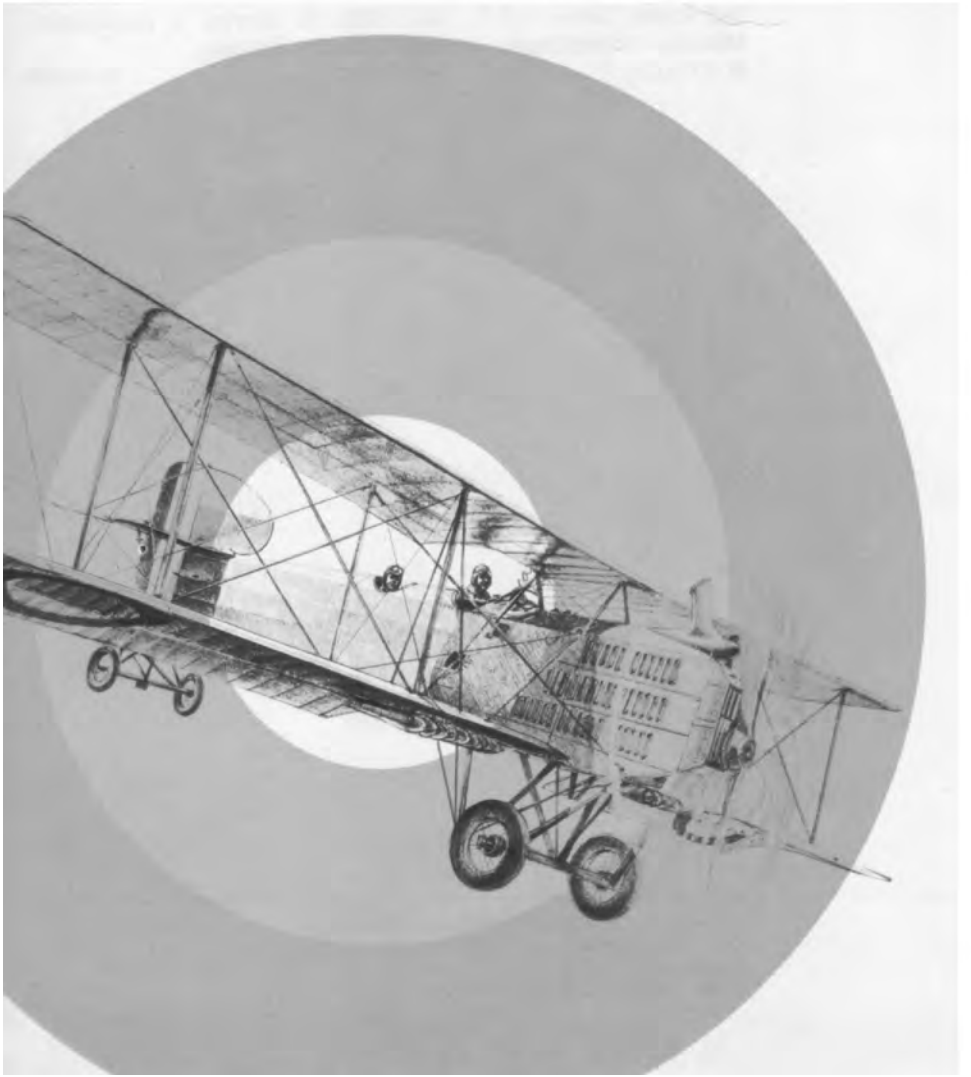

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Foreword

Following the Armistice in 1918, Maj. Gen. Mason M. Patrick, Chief of Air Service, American Expeditionary Forces, directed that a record be made of lessons learned during the war. This information, he believed, was needed for planning the Air Service of the future. The reports prepared by commanders, pilots, observers, and other members of the various Air Service units in response to General Patrick's directive are of considerable historical interest for the information they contain about the Air Service and its employment at the front. A select group of the reports on lessons learned make up Part I of this volume of World War I documents on U. S. military aviation.

Part II is devoted to a report on the effects of Allied bombing in World War I. This long-forgotten document, the result of a post-war investigation by the Air Intelligence Section of General Headquarters, American Expeditionary Forces, is the counterpart of the well-known United States Strategic Bombing Survey of World War II.

This volume is the last in a series that the Office of Air Force History is publishing on the U. S. Air Service in World War I.

Maj. Gen. John W. Huston
Chief
Office of Air Force History

Preface

On the morning of 11 November 1918, Air Service units at the front stood by waiting for the fog to lift so they could take to the air. The orders for the day called for offensive operations to destroy the German air service, protect friendly air and ground forces, and harass enemy troops with machinegun fire and bombs at every opportunity. The purchasing, shipping, and receiving of supplies and equipment, construction of new facilities, training of additional pilots and observers, and other business necessary to support plans for defeating the Germans continued as if the war would be of indefinite duration. But all of this was suddenly changed at 1100 hours.

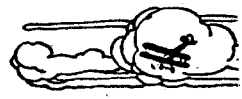
With the Armistice in effect, combat units resumed training. An air service was formed for duty in Germany with the army of occupation. Work was quickly begun to terminate contracts, stop construction, dispose of excess supplies and facilities, phase out training programs, and return personnel and units to the United States where most of the men would be discharged and the units disbanded.

In the same period, at the end of 1918 and during the first part of 1919, the Air Service, American Expeditionary Forces (AEF), was reviewing World War I to see what had been learned that might be of value to the postwar, peacetime Air Service. Documentary materials relating to this review—reports of lessons learned and a survey of the effects of bombing—are presented in this volume.

As in previous volumes in this series, the general editorial policy has been to hold the editing and annotation to a minimum. All of the documents reproduced here have been taken from a microfilm copy of Edgar S. Gorrell, "History of the Air Service, AEF," the original of which is in the National Archives in Washington, D.C.[1]

The editor wishes to express his appreciation to Lloyd H. Cornett, Jr., Chief of the Albert F. Simpson Historical Research Center, for his support and assistance; to Dorothy McCluskie, Lois Wagner, Jane Motley, Carolyn Fulk, Kathy Nichols, and Billie White for their excellent work in transcribing the documents and typing the manuscript; to John D. Ashmore and his staff in the Cartographics Information Division of Air University Library for maps and information about places mentioned in documents used in this book; and to the many other people who contributed in various ways to the preparation of this volume.

Special recognition goes to Mr. Lawrence J. Paszek, Senior Editor in the Office of Air Force History, for his work in the selection and placement of photos, preparation of art, and for guiding the manuscript through the various stages of publica-



tion. Mr. Jim Watson, U.S. Government Printing Office, deserves credit for the arrangement of typography and design in this volume. The photographs have been selected from collections in the National Archives, USAF Museum, and the USAF photo depository of the Aerospace Audiovisual Service (MAC).

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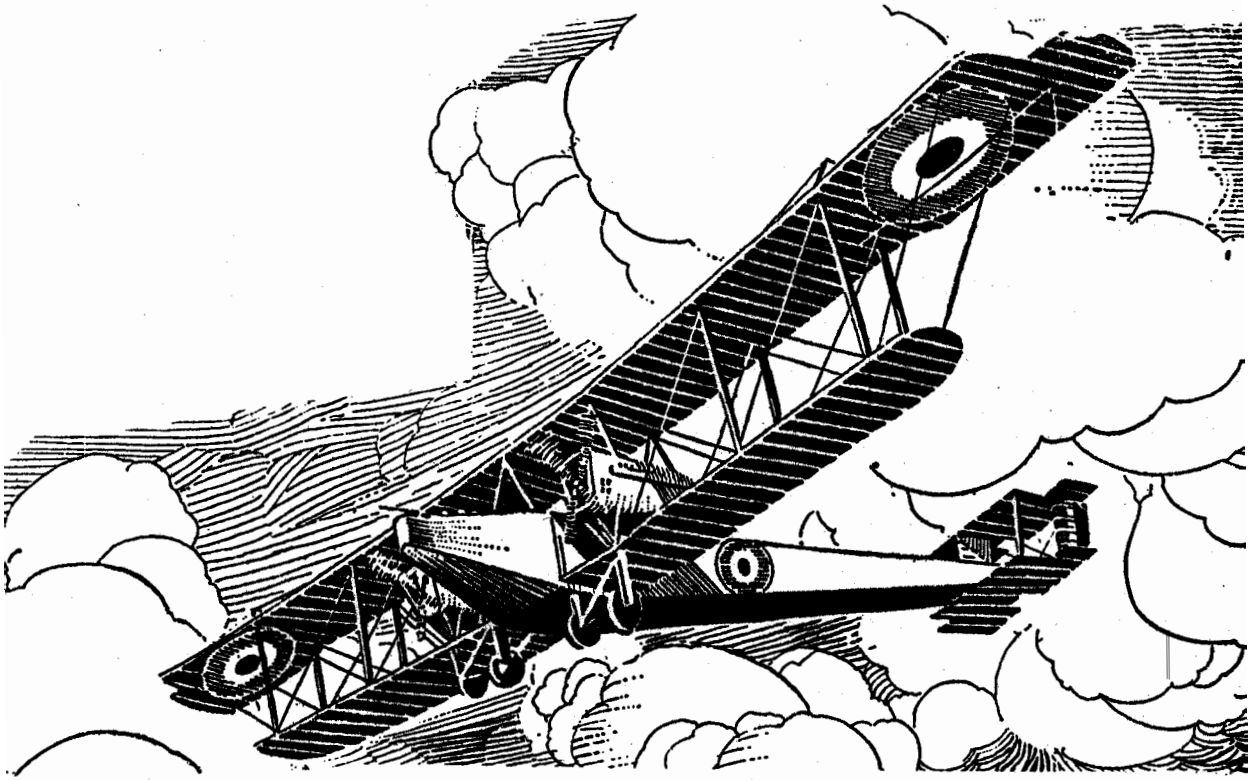


Part I: Lessons Learned

Introduction

Gen.Patrick.

When the fighting was over, Maj. Gen. Mason M. Patrick, Chief of Air Service, American Expeditionary Forces, wanted to find out what lessons had been learned, what knowledge had been gained by Air Service personnel during World War I. He directed that such information be sent to Col. Edgar S. Gorrell, Assistant Chief of Staff, who was compiling the history of the Air Service, AEF, and preparing a "Final Report" for Patrick to give to General John J. Pershing, Commander-in-Chief, AEF.[1] No one was to go home, Patrick said, until he had "furnished in writing to Colonel Gorrell any information of value which he possess[es] and which he has acquired while in the American Air Service."[2]

Setting an example, Gorrell put on paper his own experience in an earlier assignment as Chief of the Strategical Section, and told what he had learned from his efforts to initiate a program of strategical bombardment.[3] Brig. Gen. Benjamin D. Foulois, Assistant Chief of Air Service at Tours, Col. Thomas DeWitt Milling, Chief of Air Service of First Army, and Col. Frank P. Lahm, Chief of Air Service of Second Army, followed suit. The Chief of Air Service of Third Army, Brig. Gen. William Mitchell, contributed some valuable documents relating to his early work on plans and programs of the Air Service, A.E.F.[4]

As Patrick's orders filtered down through the various levels of organization, commanders of corps air services, groups, and squadrons, staff officers, flight leaders, pilots, observers, supply officers, engineers, armament officers, radio men, photographers, surgeons, and other U.S. Army officers assigned or attached to Air Service units began writing reports. Some of the reports, like the one written by a young intelligence officer, a Yale graduate who would return to his alma mater to become Lampson Professor of Latin, were well-written documents, carefully and thoughtfully prepared. Others obviously were dashed off hurriedly to be rid of a distasteful and seemingly nonsensical task as quickly and easily as possible. Someone at the Second Artillery Aerial Observation School at Souge, found still an easier way of meeting the requirement—a form letter for use by officers at the school:[5]

Date _____ 1918

From: _____
To: Col. Gorrell, Office Chief of Air Service
Subject: Information.

1. In accordance with instructions contained in telegram Z 727 TG, from Chief Training Section, Headquarters Air Service, Tours, the following certificate is submitted.

2. I certify that I have acquired, while in the Air Service, no information of value.

(Signed) _____

When such certificates had been completed and signed by 10 first and second lieutenants, they were collected by the commander, another first lieutenant, who sent them off to Colonel Gorrell, "in accordance with instructions."[6] There were other officers, however, who had learned a great deal and had information worth recording but who apparently did not submit reports. There are no reports, for example, from Capt. Eddie Rickenbacker and some other well-known fliers who survived the war, but in some instances, as in the case of Maj. Charles J. Biddle, the men had left for the United States before General Patrick's order was received.

Receiving the reports, Colonel Gorrell made them part of the "History of the Air Service, AEF." Most of them were bound together in Volume 15 of Series A, but others are scattered through various volumes of the history. Apparently no one ever attempted to organize and analyze the reports to see just what had been learned that might be of use in the future. The reports evidently have not been much used for research. Scholars who have examined them have been disappointed. As one of them said, "The volumes entitled 'Lessons Learned' belie the promise of the title; . . . they are unsystematic, not comprehensive, and inconclusive."[7] Nevertheless, these reports, written by men who had first-hand knowledge of the matters about which they wrote, are valuable as primary source materials for World War I. They supply information and ofttimes present viewpoints not found in other source documents of the Air Service, AEF.

Taken together, the reports contain a considerable amount of interesting and significant data on a variety of subjects—the care and feeding of pilots (they should eat more prunes), what it was like to be airsick in the back seat of a DH-4 (clean your goggles with the sleeve of your teddy bear), or, for example, how to fly through an artillery barrage (by a pilot who did it regularly and lived to write down what he had learned). There are reports

on how to avoid being shot down by anti-aircraft shells, machine gun fire from the ground, or red-nosed Fokkers; the best way (or ways—the men did not always agree) to carry out an infantry contact or artillery adjustment or patrol or reconnaissance mission; how to survive the forced landings that were a normal, expected part of flying in those days; why aviators were such an undisciplined lot; how uncooperative infantrymen were and how little they appreciated the help given them by the aviators; how hazardous a trailing antenna could be in formation flying; why some Air Service activities should be placed in charge of civilian experts, or why those activities had to be directed by military men; what was wrong—or right—with the promotion system, commissioning programs, or gunnery training; how this effort or that was "ruined" by the Armistice (a lament sung all through the ranks, from Maj. Gen. Mason M. Patrick and Brig. Gen. William Mitchell on down); and what wonderful things would have been accomplished "if the war had lasted six months longer."

All these and many other things—the poor construction of radiator caps, tail skids that wore out, propellers broken because the wheels on the planes lacked mudguards, etc.,—affecting the employment of aviation in World War I are brought out in the reports which follow.

Reports

—1—

Col. Thomas DeWitt Milling
Chief of Air Service, First Army

Col. Milling.

The remarks and observations that Col. Thomas DeWitt Milling submitted in response to General Patrick's instructions reflected broad and varied experience in U.S. military aviation. A pioneer aviator who had learned to fly at College Park in 1911, Milling had set some of the early flying records in the United States and had been involved in many of the early experiments with aircraft in the U.S. Army. He had been one of the original members of the 1st Aero Squadron and had flown with the squadron in Mexico. Having been in charge of flight training in the Signal Corps, he subsequently had served as chief of training for the Air Service, AEF. Later he had commanded the 1st Pursuit Wing and had served as Chief of Staff of the Pursuit Wing and had served as Chief of Staff of the Air Service of the First Army before succeeding Mitchell as Chief of Air Service, First Army. Thus, Milling was well qualified to comment on such things as the state of the pre-war Air Service, problems of training the pilots and producing the airplanes required for the war in Europe, conflicts that arose between the military and civilians and between the Air Service in Washington and the Air Service of the AEF, and, among other things, the development of combat tactics in the Air Service, AEF.

. . . . . .

At the time that we declared war on Germany few people in the United States knew anything about the Air Service or had any real knowledge about airplanes, types that should be employed or the use that could be made of them, either from a commercial standpoint or from the standpoint of war. This condition of affairs placed the Air Service at the beginning on a very unstable footing.

During the trouble with Mexico, immediately preceding our declaration of war on Germany, the United States possessed very few airplanes. These consisted of a few school machines in use in the training school and a few in service in Mexico. At this time the newspapers, based on information supplied both by civilians and by Army Officers, made an attack on the Signal Corps against the machines then being used in Mexico. While certain charges may have been true, no remedy was offered and

therefore the "muck-raking" that took place did more harm than good. At the time, these machines were the best obtainable in the United States; it was impossible to purchase machines from abroad; it was therefore a question of making the best use of the equipment at hand.

When war was declared on Germany programs were drawn showing what the United States could do towards building and putting on the battle-front of Europe an Air Service superior in numbers and efficiency to that of the Allies combined. This program was undoubtedly based on the idea that has always seemed to exist in the United States, namely, that money can do anything. It was evidently supposed that if a sufficient appropriation was secured from Congress, that no difficulty would be encountered in building the necessary equipment and in training pilots. This at the time was an impossibility to those who appreciated the true situation.

The work of drawing up the plans and organization for the Air Service at the beginning of the war, with the exception of two or three officers who knew something about aviation conditions, was turned over entirely to a board of men who had been successful in civilian life, such as manufacturers, particularly that of automobiles. This in itself, in my opinion, was a mistake. It is believed that the services of men who have been successful in the organization and handling of large business establishments in civil life can be well utilized in connection with Army work, but as a rule they should be subordinate to trained officers of the Army, as conditions enter that can only be met and handled by men who have gained knowledge and experience by actual military service.

A publicity campaign was immediately begun and the people were fed on rash promises, not only as to the number of planes that could be put on the front, but also the wonderful things they would do towards winning the war. While this may have been necessary from a political standpoint in order to obtain the appropriations asked of Congress, nevertheless it was apparent that it would do more harm than good in the end.

The programs drawn up for both the training of pilots and the building of planes were entirely too optimistic. The manufacturers of planes of course had to bid high on a production basis if they expected to receive the orders. Considering the matter in the light of our experience obtained in buying planes in the United States during the previous four or five years, it was apparent that these programs could not be met. The maximum figures for the building, establishing and putting in service of the schools were employed with a corresponding maximum output in the minimum of time. This, without considering carefully, the output

from our schools during the previous years.

If at the time the Air Service program was taken up, it had been decided to develop the service on what might be considered two separate programs, it is believed that many difficulties would have been eliminated. The first program could have provided for the immediate needs of all mobile troops by copying standard makes of planes and motors pending such time as the larger program calling for thousands of pilots and planes with new equipment could be developed. It is also believed that too much consideration has always been given to the views and opinions of foreign officers, rather than placing full dependence on those of our officers who, knowing our own peculiar conditions, were, from their experience in aviation, better fitted to determine all questions affecting our service.

It is not believed that sufficient consideration was given to the planes that had been developed in the United States. In addition to those selected for training purposes, there were two or three types susceptible of development, which, in my opinion, would have proved satisfactory for use on the front.

The organization as finally built up in the United States and that in Europe lacked co-ordination. If success was to be obtained it was essential that the closest co-operation and co-ordination should exist between the Air Service in Europe and in the United States, bearing in mind always that the Air Service in the United States existed purely for the purpose of supplying the American Army in Europe with all the necessary personnel and material. This seemed to have been lost sight of. The Air Service in Europe, due to the new conditions it had to face and being directly in contact with conditions actually existing on the front, developed a view-point which no one in the United States could possibly acquire unless he had had the same experience in Europe and especially on the front. The opinion of those in Europe should have been accepted without question. Such was not always the case.

The program as outlined for the production of pilots in the United States was based on the number of schools to be established, either two or four squadron stations. This was figured on the maximum capacity of the school and a sufficient length of time was not allowed for the construction and preparation of the school before it was supposed to produce its maximum number of pilots. The fields should have been located in those sections affording the best climatic conditions. Instead of establishing a large number of small schools, it is believed to be a better policy to establish a small number of large ones with a sufficient number of outlying fields to complete the full course of any particular phase of training. The greatest care should have

been exercised in the selection of commanding officers for schools, as only in such cases can the best results be obtained, where morale is such a high factor and where the temperament of the individual must be thoroughly studied and understood. It is not believed that this was thoroughly appreciated.

The type of machine selected for primary training, namely the Curtiss J.N.4, is believed to be good for the purpose. It is understood that a sufficient number of high powered machines, either single or two place, could not be obtained. It is believed, however, that a mistake was made in holding back pupils in the States who had from 100 to 150 hours flying, even though it had been on Curtiss J.N.4 machines, awaiting such time as faster machines were available. The man who is thoroughly trained to fly and has had a large amount of practice, even on machines of this type, will require but little additional training on faster types to equip him for work over the front. The principal reason for employing three or four different types in training a pilot is to cut the time as short as possible consistent with the results. If a sufficient amount of time can be devoted on a slower type machine, all results can be obtained except the finishing touches. In spite of the information received from the States that fully trained personnel would arrive ready for the front in a short time, it was determined to maintain the schools in Europe with

Curtiss JN-4 trainers.

the idea in view of using them for revision and selection of pupils arriving from the States. By this method a pupil who arrived for any particular phase of work such as pursuit, bombardment or otherwise, would be sent to the school in question and after being examined, would remain there for the length of time necessary to determine that he was competent before being sent to the front. This period would probably have varied from one to three weeks. This unfortunately never had a fair test, as men were sent over in all stages of training.

The method of training followed in our schools in France was based on the French system. This method was based on a system of individual training, the result of which may be seen in the "French Ace," rather than teamwork and formation flying. We never fully appreciated the necessity for training in formation work until after the Battle of St. Mihiel. Steps were then taken by the Training Department of the Air Service to change the course of instruction in order to institute this new method.

In order to develop pilots of espree and to instill in them the desire to be constantly "on the job," regardless of conditions, it was essential that they receive proper treatment in the schools; in other words "morale," one of the biggest factors of success in the Air Service, had to be maintained. Due to the congestion of cadets sent over from the States for training, there was much dissatisfaction. In many cases cadets who were sent to Europe, because of their high standing on graduation from ground schools, were still privates when men who had attended school with them began to arrive as first lieutenants. The mixing of cadets and officers, who had been at the same ground schools together, was very detrimental. In other cases, due probably to the shortage of enlisted personnel, they were required to do police work and other odd jobs. Under the conditions this may have been necessary; however it is believed that it would be better policy to establish a definite status for these men which could be clearly defined and followed.

The bombardment school at Clermont-Ferrand was inspected by the undersigned in the early part of last Spring. The school at that time was in very poor shape, discipline lax and morale poor. It is believed that the resulting poor morale in the bombardment units at the beginning of the Argonne offensive was due in a large measure to the conditions existing at this school.

Due to the shortage of our Air Service during the battles of St. Mihiel and the Argonne and the fact that we were unable to obtain a sufficient number of squadrons from the French to take care of the sector alloted us, it was necessary to take squadrons of enlisted personnel directly into the army area and organize them as fighting units while the battle was in progress. It is

believed that it is only due to the high character of our personnel that this was possible and that the resulting fine service was obtained from the units so organized.

Some trouble has been encountered in maintaining harmony between the flying and non-flying personnel. This is due principally to the fact that the flying personnel as a whole looks upon the average healthy man who holds a non-flying position as one who has either obtained it through political influence or who desires to escape danger. It is believed that the best way to eradicate this situation is to place all flying officers who through wounds, nervousness or other causes lose their usefulness as pilots over the front, but who are still capable of performing non-flying duty, in these positions.

So far as flying personnel is concerned, pilots, as a rule, should be between 19 and 24 years of age; observers 23 to 30. Also it is not thought necessary that an observer should be forced to undergo the same physical examination as a pilot, nor that exactly the same physical qualifications should be required of him.

At the beginning of the battle of Chateau Thierry, the tactics employed by our Air Service were in general what we had learned from the French and British. It soon became apparent that their method of employing the pursuit in large massed patrols was not the most effective. It was therefore decided that while the large numerical strength of patrols should be maintained, instead of employing the patrol in one massed formation as was commonly the case, the formation should be made up of small groups in echelon properly articulated and within supporting distance. In this way only one small group could be thrown into confusion if attacked and the remaining groups would be in a position to counter attack. This method proved very effective, as is shown by the fact that it was immediately adopted by the Germans. The lessons learned in this battle in the employment of pursuit and Corps Observation proved of great value to us later. During this battle the only American units employed were pursuit and corps observation, all under the general command of the French. It was not until the beginning of the battle of St. Mihiel that our Air Service began to function under American command throughout.

Our Air Service for this battle consisted of about 45% American and 55% French but all under the command of an American Chief of Air Service. The lessons learned at Chateau Thierry were taken advantage of with excellent results. Our pursuit was equipped with bomb racks to carry light bombs for use against concentrations of enemy ground troops, convoys, etc. One group was held in reserve for this purpose and to meet

any sudden concentration of enemy aircraft. In the withdrawal of the Germans from the salient the wiseness of this move was shown, as an opportunity was afforded on the afternoon of the 12th to attack heavy congestions of traffic and troops with bombs and machine guns. Thereafter the general policy was to always retain one group in reserve. However, such a group was not idle during the day. If its services were not needed to meet concentrations of enemy aircraft or if no special concentrations of enemy troops or convoys could be discovered, it was sent out at various times during the day as concentrated patrols to sweep the front.

The First American Pursuit Group was given an entirely new phase of work which had never before been tried, namely, what we might call "low flying". This was done in order to attack the Corps Air Service of the enemy, to prevent his battle-planes from operating successfully and for the purpose of attacking and destroying balloons. Up to this time the tendency in pursuit had been to work at higher and higher altitudes. By instituting this method of low flying in the offensive we were able to combat successfully the German battle-planes, which up to this time had been able to work unhindered and in addition to place a full barrier of pursuit on the front.

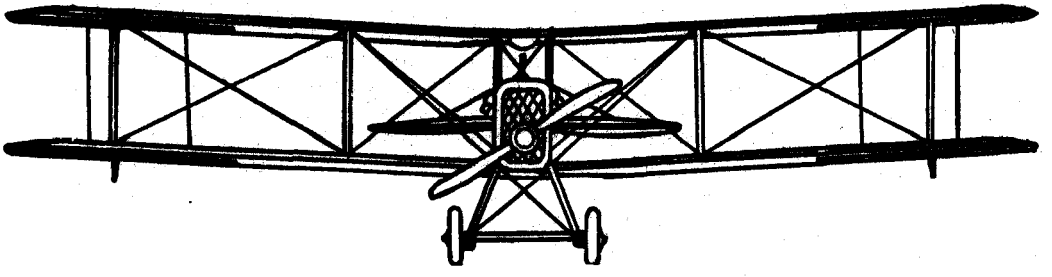
The day bombardment was employed as the French and British had always used it, practically without protection, to attack important hostile P.C.'s and points of strategic value from ten to twenty kilometers behind the lines. This method of employment is highly unsatisfactory and is attendant with what might be considered heavy losses. It is believed that the Germans, realizing this, never seriously employed or attempted to organize day bombardment units. As will be explained later, in the Argonne-Meuse offensive, however, the method which we employed in using the day bombardment together with the pursuit not only did away with excessive losses but also increased our efficiency.

After the Battle of St. Mihiel the transfer of the units to the new fields for the Argonne-Meuse offensive was completed in ample time for the attack on September 26th without the pursuit ever ceasing its work, but with great difficulty on account of the lack of transportation. It might be pointed out in this connection that if the Air Service is ever to be successful in the field, especially in the system of open warfare which had been reached during the last months of the war, they must be equipped with a full allowance of transportation in order that they may be absolutely mobile. It was only by using our transportation twenty-four hours a day that the move was completed, but the transportation was left in such shape that a similar movement

would have been impossible. It has been demonstrated without question that if mobility of Air Service units is to be realized, it is essential that the Air Service have and control its own motor transport service.

At the beginning of the Argonne-Meuse offensive our general tactics of employment were retained. After our attack which began on September 26th was checked, the air fighting continued to be very severe. For a period of about ten days, or until about October 12th, we encountered difficulty on account of the losses in the day bombardment. This was having an effect on their morale. It was therefore decided to employ them only in connection with the pursuit. On October 12th, therefore, one pursuit group was sent as protection for the day bombardment; this protection being afforded by setting a definite hour for a rendezvous over the target to be bombed, the pursuit being in place in groups above and below the level at which the bombers were operating. The presence of day bombardment always draws out the opposing pursuit, and as a consequence our pursuit was afforded an opportunity to attack their opponents as soon as they appeared in view. This method proved highly successful with practically no loss to the bombardment. It was then decided to continue the development of this method by employing pursuit in greater numbers and loading them with light bombs at the same time. During the succeeding days the morning raid by day bombardment was made in conjunction with one pursuit group. For the afternoon raid a time was selected so that the bombers would be across the lines during the last hour of daylight. In this way all pursuit could be concentrated with the bombing and a force of from 140 to 180 machines employed in a single raid. These raids proved so successful that during the last days of the battle approximately 75% of the total planes brought down during the day occurred as a result of these raids. After escorting the bombers back to the lines, the pursuit would disperse and would straff the front line troops, machine gunning any concentrations of the enemy that could be discovered and clear the front of opposing machines.

DH-4.



In connection with the day bombardment, it might be mentioned that another reason which existed for their low morale was due to the fact that the type of machine with which three of the squadrons were equipped, the D.H.4, carried gas tanks which were unprotected against fire. It seems that it would have been a simple matter to have foreseen the necessity of supplying protected tanks. Successful experiments with such tanks had been made in the United States before the undersigned left there, which was in August 1917. There are numerous cases where these machines were set on fire, not only when being attacked by enemy machines, but also when being struck by enemy anti-aircraft. French machines with protected tanks were returning to our lines intact with numberless holes in their gas tanks, one specific case of which I know having fourteen.

During the month of October an additional pursuit squadron was brought to the front and equipped with Sopwith Camels for the purpose of being used for night work. This squadron was put into shape very quickly and did very good work on night patrols. However, the Germans were not employing their large bombers over the front at this time and only one opportunity was given for them to engage in combat with an enemy plane. Unfortunately this took place without the aid of searchlights and no results were obtained. However, a sufficient amount of experience was obtained from this squadron to show that it is as practicable as day pursuit and if proper liaison is maintained with the anti-aircraft service, that the employment of night bombers without protection will be a difficult matter in the future. At the time the armistice was signed provision was being made to equip this night pursuit squadron with bomb racks for the use of light bombs against the front line trenches. Such bombs would cause little, if any, real damage against the enemy but from experience with our own troops, it would have a great effect on their morale. The night pursuit can be very well employed in connection with night squadrons, whether of the night reconnaissance or night bombing type.

Numerous cases occurred where both German pilots and German observers saved themselves from being killed by leaping with parachutes from their plane when it caught on fire. From examination made of several men who descended in this manner, it was found that their machines had not been designed nor constructed in the factories to carry parachutes but that they were carried in different ways; in some cases they were used as seat cushions, in other cases they were carried strapped to the back. However no case is known where any observer or pilot

jumped and his parachute failed to open. It is believed that it would be a simple matter to arrange for receptacles for the installation of parachutes in all machines when they are manufactured.

It is not believed that the so-called two-place fighter has yet demonstrated the fact that it can be considered to exist. Unless it is intended to use such a machine in connection with observation or bombardment, its use is not recommended. If it is intended to be used in connection with observation or bombardment it is not seen where it would be sufficiently superior to the types of machines now used for that purpose to warrant the use of material and personnel for this purpose alone. In the natural course of events one-place fighters should continue to improve in performance as rapidly as a two-place fighter and will therefore retain its advantage from the standpoint of speed and maneuverability. Also in any two-place machine the fighting is done by the man in the rear seat and not by the man who operates the bow-guns. In such case the pilot maneuvers the machine so as to put his gunner in position where he can fire in the most effective manner. When placed in this position he is usually going away from the enemy. He therefore immediately places himself on the defensive and the offensive spirit is lost. It is believed that this offensive spirit is essential and can only be obtained where the pilot is constantly going forward and toward his adversary. Undoubtedly the two-place fighter was designed with the idea in view of individual combat, which had been the rule up to the last few months of the war. It is believed that the best two-place machine would be able to defeat the ordinary single-seater machine. However, it must be remembered that the one-place fighters are only used in groups and that it is against the rule of our service for a man to leave his formation for the sole purpose of indulging in individual combat. The so-called making of "aces" is not countenanced in our service and undoubtedly this is the main reason why we have been so successful in making a record with our pursuit that has been equalled by no other service in the world.

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Air Service Commander, First Army

In addition to a statement of lessons learned, Milling was asked to make recommendations for changes in the Tables of Organization (see appendix A). The following recommendations were provided to the Chief of Air Service, AEF on 11 January 1919 by Maj. R. L. Walsh, Chief of Staff, acting for, and in the absence of, the Army Air Service Commander, Colonel Milling. While the recommendations pertain mainly to specific authorizations, the commentary contains some significant remarks (extracted below) about the organization and employment of aviation.

It must be remembered that each war is fought in a different manner from the previous one; therefore organization and equipment in this war is not necessarily that which will be used in the next war. This was not an open and mobile war but a stationary war and the organization and equipment is more or less based on that idea.

The Operations Department must be considered as one of the most important in all Headquarters units . . . Headquarters officers should be men who have had experience and they should have a constant knowledge of the situation by actually flying themselves.

There should also be schools established to train Air Service Staff officers in all branches of the Air Service and also in the work of the line and work of the balloons.

In the employment of bombardment and pursuit together it was found that better results were obtained when both were under one head. But with trained staffs, there should be no difficulty in cooperating pursuit and bombardment, and in such an event this would not be necessary. There should be one pursuit group in the army assigned to low flying work against battle planes and balloons. This group should have night flying equipment as the work is such that it requires "taking off" or "landing in the dark." There should also be two night pursuit squadrons. These six squadrons are included in the 24 for the army.

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If the personnel and commanders of the Observation Group and Balloon Group together with G-3 of the Corps are thoroughly trained in the employment of Air Service, the position

of Corps Air Service Commander could be done away with, as the airplanes and balloons could be co-ordinated by G-3. However, there should always be a thoroughly trained Air Service Officer with sufficient rank for his opinion to carry weight as a member of G-3 of the Corps.

. . . . . .

A Divisional Air Service is not recommended.

1. Due to constant changing of divisions in attack it will require an excess of Divisional Air Service.
2. It is uneconomical in both personnel and materiel.
3. The necessary cohesion and control will be lost in the Corps Air Service.

. . . . . .

This table [of organization for Headquarters, G.H.Q. Air Service Reserve] should be that necessary for a Headquarters, Group of Armies or an advanced General Headquarters. These headquarters should control the large bases and feed supplies and personnel to the small bases (depots) of each army. The personnel and equipment should be that necessary to operate in this manner.

There should also be a reserve independent force, under the command of the Group of Armies, capable of being placed at the most vital points to assist the Army Air Service. This should be large and contain picked units. It should be made up mostly of pursuit and bombardment units.

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Col. Frank P. Lahm
Chief of Air Service, Second Army

Col. Frank P. Lahm, who was 10 years older than Milling, had entered aviation by way of ballooning, in which his father was interested. The younger Lahm had learned to fly a balloon in France and had won the first James Gordon Bennett International Balloon Race, in 1906. The following year he had been assigned to the Aeronautical Division of the Signal Corps, and two years later he had become the first member of the U.S. Army to

Col. Lahm.

go up in an airplane and the second to make a solo flight. Sent to Fort McKinley in a cavalry assignment, he had started military aviation in the Philippines. Later he had been secretary of the Signal Corps' Aviator School at San Diego and commander of the Balloon School at Omaha. Sent to France in September 1917, he had been placed in charge of balloon activities in the AEF. Later he had served as a balloon representative at GHQ, AEF, chief of the advance section of the balloon service, and on the staff of G-3, Headquarters, First Army, before being made Chief of Air Service, Second Army, in October 1918. Lahm's report on lessons learned was in two parts, the first being concerned with the Air Service in general and heavier-than-air aviation in particular (below), the second pertaining to balloons (see below, Document 72).

Historical. Like the entire Army, we had the problem of rapidly organizing, training, equipping and putting on the front, a large Air Service.

We suffered first from lack of a reasonable nucleus with which to start, then from lack of coordination between efforts in the U.S. and those in the A.E.F. This was early recognized and liaison officers were exchanged, but they frequently did not have full knowledge of the conditions on which they were to report, moreover in the case of officers returning to the U.S., I know that conditions changed rapidly, and information taken back by them, was frequently superannuated by the time it was delivered.

The Air Service in the U.S. worked along certain lines, but we did not know in France, just what these lines were. For instance, trained personnel was supposed to come from the U.S. and at a time when trained personnel was lacking in France, we knew that there was supposed to be some 16,000 aviators in the service, but sufficient were not obtainable to maintain a dozen squadrons on the front. The U.S. had failed to foresee the large overhead required in producing rapidly a large trained personnel, consequently many of the earlier trained ones were held at instruction centers starting right from the ground schools in the U.S. and up to the final training schools in France, from which aviators were sent into squadrons. Our permanent training cadre maintained with the colors after the war, should be large enough to suddenly take the largest influx of green material that any future war may call on us to train and put on the front. We know now what machinery is required for this purpose. We should never again find the "neck of the bottle" to be, for instance, aerial gunnery. With our past experience, no one

feature of training should be overlooked, but a symmetrically developed system should be maintained in time of peace, that will produce completely trained aviators with facilities for passing them from one phase of their training to the next without delay. We should be self dependent and never have to depend on foreign services to assist in our training, utilizing them simply for broadening our knowledge and view point. From my personal knowledge I know that the training given our pilots and observers in French units, airplane as well as balloon, was of material value to them in their later work in our own squadrons on the front. It is not sufficient to have trained officers of the French and British Air Services attached to our training section at home, we should continue to maintain at all times, a personnel under instructions in foreign schools, as has been done in our cavalry service for many years past. American officers who had the advantage of the course of instruction at the French Cavalry School of Application at Saumur,[a] were of material assistance in developing our own Cavalry Service. The Air Service should follow this principle and keep up the date in all the developments of foreign aviation, French, British as well as German.

Coordination is a subject on which we have learned many lessons. I believe a well organized coordination section, operating a year ago would have assisted materially in the development of the Air Service in Europe. At first we were ahead on pilots and observers, sending the trained men to French and British squadrons while waiting for planes to equip the squadrons we did have. This existed from perhaps February till July, when we found we had a sufficient supply of planes, but pilots and particularly observers, were lacking, and before this, the shortage of service squadrons had made itself felt. A coordination section would have foreseen some of this difficulty. However, neither a coordination section nor any other amount of foresight will ever be able to overcome the difficulties which resulted from our being dependent on our Allies for supplying us with ships and with training our personnel. It is evident that we must be in a position to supply all our own needs, and our future plans should be based on this plan. It is probably entirely unnecessary to state that money and men in unlimited quantities will not mobilize an Air Service in time of war. We had both, but took just a year to put our first squadron on the front, from the time war was declared.

A fixed policy was another one of our difficulties. At one time early in 1918, three different organizations for a balloon company were in effect. Companies were arriving from the U.S. composed

of six officers and ninety-one men, the organization which had been approved in the U.S. the previous spring. As a result of investigations carried on in France, a balloon company organization of nine officers and two hundred men had been approved at G.H.Q., A.E.F., sent to the U.S. and approved by the War Department. About this time a new organization was proposed and adopted in the A.E.F. cutting down the number of officers by one and the number of enlisted men by thirty. No one of the three organizations was perfect, but the continuation of any one of them at least for a reasonable length of time would have resulted in less confusion and greater efficiency. I think we should take this lesson to heart and avoid a repetition of it in the future. Another example, has been the First Air Depot. This has at various times been destined as a main supply depot, an advanced depot and a park. While its functions were being discussed and changed, squadrons came to the front and the depot was unprepared to handle to work at hand. I suggest that first a well thought out system of supply be adopted to meet any kind of warfare we may be called upon to conduct, and that conservatism be exercised in all changes of organization and supply, once reasonable systems have been adopted. Swapping horses in the middle of the stream is known to be bad policy.

Tactically I believe our Air Service has been as sound as that of the British, French or German. Tactics have been in a stage of development right up to the end and probably would have continued to change rapidly and radically as equipment changed and the war progressed. In less than a year we passed from the exploits of individual "aces" to the well thought out operations of teams. Team work must be the basis of future tactical development as illustrated by the French Aerial Division. Formation flying must be given a place of great importance, starting with the patrol of a flight and working up to groups of squadrons operating together in bombardment and pursuit. It has been recognized for some time that proper training in the line can only be accomplished by concentrating divisions or larger units. I believe the same is true of the Air Service. Isolated squadrons will not arrive at the desired efficiency. Bombing and pursuit must be concentrated, and the different kinds of aviation must train together, not wait until the outbreak of war to develop team work. Bombers and pursuit must know each other and train in the same vicinity. The same applies to pursuit and observation. Moreover it is absolutely essential that corps observation squadrons should train with the line in time of peace. Consequently, taking into account climatic conditions, I believe the Air Service should be concentrated in large units in

Balloon ready for ascension.

the vicinity of the training centers for troops, there to come in contact with the line and let the different services become mutually acquainted.

Perhaps our weakest point has been in the lack of understanding between the Air Service (observation in particular) and the line. Great progress in overcoming this difficulty has been made in the last three months, first by detailing observers to the line units down as far as battalions where they lived and talked aviation, explained the capabilities and limitations of the Air Service, learned the line officers view point, second by bringing the line to the Air Service and demonstrating its operations. Corps Schools have proven of particular value in this work, details of one hundred men and six to a dozen officers being taken from a division onto the corps observation airdrome for a five day's course of instruction and training, covering the equipment, methods and usual procedure, and practical exercises with panels, pyrotechnics and radio. . . . Every opportunity should be taken to participate in the problems and maneuvers of the line troops. To accomplish the above results, the Air Service in time of peace must be located near the training centers for line troops.

Mobilizing and putting a large Air Service on the front in a minimum length of time was our problem the past two years. The greatest one feature of this problem was supply, and this will probably always be the case. In our eagerness to get the

first squadrons to the line, we sent them there with equipment that could not be rated as first class and that was insufficient in quantity. I refer to the Spad type XI, A.R. Two, Sopwith and Nieuport planes in particular. It is a fact, however, that putting squadrons on the front with these planes resulted in expediting the delivery of additional equipment, and what was far more important, it gave our aviators the opportunity to demonstrate their efficiency, as a result of which the quality of equipment furnished by the French improved materially.

Spad types VII and XIII for the pursuit and Salmsons for the observation took the places of the earlier equipment. While it would have been desirable to wait for these better ships before sending squadrons to the front, I believe the plan adopted was of greater benefit to the Air Service in the end.

Supply. The original supply system for units in the field, drawn up in the summer of 1917, is believed to be sound not only for the peculiar fixed warfare we have grown accustomed to, but for any future form of warfare. We shall always require depots, probably backed up by receiving and regulating stations, with parks out in front of the depots. These parks should be fairly mobile and capable of moving with their supplies as troops move. The park squadrons with the groups are of particular value, especially in the pursuit groups, and in case of mobile warfare for which we must be prepared, they would prove particularly valuable. In the observation group the park squadron is less important, due partly to the greater reliability of the Liberty motor and partly to the fact that the observation group has been more fixed. This should not be taken as the normal case however.

The D. H. 4 has proven a very successful observation plane. It has the power, speed, carrying capacity and ceiling. The adoption of the D.H.9 will obviate the difficulty due to the separation of the pilot and observer as in the D.H.4, and will also give the added improvement of having the tank where it will not be a menace to the pilot in case of a crash. Covered gas tanks are absolutely essential. The morale of the observation and bombing flyers was noticeably lowered due to the danger from fire which they knew was always present with the uncovered tanks. The Selden pump in place of the pressure feed is another improvement that will react favorable on the morale of D.H. 4 flyers.[b] Mud guards should be provided on all planes sent to the front. With the arrival of the rainy season and consequent muddy fields, many propellers have been broken in taking off, and flying has had to be suspended in many cases until mud guards could be made and put on the planes.

Low flying, high speed, protected two seater fighting planes

would have proven of great value in the Second Army. A machine of this type should be developed at once, capable of shooting up troops on the ground and of carrying out low reconnaissance missions. The moral effect of these planes on front line troops is out of all proportion to the material effect. Our own troops were greatly harassed by enemy planes flying over them, though as a matter of fact the casualties were negligible. On the other hand, the mere presence of our own planes flying at a low altitude over the front lines produces a feeling of confidence in the line troops that cannot be overestimated.

During the last five days before November 11th, Second Army Headquarters was particularly anxious to verify the suspected withdrawal of the enemy from our front. This was the Air Service's one most important mission at that time. It could be accomplished only by low flying reconnaissance and for unprotected planes this is a mission that can only be accomplished by the most daring flyers, the ones we could least afford to lose. A squadron of fast, protected two-seaters would have proven invaluable on this front.

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Brig. Gen. Benjamin D. Foulois
Assistant Chief of Air Service, AEF

On 29 January 1919, Brig. Gen. Benjamin D. Foulois, Assistant Chief of Air Service at Tours, turned in a 140-page report, typewritten, single-spaced, on legal-size paper, on "Air Service lessons learned during the present war." After briefly reviewing the status of U.S. military aviation at the time the United States entered the war, Foulois told of his work in the Aviation Section of the Signal Corps in Washington in the period from April to October 1917. During that time, first as a captain, then as a major, and finally as a brigadier general, Foulois had played an important role in the expansion of the Aviation Section into the wartime Air Service.

The main part of Foulois' report, however, was devoted to his accomplishments as Chief of Air Service, AEF from November 1917 until May 1918, when he was concerned mainly with organization, logistics, and training. This section, some 110 pages, was made up largely of letters, memoranda, orders, reports, cables, and other documents copied in their entirety and strung together with brief passages supplied by Foulois.

The next section of Foulois' report, (12 pages) covered the period of his service as Chief of Air Service, First Army. The most important thing during that time, and the one on which Foulois concentrated, was his conflict with Billy Mitchell. Here again a large part of the text was built up from documents, including those in which Foulois requested reassignment and recommended Mitchell for the post of Chief of Air Service, First Army.

A few pages then were used for the period, beginning in August 1918, when Foulois was Assistant Chief of Air Service, first in the Zone of Advance and then at Tours.

The report is much too long for inclusion in its entirety in this volume. Furthermore, the way in which it was constructed from copies of documents prevents the selection of a series of meaningful extracts. The lessons learned were reflected, however, in the recommendations with which Foulois brought his report to a close.

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126. In closing this report on lessons learned, I submit the following recommendations for future consideration.

126a. Future Preparedness. Each and every paragraph of this report shows the necessity for future military and industrial preparedness.

The United States has developed an aeroplane and engine industry during the period of our participation in the war, which if effectively fostered and not allowed to die, will put the United States in its proper place in the League of Nations, and in the event of future military emergency we will not be required to go through the chaotic and unpleasant experiences which developed in the United States in 1918, due primarily to the unprepared state of the American aeroplane and engine industry.

The United States had developed a large aeronautical personnel which at the close of hostilities was, in the aggregate, the superior of all other aeronautical personnel in the world.

In other words, the United States is in a position today to take and maintain the supremacy of the air, both militarily and commercially, if prompt advantage is taken to maintain and keep up the development of our present aeronautical resources.

Great Britain, during the entire period of the war, has constantly looked forward to the supremacy of the air, both militarily and commercially.

Recent news dispatches indicate that Germany is already turning toward the development of an enormous air force.

The terrific impetus given to the development of aeronautical equipment, as a result of this war, makes it an absolute certainty

Gen. Foulois talks with airmen at the front.

that each and every Allied nation, and other first-class nations, will foster and further develop the resources of aerial navigation. It therefore behooves the United States to do likewise, if we wish to be prepared for any future military emergency, which, judging from the trend of tactics at the close of the recent hostilities, clearly pointed to a greater and more frequent use of aircraft in offensive and defensive military operations.

127. Policy as to general staff administration, and control of air service administration and operation. As a firm believer of the principles and function of the General Staff, I believe in the administration, control and operation of the Air Service by the General Staff, as in the case of all other branches of the military service.

I do not agree, however, with the way in which General Staff administration and control was exercised in the early stages of the development of the Air Service, American Expeditionary Forces.

During the first six months of the Air Service development, the General Staff, A.E.F., did not possess a single General Staff officer with sufficient knowledge of aviation to act intelligently, from his knowledge, on any vital problem concerning the organization or equipment of any Air Service activity. This condition of affairs was perfectly natural, in view of the comparative newness of aviation and the limited number of officers in the United States Army, at the date of our entrance into the war, who had had the opportunity to come in actual practical contact with aviation.

The future military efficiency of the Air Service will depend for its development upon the intelligent guidance and administrative control of the General Staff, as heretofore.

In order, however, to secure intelligent guidance and administrative control, General Staff officers charged with the Air Service affairs must have practical knowledge of the many technical problems involved in the organization, development, and use of an efficient Air Service. *That practical knowledge can only be gained in one way, and that is, by actual service with air units.*

The Air Service, as a result of the past eighteen months' experience, includes in its present Regular Army personnel a number of officers who possess the qualifications of General Staff officers. These officers should be utilized as far as possible for General Staff duty and charged with the General Staff supervision and administration of Air Service affairs.

If they are not so utilized, and officers with no practical knowledge of Air Service work are charged with the General Staff supervision and administration of Air Service affairs, such

officers, before they are allowed to actively dictate any Air Service policy, should be required to serve in the Air Service for a period of at least six months in order that they may be practically acquainted with the Air Service problems of organization, administration, and development of personnel and materiel.

128. General Staff, American E.F., Policy Reference the Creation of an American Independent Air Force. The question as to the future organization of an efficient Air Service, for the United States Army, is at this very instant seriously involved.

Tentative bills have already been introduced in Congress, which plan to create an Independent Air Force, similar to the present Air organization of the British Government, and which will combine the U.S. Army and Navy Air Forces, under a separate cabinet officer, independent of the War and Navy Departments.

Efforts have been made, and bills have been introduced in Congress for the past four years, to create such a force. Heretofore all such efforts have failed, due to the opposition of the Navy Department, and of the General Staff of the Army. I am very reliably informed that the general sentiment of the War Department, and the General Staff on duty in Washington was about two months ago in favor of the creation of an independent air force.

I am not informed as to the views on this subject, of the General Staff, A.E.F., but of this I am certain, that if the General Staff, A.E.F., (which in my opinion represents the most up to date General Staff views of the United States Army today) is not in favor of such a radical step, they should take immediate action toward its prevention.

128a. The creation of an independent Air Force at this period of our military existence will operate, in my opinion, against the the full future military efficiency of the United States Army. It will operate to separate an indispensible military auxiliary arm from control and military co-ordinated by the General Staff of the Army. It will operate to train up, in time of peace, a separate organization distinct from Army control which in time of war, must inevitably be brought back under military control, if efficient and co-ordinated military action is to be obtained. It will foster and keep alive the feeling which existed in the General Staff, A.E.F. during the winter of 1917 and the Spring of 1918, that the Air Service considered itself as an independent branch of the military service, and did not desire coordination with the rest of the Army.

It took from 6 to 8 months of constant effort on the part of, Colonels Burtt, Whitehead, Van Horn,[a] myself and other older

Regular officers to remove, once and for all from the minds of the General Staff A.E.F. the impression that the administrative heads of the Air Service were endeavoring to create a separate service which would not be in full coordination and under full control of the General Staff, A.E.F.

The steps which have already been taken in Washington, by the introduction of proposed legislation to create a separate and independent Air Force for the United States, should be made the subject of immediate study and action by the General Staff, A.E.F. if they are to have under consideration the problems of the future organization of the Air Service.

If the General Staff, A.E.F. is opposed to the policy of an independent Air Force, its opinion should be voiced without delay, and it must be voiced in the Halls of Congress, as the question has already reached that point in the issue.

The General Staff, A.E.F. should have representation, in Washington at this very date, in order that a full presentation and discussion of both sides of the question may be had.

Many of the flying officers of the Air Service, A.E.F., who are enroute or have returned to the United States under orders from the War Department, are strong advocates of a separate Air Service, and unless prompt action is taken by the General Staff, A.E.F. the question will be settled in favor of an independent air force, without reference to the General Staff, A.E.F.

128b. One of the strongest arguments that has been used in the past, is the example of Englands' step in creating an independent Air Force, by combining their Army and Navy Air Service under one head, the British Air Ministry. Under the acid test of field service in war this creation of a separate and independent Air Force under the British Air Ministry has failed. The Naval Wing of the British Royal Air Force has practically carried on its operations independent of the Army Wing. In addition to the strictly Army Wing, which operated under the Commander-in-Chief of the British Armies in the Field, we have witnessed during the past year, the creation and operation of another Independent Royal Air Force, which operated directly under the orders of the British Air Ministry, without reference to or control by the Supreme Military Command in the Field.

The question of the creation of this military force destined for operation in active service in France, under the direct orders of the British Air Ministry was considered for the first time, in the early spring of 1918, when it was brought up for discussion before the Aviation Committee of the Supreme War Council, of which I was the American representative. I emphatically opposed before the Committee of the Supreme War Council, the creation of a military force for active service in France, which

was destined to operate under the direct orders of a civilian body, without reference to or control by the Supreme Military Command in the Field.

As this Independent Royal Air Force, was contemplating its operations in the same territorial area which had been designated as the American Sector in France, I very plainly pointed out to the Allied Representatives on the Supreme War Council, and especially to the British Representatives, that the problems which this British Independent Air Force, operating in the American Army area, would encounter, in connection with the use of railroad lines, sites for depots, aerodromes, etc., would make it absolutely necessary for such a force to be subject to some Supreme Military Command, in addition to such control as might be exercised direct from the British Air Ministry.

128c. Fortunately, for the operations of this Independent Air Force, it was placed under the command of Major General Hugh Trenchard, an officer of the highest practical knowledge and experience, not only as regards Air Service operations, but military operations in general, and an officer who was well known and liked by all American officers with whom he had associated. In my opinion the success of the operations of this force, during its period of service, was due entirely to the personality and judgment of General Trenchard, and not to the policy which created this force and placed it under the direct control and orders of the British Air Ministry. In fact, it is my understanding that shortly prior to the signing of the armistice on November 11, 1918, that, the policy of direct control of the Independent Air Force by the British Air Ministry was done away with, and that Major General Trenchard, reported for duty with his force to Marshall Foch, the Supreme Commander of the Allied Armies.

This practical failure of the British Royal Air Force to operate efficiently in active service, as an independent force, directly under the control of a civilian body, is in my opinion a sufficient argument against any such experiment in connection with the creation and establishment of a similar American Air Force.

129. As a result of the lessons learned during our active participation in this war, many other recommendations and suggestions as to the future organization, training, equipment and operation of the Air Service, U.S. Army, could be presented in this report. Such recommendations however, all hinge in my opinion, on the efficient solution of the three problems outlined in the three preceding paragraphs of this report.

If these main problems outlined in paragraphs 126-127 and 128 of this report, are satisfactorily solved, in my opinion the other problems of organization, training, supply and operations will solve themselves without much difficulty.

Marshall Foch.

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Maj. Harold E. Hartney
C.O., 1st Pursuit Group

Harold E. Hartney, a tough and cocky Canadian, had fought with the Royal Flying Corps before being commissioned in the U.S. Army. Assuming command of the 27th Aero Squadron at Toronto, where the unit was in training, Major Hartney had taken the 27th to France in February 1918 and into combat as part of the 1st Pursuit Group in June. When Maj. Bert M. Atkinson had moved up in August to command the 1st Pursuit Wing, Hartney had succeeded him as commander of the 1st Pursuit Group.

One of the units under Hartney's command was the 185th Aero Squadron, which joined the 1st Pursuit Group on 7 October 1918. Commanded by 1st Lt. Seth Low, the 185th arrived at Rembercourt with few pilots and no planes, but it soon received additional personnel and Sopwith Camels, which were fitted with 165-horsepower Monosoupape engines. The squadron then learned that it was to be "a Night Chasse Squadron, the first of its type in the American Army." The mission of the squadron was "to establish a barrage over our line of search lights against enemy night bombing machines."[a] The squadron's historian described some of the problems the 185th encountered in trying to carry out this assignment:[b]

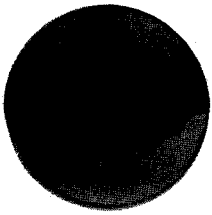
> Night Chasse work in Aeronautics is only in its infancy, and as we were a new type of squadron equipped with planes that had almost gone out of use, except in training fields,[c] we were confronted with numerous difficulties which greatly hampered our work. In the first place our Pilots were not trained for night flying, many of them never having been off the ground after dusk before. Then too we had to experiment with wing flares, parachute flares, and instrument lights. The lights on the Airdrome had to be developed. The searchlights and Anti-aircraft Batteries in this vicinity apparently were not versed in the proper cooperation with night chasse machines, and they were able to give us but very little assistance in our game of "hide and seek" with the Huns. Also there were not enought searchlights and mortars for the guidance of our pilots, who frequently [became] lost, ran out of gasoline, and then had to make forced landings, invariably crashing their planes....

Ready or not, the 185th began operations on the night of 18/19 October. In the short time left before the Armistice, there were many nights when the weather was too bad to permit flying. By 11 November, however, the 185th had flown on eight nights with a total of 31 sorties on patrol or from alert. In addition the squadron had sent two planes on night bombing missions, but neither pilot had found the target. The squadron reported combat on only one night, 24/25 October, when one of the pilots fired on enemy planes at five different times, apparently without scoring, and was fired on once, without receiving any damage. In these operations, the 185th had one plane damaged and three wrecked, and one pilot killed, in crashes and forced landings.

Hartney, who had learned a lot about night flying by taking a Camel up on patrol one night,[d] foresaw an important place for night pursuit in the military aviation of the future.

With the development of the Air Service, the problem of night flying, and more particularly, night pursuit has to be faced and solved. The First Pursuit Group has had one night pursuit squadron attached to it and while they have been handicapped by shortage of machines, spare parts, and pilots, considerable

Maj. Hartney (left), with his Operations Officer, 1st Lt. A. L. Cunningham.



The 185th Aero Squadron appropriately selected a bat for its insignia to represent it as the first "night chasse squadron."

experience has been gained which may prove of great value in the development and which is outlined herewith.

At first sight it might appear the limitations of night pursuit are so great that a squadron of this kind would not justify its existence, but on more careful study one finds that the potentialities are great and the possibilities almost unlimited.

The main function of night pursuit at present is, of course, the defensive patrols for the purpose of destroying night bombers. The British have already demonstrated that this is quite practical and have indeed almost succeeded in bringing the day of the twin engine night bomber to a close. One squadron of night flying Camels brought down 25 enemy bombing machines in 3 months.

As the Air Service develops, the night pursuit will be used in conjunction with patrolling for the purpose of surveillance and reconnaissance. All big movements of troops now take place by night and in time chasse pilots will be sent out to predetermined objectives for the purpose of dropping a flare at an important crossroad to ascertain movements of troops or for the purpose of confirming a suspected withdrawal. At first, night reconnaissance by chasse machines will probably be done in the late evening or in the early morning but as time goes on and the number of squadrons of this kind increase, this kind of work will be done in all favorable weather at night. Concentrations will be located and bombs will be carried, enabling the chasse machine to descend and straff same from very low altitude with extremely great accuracy. Balloon straffing at dawn and in the dusk of evening as carried on by this Group will be almost entirely the function of the night chasse machine and this practice may in time blind the enemy insofar as balloons are concerned as the experience of the First Pursuit Group in the past offensive has shown. Straffing enemy troops by machine gun fire will be a very safe and effective work of the night pursuit and its possibilities are limited only by the weather conditions.

There are many difficult problems in connection with night pursuit that have to be faced and attempts made to solve before a squadron can hope to meet with any success. The pilots must be specially trained in navigation by night although this can be learned in a very short time by one of ordinary intelligence and can be helped greatly by increasing the number of lighthouses, mortar signals, and cooperation between the units of the Air Services, day and night forces combined. Forced landings at night discourage pilots more than any other feature of this work, but with proper landing flares and emergency airdrome lighting sets on all fields and cooperation of searchlights in the defended area, the dangers from this source can be reduced practically to

the same as day flying.

Pilots find that one of the greatest problems of night pursuit is locating the enemy. They claim it is impossible to see him even with the aid of searchlights. It is difficult, but it is not impossible. On moonlight nights, the enemy is visible at 500 to 600 yards, even when he is not in the beam of the light, and on bright starlight nights, he appears as a dark shadow at a distance of 200 yards. If he happens to be picked up by a beam of searchlights, his planes show up for a very great distance and he has been known to be held in a beam as much as 10 minutes by American searchlight officers. Sometimes he can be seen in the twilight of the searchlights and fights have taken place without the beam picking him up or without the knowledge of the operators of the light.

As for the actual combat, it is safe to say that the enemy can be engaged and brought down with slight danger of his retaliation, provided he is first seen by the Pursuit machine.

One of the great problems of night flying is equipment. This Group has found it very difficult and in fact almost impossible to obtain supplies. Day machines for some reasons unexplainable seem to obtain priority, but if night flying is to be attempted it will be necessary to provide for the essentials. The squadron in this Group has the night machines but did not have the necessary spares. It had to develop all its field lighting, landmarks and pyrotechnics itself and in many cases the necessary supplies were unobtainable in that they did not exist. Estimates will have to be made and large contracts for the necessities must be let immediately on a big scale and under the direction of an experienced man if the branch is to be developed to its full efficiency. These necessities include American searchlights, American machines, American airdrome lighting planes [?], lighthouses, mortars and signals.

For night flying as a whole in the operations of any army it is absolutely essential that we have the proper cooperation and liaison with the neighboring arms. The searchlights are operated by the Engineers. It would be well to have a Liaison Officer on the staff of the Chief of night flying who can advise and insure the proper location of searchlights and the cooperation of their personnel with the pilots. The same liaison applies to the anti-aircraft artillery. The Chief should have a liaison officer from this branch on his staff and the guns should be located and operated on his advice and with his cooperation. In addition, official observation posts should be established in all units on the lines, each in touch with a P.C., where there should be located a wireless station, in order that the chief of all wireless stations in the rear will be kept in constant touch with indications and

locations of enemy aerial activity, and likewise advised of its cessation, so that concentrations and patrols may be determined wth the greatest efficiency.

Defended areas have been one of the incidentals in the experience of night pursuit and it is suggested that as the night pursuit develops these be reduced to a minimum if not dispensed with entirely. Arrangements could be made whereby all machines crossing the lines could be challenged by the forward observation posts and the identity of the machine fixed at this point.

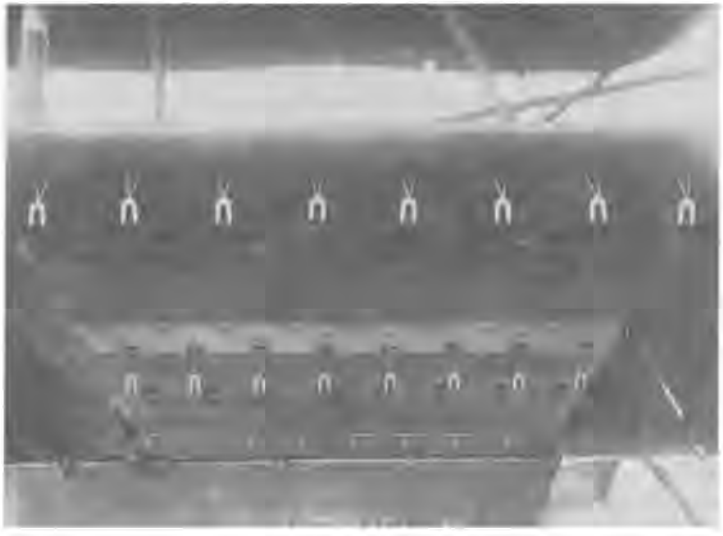
It is quite essential to obtain the proper kind of a machine for night work. In the first place the engine must be reliable and simple and, if possible, one that starts easily and instantly. The Le Rhone, Clerget, Mono-Soupape, BR, or any reliable rotary seems best adapted for night chasse. The machine itself should be light, maneuverable and with great flexibility of speed, owing to the fact that after overtaking a twin engine machine a pilot must reduce his speed to the same or less than that of the bomber. It is essential that it climb and dive rapidly and at the same time should land very slowly so that it can be safely "pancaked" into a very small area as is essential in night forced landing. It is well to strengthen the center section struts so that in case of a turnover, the pilot can be sure of getting out and it would be advisable to have a machine sensitive laterally rather than fore and aft. If a machine is too sensitive fore and aft, one is apt to pique into the ground or stall on coming into the airdrome when one's attention is diverted to landing lights, instruments, or ground lights. With regard to fuel, it is well to have as much gasoline as possible. Although a patrol should not be for more than 1-½ hours, pilots sometimes get lost returning and have to fly around a long time before they get their bearings.

Armament is an important feature; equip the machines with two guns, one balloon and one ordinary. Have illuminated sights and ordinary ammunition, with the exception that very few tracers should be used (1 in 15). Bomb racks are essential, and it would be well to have a rack that could be bodily taken off with bombs and replaced on short notice, as normally this will not be the duty of night machines.

The instrument board is an important feature. All instruments should be lighted as well as luminous in themselves and there should be two movable flashlights, the whole electrical equipment being run off two separate storage batteries which, in themselves, should be very accessible, yet substantially fixed. A good speed indicator and a good altimeter are even more essential in night flying than in day, and the compass, too, should be of the very

best. A machine should carry Holt flares, one under each wing tip; navigation lights on the outer struts, and signaling light on the bottom of the fuselage and least one Michelin parachute flare. Normally, the Holt landing flares will not be used, but in the case of forced landings they will be lighted, sufficiently high above the ground to insure their being burned out by the time the ground is reached. These should be examined very frequently and under no circumstances should they be used later than the date stamped thereon. There is no such a word as economy in connection with the testing of flares. They should not be opened until they are actually going to be placed on the machine. Michelin parachute flares only should be carried. The Grench parachute flare is a total failure and represents false economy in the purchase. The signal light beneath the fuselage must be operated by a tapper key and a permanent switch be opened interchangeably at will and instantly.

Two kinds of airdrome equipment should be recognized, first that in vogue on the fields of the squadrons operating, which should be most reliable and, if necessary, elaborate; and secondly, the emergency landing set, which should be at hand on these fields but in addition should be placed on every airdrome day and night in the area so that a pilot lost in a fog may with safety call and land at any field. The arrangements of the main fields can be worked out as circumstances require, but it is essential that a good generating unit be at hand and that the



Empty bomb rack on a Breguet.

bounds of the field be clearly defined. For an emergency lighting outfit would recommend these Aldis signal lights with a 15-volt storage battery placed on a trolley. These are quite inexpensive and would on every field justify their existence many times over.

The Army area as a whole should be lit up with Mortars and lighthouses and it would be well to place a 36-inch Sperry light at the main airdrome for purpose of defense as well as with the object of directing machines home.

Certain rules will have to be inaugurated for landing on Airdrome at night. These will be formulated not forgetting the possibility of the enemy bombing and will consist of a signal for reconnaissance and on the main fields the use of a dummy airdrome as an adjunct. All pilots will be called upon to make circuits to the left and glide in parallel to the main line of lights. Each pilot must flash the proper code letter before landing. If a crash occupies the field, proper signals must be flashed to him. In this connection, it will be essential to instruct one man at least on every field in the placing of lights so that a pilot will never be required to come in over obstacles and so that he will be able to make a landing even if he is unfamiliar with the airdrome. At the present time, a great deal of ignorance exists throughout the Air Service in this respect and few seem to appreciate the first essentials.

Probably the greatest difficulty to be encountered at first will be the selection of pilots for this work. It is absolutely imperative that night pilots master the science of flying. It is quite possible to be a successful pilot in the daytime and yet know very little about flying but he who hopes to succeed at night must be capable of flying any kind of a machine by the feel and in addition must have mastered the peculiarities of the particular machine that he is to use. It is essential that he be keen about his work and the responsibility for this rests primarily with the Squadron Commander directly through the Flight Commander. He must be imbued with a spirit of determination, first, to develop this new branch of war aviation. He should be steady, sober, keen, and industrious, and so fond of flying that he seizes every opportunity to get up day and night.

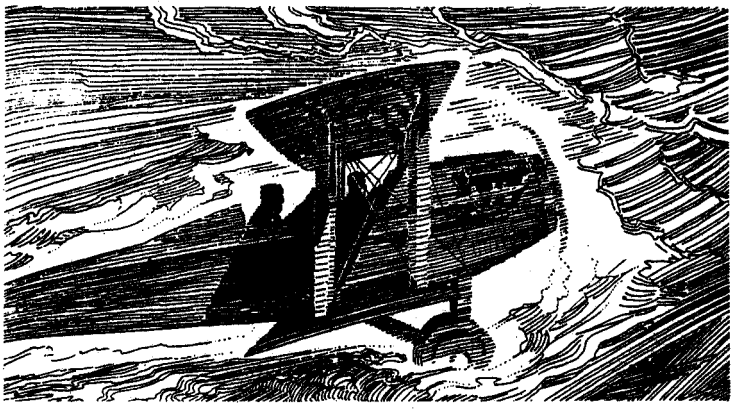
In flying a pursuit machine at night, a pilot who has mastered his machine thoroughly should have no difficulty in flying at night, whether chasse or bomber, but it is useless for him to attempt the work until this is the case. In all armies there have been regrettable accidents in this connection which have tended in a long way to bring night flying into disfavor with the pilots and in most cases they could be traced to this source. It is a fact that any good day pilot will make a good night pilot provided his vision is normal. In addition to being good pilots the

night flyer must have thorough knowledge of the country, of the landmarks, and must be skilled in the location of possible fields, airdromes, forests, rivers bad grounds, etc., and when he is first enlisted into the service of the night squadron, he should spend 2 months mastering the situation, never feeling satisfied until he knows the country thoroughly. He must be instructed in cloud flying but should be warned never to attempt it unless compelled to do so.. If overtaken by a mist or clouds he should never let the ground get out of sight. If necessary he should make a forced landing rather than attempt to get home at night through the mist, unless of course he is flying high and is sure of the weather.

After a pilot becomes competent, he should practice forced landings on his own airdrome on moonlight nights, and practice combat fighting with two seaters with the cooperation of the searchlights, and as an extra, aim at making forced landings by means of parachute flares, using the engine if he discovers that the field sought is liable to cause him to turn over.

The location of instruments and the methods of using them in the dark should become a matter of second nature to him, so that this will in no way distract his attention from more important things. Patrols will often be monotonous in that they will cover short beats over important points. Enemy night bombers are certain to follow permanent landmarks, such as rivers or forests. This means that a pilot on patrol will have to patiently stay over this spot and await his opportunity and he will do well to have patience and not be distracted by neighboring lights from his particular mission. Pilots should never attempt to fly under 200 meters at night as the risk involved is too great and on his first flights he should arrive over his airdrome at a height of at least 1,000 meters and take his time coming in. Pilots in all branches of the Air Service have to be humored to a certain extent but this is more so in the case of night pilots. Day flying should be indulged in and should only be permitted between certain definite hours of daylight. Otherwise, pilots will never feel that they are off duty and in a short time will become tired and disgusted with their work, and lose all their keenness.

The main duty in the operations of night pursuit at the present time is defensive patrols. These are carefully planned with the object of intercepting hostile bombers at the point where they are picked up by the searchlights. Patrols will therefore be carried out slightly in the rear of line and more particularly over permanent landmarks. They should not last more than 1-½ hours and vary in altitude from 2,000 to 4,000 meters, according to the situation. It is inadvisable to send patrols up until enemy activity has been reported by the advanced posts and it is quite possible



to determine with great accuracy when the enemy is operating by observing his mortars, lighthouses, airdromes, etc. Balloons may in time be utilized for this purpose as they would in all probability render valuable assistance.

When a pilot is on patrol, he will have his attention called to enemy aircraft by the firing of the Archie guns, by observation of the explosion of bombs on the ground, and by the direction and concentration of searchlight beams. He should cut his motor frequently and glide as long as possible with a dead motor so that the light operators and gunners can listen for the enemy ships. In time it will be possible to institute a system of rockets and flares which will enable a pilot on patrol to follow the course of an enemy bomber and it is within the range of possibility that before long wireless telephones will come to the assistance of a pilot on patrol and solve many of his difficulties.

When a pilot sights an enemy machine, his method of attack simply will be to get under his tail, closing in to very close range and opening up fire after throttling down, making use of the element of surprise to the utmost, for, if the enemy begins to side slip and maneuver, he will probably get away. Should a pilot be so unfortunate as to be seen by the enemy machine before he has effected a complete surprise, he should endeavor to keep his eye on the enemy, observing his instrument board, his exhaust or the explosive tracers from his machine guns. After a short time, the enemy will steady down and even attempt to dive for home, when it will be quite safe for the pursuit machine to close in on him again. It is easier on a clear night to see a machine above silhouetted against the sky but should he dive and get below the

attacker it is quite possible to pick up his outline once more against the lights on the ground; probably in time special illuminating lights will be provided for this purpose.

In addition to defensive patrols, night pursuit will be utilized in time for reconnaissance and surveillance and special machines will be dispatched to intersections and crossroads, railway stations, rivers, etc., for the purpose of locating and confirming enemy movements. In some cases, parachute flares will be used and in time it may be possible to take photographs at night. The same machines will be able to carry Cooper bombs[e] and shutting off their motors, glide down to a very low altitude and with great precision and accuracy drop them, insuring good results.

Other duties, however, beside these will be required of night pursuit squadrons. They will be able to attack balloons late in the evening, in the air, and in their nests after all the enemy airplanes have landed, and come back in safely to their own lines landing after dark. In the early dawn, the same work can be accomplished and it is not without the range of possibility that the present efficiency of balloons will in this way be reduced many times over.

Airdrome straffing in the late evening and in the early dawn will in time become one of the chief functions of night pursuit and may result in enemy airdromes being so far back that the whole situation will be changed. It is quite conceivable that hangars will have to be underground and that mechanics will have to live in dugouts. On fine nights, single machines will be able to harass enemy airdromes many times over and before large offensive operations will be able to put many machines out of action. Before and during an offensive, enemy concentrations will be straffed and machine gunned from low altitude. Indeed possibilities are unlimited.

A great deal of the success of night pursuit will depend on the location of the airdrome. The ideal place will be in the center of the line of searchlights. This will enable pilots to be on alert and reduce the time of their patrols. With an airdrome in this location, pilots will be able to go up and take short flights, making many sorties per night if necessary. Many devices, such as dummy airdromes, will be used to enable the location of this advanced field to be kept secret and to prevent its being bombed. It is possible that the machines will not be brought up until the night of an anticipated raid, the actual location of the squadrons being well in the rear. It is very much better, however, to have squadrons work from the field where its headquarters, hangars, machine stop, etc., are located, as advanced fields are never entirely satisfactory, and if at all possible this should be insured. The location of this field, near

Antiaircraft gun.

the searchlights, keeps a possible landing ground within gliding distance of the pilot at all times and greatly increases his confidence and efficiency.

While it is important to have the airdrome located centrally, the proper location of the lights is perhaps more essential and two methods seem to present themselves. First, the concentration of searchlights around important bombing objectives from the enemy standpoint of view, and, second, the location of a continous line of lights along the whole front. There are many points in favor of both and the ideal, of course, is the adoption of both. Certainly it is best to have as many lights as possible and in this the question of economy does not figure. It is quite determined that the unit of lights should be three in triangular formation, the sides of the triangle being roughly 3000 yards. All the lights should be under one P.C. and if possible this should be located on the airdrome and in direct touch with the operations officer of the squadron. Another very important feature about the location of the lights and one which will go a long way to the success of the operations is that of possible "forced-landing" fields. Every searchlight, if possible, should be placed on a possible emergency landing field and instructions given to the operators that upon a distance signal from the planes all lights so located will concentrate on their emergency field. In locating these searchlights and instructing the operators, care should be taken that they should understand that a plane lands best uphill and into the wind, not forgetting to point out that it is next to impossible at night to land over obstacles.

Antiaircraft guns should be located so as to fire in zones and probably the best rule is to have them fire only towards enemy territory and over the enemy lines. In this way they will serve as a signal for a pilot who may be in the air and at the same time there will be no chance of the pilot being hit. Experience proves that enemy bombers prefer to penetrate an anti-craft barrage than searchlights when there are pursuit machines about. With this in view tactical distribution of the guns can be made to suit occasions.

—6—

Lt. Col. Davenport Johnson
C.O., 2d Pursuit Group

"Johnnie" Johnson commanded the 2d Pursuit Group from its organization on 29 June 1918 until after the Armistice. A graduate of the U.S. Military Academy in 1912, he had served with the 1st Aero Squadron in Mexico before being sent to France early in 1917 for flying training in combat aircraft. After serving as a staff officer in the Air Service, AEF, Johnson had commanded the 95th Aero Squadron in combat before assuming command of the 2d Group.

1. It must be borne in mind that no two problems are identical and that different problems will be encountered in other campaigns. Such as mobility of organizations in open warfare. This is the time when Aviation will be, if possible, of more value, keeping its relative position with the advancing or retreating Armies, gaining information of the enemy and protecting our troops from enemy aircraft.

2. In view of the fact that one experienced pilot at the front is worth two pilots of same training but without experience at the front, the effect of the different uses of Aviation on the individual pilot must be considered, as morale, or will to do, is one of the big assets of pursuit Aviation.

3. The missions of pursuit Aviation are to protect our troops and air forces from enemy attacks and observation, and to attack and destroy enemy aircraft and harass enemy troops on the ground. These missions are accomplished by protection patrols, barrage patrols and alerts. Upon rare occasions special reconnaissances are made by pursuit Aviation.

(a) Protection patrols are when a number of pursuit machines accompany an observation plane. The methods insisted upon by the observation has been for the pursuit patrol to stay within 100 to 200 meters above the observation plane. This gives a moral protection only as monoplace machines are offensive fighters only and not defensive, and the pursuit has its hands tied because it must remain with the observation and the enemy can get position and attack at its pleasure. It would be better to have small fast biplace Aviation for this kind of work, or designate the time, place and altitude that the observation plane is to work and have the pursuit to sweep the air clean of enemy machines.

(b) Barrage patrols consist of keeping an adequate number

of machines constantly in the air patrolling the desired sector, with the mission of destroying all enemy aircraft in the sector thereby protecting our troops and aircraft from observation and molestation by the enemy. This is easiest on the pilots as they have certain set hours for this work and are free the rest of the time. However, as barrage patrols use up a great deal of Aviation material and energy, these should be cut down to a minimum with the work to be done.

(c) Alerts are where all available planes not on other duty are kept lined up and warmed up with the pilots at the hangars so as to be able to leave the ground within 15 minutes notice for special missions, such as reinforcements for the barrage patrols, attacks on enemy ground troops with both machine guns and bombs, clearing the air of enemy aircraft at certain places, at certain times etc., or in other words these are the reserves to be thrown in at a minute's notice.

4. Army Air Service Commander, or Wing Commander keeps absolute liaison with the enemy and troop activities by means of advanced observation points, balloons, observation planes, etc., and sends out his alerts when enemy activities justify it. The most dangerous from a physical standpoint is the attacking of troops on the ground with bombs and machine guns and this should never be done unless a clearly defined target on the ground is known beforehand. Alerts are the hardest wear on the pilots as they, when not flying, are waiting at the hangars under a great tension to go, which is infinitely harder than the actual flying itself. But alerts have the great advantage of attacking the enemy at unexpected times with overwhelming force, and consequently do excessive damage materially and morally to both the enemy aircraft and ground troops.

5. As pursuit Aviation is essentially offensive, the ideal employment is, for protection of special observation, to designate a time, place and altitude that the observation plane will work, and have pursuit planes thoroughly police the air at that point, for the protection of our troops and aircraft and destruction of the enemy aircraft and harassing of enemy troops on the ground, to keep a permanent barrage over the sector only large enough to do this work, and to keep all remaining planes on the alert as a reserve to be used at a moment's notice.

—7—

Maj. Milton F. Davis
C.O., 4th Pursuit Group

Davis, who had spent several months at the Third Aviation Instruction Center at Issoudun as commander of a training field, had succeeded Maj. Charles J. Biddle as commander of the 4th Pursuit Group when Biddle had left on 29 November 1918 for return to the United States.

1. In compliance with your Memorandum of December 13, 1918, the following report is submitted:

(a) From my experience in the Air Service previous to assuming command of a group, I think that our system of giving training in the S.O.S. made the training of pilots unnecessarily long and expensive. The training that the pilots received in the S.O.S. often duplicated and overlapped that which they received in the U.S. without putting them on service machines until they actually were assigned to active squadrons at the Front. The pilots thus were called upon to do war flying in types of machines which they were absolutely unfamiliar with.

(b) My recommendation is that pilots be thoroughly trained at home through everything, including gunnery and combat, on their service machine. Then when arriving overseas they go to a dispatch center which is both for new squadrons and pilots going to the Front. At these dispatch centers, the pilots and machines are assigned to squadrons, and thus both pilots and personnel get acquainted with the machines they are to use at the Front, and with each other. Thus the pilot's work in the S.O.S. is entirely with the machine, guns and men he is to be with at the Front. The pilots meant for replacement would not get all of this, but would see and become familiar with the most up-to-date experiences and lessons from the Front.

(c) My experience as Group Commander has been entirely since the cessation of hostilities, but emphasize the need of both Pilots and Enlisted personnel becoming acquainted with their machines, guns, and with each other before beginning war flying.

2. The above applies principally to scout work, as practically my entire experience has been in this kind of work.

—8—

Maj. Maxwell Kirby
C.O., 5th Pursuit Group

Maj. Kirby.

Kirby, who had enlisted in the Army in 1904, had been commissioned in the Cavalry in 1913 and detailed to the Aviation Section of the Signal Corps in 1916. His prewar service had included flying duty with the 1st Aero Squadron in Mexico. Later, while attached to the 94th Aero Squadron in France, he shot down a Fokker, the last enemy plane officially credited to a pursuit pilot[a] of the U.S. Air Service in World War I. Major Kirby assumed command of the 5th Pursuit Group on 1 December 1918, succeeding Capt. Dudley L. Hill, who had been in command since the group was formed two weeks earlier.

1. Herewith enclosed report covering functioning of the Fifth Pursuit Group, Air Service, Second Army, since October 12, as ordered.

2. . . . it is believed that the important lessons drawn from our experiences during the present war in regard to Air Service, particularly pursuit, are as follows: The proper functioning of both Air Service, and Anti-Aircraft, should compose one branch of the service, and hence a comprehensive cooperation is necesssary, the noticeable lack of liaison between these two arms, or sections of one arm has been a very great retard to the progress of American arms. It was noticed by the undersigned during a short tour of work at the front that, in many instances, patrols were sent out without a definite mission to perform. It is felt that in a great many cases, if not the majority, there was very little, if any cooperation between flights, or patrols sent out from different units. It is believed that the pursuit was not sufficiently utilized as a protection for Army Corps and bombing, and in the majority of cases, definite methods were not laid down.

3. The idea altogether too common that pursuit planes are used only for individual combat and protective purposes is felt by the writer to be in error. Some of the greatest uses to which monoplace machines can be put, as have been proven, particularly by sorties on the Flanders front, are trench and troop straffing by Chasse planes in numbers, concerted attacks on emplacements and reserves immediately before and during a general attack and in covering a retreat, in short, every use to which Cavalry has been put may be given with advantage to Chasse planes.

4. The duty covered by the undersigned as Group Commanding Officer has been principally with organization and coordination.

—9—

Capt. John Wentworth
Assistant Operations Officer, 1st Pursuit Wing

Wentworth had been a flight commander in the 49th Aero Squadron before moving up to wing headquarters to become assistant operations officer at the beginning of November 1918.

Capt. Wentworth.

The work of a pursuit pilot in time of attack and when engaged on duty over a quiet sector has been of somewhat different character. On a quiet sector his individual ability has had fuller play. He has flown in small formations, or occasionally alone. His importance in the formation was relatively greater as its size diminished, and tendencies that required regulating in the massed action of offensives were encouraged.

This is because the enemy have been in the habit of using their pursuit for shock, massing it at offensives, so that in quiet sectors few formations of 7 or 8 (very rarely over that number) were encountered, these only occasionally, 4 or 5 monoplaces were often seen together, and frequent unprotected bi-places. It was most desirable to prevent these bi-places, employed in reglage and high photographic work, from accomplishing their missions. Therefore, a thin veneer of our pursuit covering the sector at all altitudes and continuously, was preferable to strong periodic formations, which, while they cleared the sector for the moment, left gaps of time during which enemy machines could operate. Large formations were not economy, as they were not needed (Toul Sector, April-May-June), the talent of the individual came into more prominence.

However, the fundamental upon which successful pursuit must build—discipline—is as important in quiet sectors as in time of offensive. The necessity of discipline must be explained, it has been found, to pilots, that every pilot, on whom it is naturally most difficult to maintain a check while in combat, may realize that from both the standpoint of attack and defense, efficiency depends on each man absolutely a definite function. These functions of course vary with the situation, but possible situations may be grouped and classed.

Therefore, when a new pilot joins a squadron, he is impressed with certain essentials arrived at through experience by his predecessors. Their purpose is to minimize in so far as possible the undesirable necessity of his solving situations as seem best to him at the moment. They are based on the fact that similar situations have been encountered before, the possibilities, analyzed and the method of dealing with them incorporated in the essentials.

The formation is the unit—all operations will be directed so as to maintain it as a unit. Therefore, when flying over the lines, the primary point to keep in mind is that a pilot is an asset just so long as he remains part of that unit. Any separation means that the danger of attack by enemy planes is tremendously enhanced. If his motor lags, for example, so that he cannot keep up, he should go home. He becomes a liability. The formation will be hindered in its work by attempting to guard him, and to carry on at the same time. If he is, as a straggler, attacked by an enemy patrol that would hesitate to engage the unit his formation must go to his aid, giving combat under perhaps most disadvantageous circumstances (Chateau-Thierry drive, July). He jeopardizes the safety and efficiency of all. Such separation applies equally to a pilot breaking from his formation to give combat. Combat should invariably be entered into by the leader of the formation. The reasons against a pilot breaking away are self-evident. He may attack a machine or formation that is headed into our lines, and which his leader wishes to be allowed to proceed as far as possible into our territory before attacking. The leader, a man of more experience or better judgment, may be maneuvering for better position. He may see another enemy formation above, which makes immediate attack undesirable, or a lone machine may pass close under the formation, going in the opposite direction. The odds are apparently 1 to 1, to the pilot who breaks off. The leader has seen that lone machine, however, break out of a large formation above, diving from the side underneath in the very hope of exciting someone to break away and follow it. Result—the whole enemy formation with its advantage of altitude mobs the machine that has broken away before its own formation can give aid (Chateau-Thierry drive, August).

The foregoing episodes could not have occurred if the formation had been in its unit form. There are some eventualities that have happened directly as the outcome of lack of understanding in the absolute necessity for discipline.

Again, when attacked, to break out of the formation is often fatal (St. Mihiel Sector, August). It requires the greatest self control when enemy planes are following, diving and firing on the

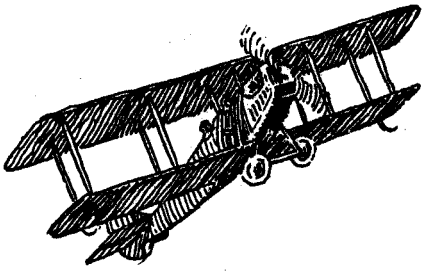
rear men of a lower patrol, for those men to avoid turning away or maneuvering wildly. However, it has been proven beyond question that the defense is to dive under their own formation and to stay there. If the formation is properly echeloned, the attack continuing, the next men, becoming the rear two, receive the fire, and in turn will dive underneath. So long as the enemy planes stay well above, it is impossible to counterattack effectively. The leader of the formation attacked will turn into his own lines, climb, perhaps dive, to shake off the pursuit, and return with the advantage lessened; for in all pursuit work the advantage of altitude is everything. The formation thus retains its unity, differently massed for the moment, but still a mutually, protective and aggressive unit.

Small formations of Germans, by way of notation, when attacked from above, sometimes formed a circle, following each other around, protecting one another's tails, and gradually edging back into their own lines. They thus become a difficult mark, but were absolutely on the defensive for just so long as the attackers wished to continue (Toul Sector, May, June).

It is reported that in 2 cases, when attack of this character was imminent, one or two machines dove back into the German lines, climbed and returned to harass the allied formation from above. It would seem that a maneuver of this character would require too much time in execution to make it valuable as a practice.

We are still dealing with the action of a single formation unreinforced by a protective patrol at higher altitude, or guarding a lower formation engaged in some definite mission requiring cooperation. It will be observed that the foregoing has been in character, defensive. Discipline has been emphasized in this connection. It is as important when attacking and the function of pursuit being to *attack*, it becomes all important.

The first pilots of the United States Army in this war were trained under French instructors. They had at their command the experience of men who had been long at the front. There was no word spoken that would lead to any other conclusion than that the action was individual in war flying. A protective patrol was mentioned as remaining above in attack. The leader opened the attack, but from there on, the individual acted as he thought best. The American pilots instituted and initiated "gang fighting." It may have been in the minds of the French, but no hint of it as a practice was given, nor in any of the matter circulated to the pilots by the French were any problems worked out along these lines. Gang fighting by the test of trial has proved the most efficient and only form adaptable to the character of fighting pursuit has met with as the war progressed.



In the early days, aviation was in a way based on individuals. Time has brought new problems, as the size of the fighting air forces increased, that are solved only by this method.

Gang fighting is based on an attempt to figure out a system whereby the enemy has no chance. It is efficiency, the exact antithesis of the "sporting attitude." The pressure of time prevented it from acquiring the finesse that might have been later commanded, but along its lines cumulative training will not be wasted. An organization to be schooled in the unit action necessitated by this mode of scientific air fighting, requires much training. It requires mock combats wherein the real conditions are simulated, and the possibility of the unexpected reduced until each man is a part of a mobile machine, thinks with one head as the actions of the enemy in combat convey that this, that, or another set of maneuvers is required.

Two examples will impress the intent of this system. A simple case of a lone bi-place attacked by a formation of 5 or 6 mono-places, which approaches from above or behind in V formation. The leader of the mono-place formation sees that the enemy machine turns quickly into its own lines. He is observed. He reaches a position three or four hundred meters behind, wiggles his wings (the prearranged signal for attack) and "cabarets" (slowing up forward speed by pulling plane into steep climbing angle with reduced motor). At once number 2 and 3 machine on each side and directly behind him fan out and dive to a position on each side of the bi-place, coming no closer to it than 350 or 400 yards. This is done in a moment, on account of the extra speed gained while diving to the enemy's level. The leader still holds back, not attempting to gain on the fleeing bi-place. The two or three remaining machines of his formation fly on, climbing as soon as possible to a position high over the bi-place. They are protection, watching for enemy planes, that may seek to interfere, and taking no active part in the combat. Meanwhile there is a mono-place on each side of the bi-place, and the leader still above and behind. The two on the sides swing in and away as the gunner of the bi-place fires on them (they can see the smoke of his tracers) never coming nearer than 300 or 400 yards; turning away when he fires their way, coming in when he is engaged with the plane on the other side. The attention of the gunner and pilot of the bi-place is concentrated on these machines, with possibly a share given to the protective planes above and out of range. The leader now drops down, comes up very close below, and shoots the bi-place down from 30 or 50 yards. Normally he has not had a shot fired at him. The planes on each side are well away, where they run only the very slightest chance of being hit, and the planes above are both an

annoyance to the bi-place and protection to their own.

The protective planes then drop down to the altitude of the leader, the two on each side, close in, and the formation is again complete (May 30, St. Mihiel-Toul Sector).

In contrast is an attack wherein 4 monoplaces attacked a bi-place under parallel circumstances. The leader dove and attempted to come up underneath, but was driven off as the bi-place pilot switched his tail around, and the gunner got in a fair shot. Two more machines dove together, from the side now, trying to get behind as they came down. They watched each other and the bi-place. One got behind for a moment, getting in a short burst, but his speed carried him by. The fourth waited a moment and came down, but could not fire as the first machine was getting back in position and came in line with the bi-place. So it continued while the bi-place turned leisurely in quartier [?] circles, losing altitude till it was too low and far in its own lines to make further pursuit reasonable (June, St. Mihiel-Toul sector).

The foregoing has been somewhat generalized. It is because the writer believes that as soon as the strength that the enemy had to offer against us in any sector, was determined, and the situations that might occur reasoned out, with applications of the gang fighting method, special problems ceased to exist. There are definite rules, and as definite situations that may arise on patrol work. They are limited if the patrol continues *as a patrol.* It must not be split by faulty technique or drilling of the pilots. Its effectiveness then as a patrol will depend on the sort and amount of training in gang fighting that it has received. If attacked by superior numbers from above it must get back to its own lines as already stated, or climb to an altitude from which it can work. If attacking monoplaces below it, it must keep above them, the leader and those on each side of him diving and firing and zooming up to rejoin those that have acted as protection and remained above. If attacking bi-places, there will rarely, if ever, be more than one to deal with. Two together split on attack, make no attempt to defend each other.

The American pursuit pilots have had no experience with groups of bi-places flying together, since the Germans employed no day bombers in the sectors over which our Aviation worked. The Germans solved this problem by following our bombers, firing at long range or mobbing machines that might become crippled and drag back from the formation. They would also dive far beneath, zoom, and hanging on the propeller get in a burst from below. This required a fine judgement of speed by the attackers and was apt to entail casualties as great as the results obtained by it.

The possibilities that may then develop for a single patrol on the line are:

1. Attack on pursuit plane or a formation of pursuit planes.
2. Attack on a single bi-place. (If a bi-place is protected by enemy pursuit, the attack is on the formation of pursuit, working always from the higher altitude downward).
3. To be attacked by pursuit planes from the same altitude or from above. There is a sameness in the working out of these possibilities that lends itself well to analysis and preparedness.

The necessity for tactical decision begins to assume more definite shape for the patrol leader, when instead of being on patrol with a single formation, he is carrying out orders in conjunction with another formation or performing a special mission. It is the patrol leader only who should have the thinking part until contact with the enemy is gained. Before this time the pilots' place is to follow. From the moment of signal for attack or when attacked, each pilot in the formation at once assumes his part as cog in the prearranged scheme.

Cooperating with another formation which is leading or protecting photographic machines, he must so maneuver as to keep contact with the leading formation or machines and still regulate his speed so that his formation can follow. He must further place his formation in position to render the most efficient aid to the lower formation or act as a buffer to incipient attack on . . . [?] the photographic plane.

This is distinctly an article on ways and means. It is taken for granted that the function of pursuit is known, that in time of attack it is to clear the air for observation. that it has objective to prevent the enemy from getting within a prescribed distance of our line with any form of airplane, and to destroy whenever possible, working always on the gang fighting principle, a principle of cooperation, throughout.

Cooperation then between patrols. An upper patrol will of course go to the aid of a lower if attack comes from an intermediate altitude. It must leave part of its number above, part going down to harass the attacking enemy, the part above, depending in size on the actual or likely presence of enemy planes in the region, or on the size of the attacking enemy force. It must above all things not lose contact, immediate contact, with the number that have gone down. The same procedure as in attacking any enemy formation of mono-places will be followed, diving on the highest machine of the enemy, zooming toward their protections, and diving again until the enemy force is split or turns off, never getting below enemy pursuit planes.

In this connection, and throughout all pursuit fighting, ability to see in the air, is of paramount importance. To be able to discern

airplanes far away means preparedness. The advantage to the man who observes the other formation, who can spot friend or foe by the silhouette and general look, is not to be taken unawares. He can climb for combat if below, he can maneuver for perfect position if above. The surprise element becomes possible for him. Therefore signals are arranged; for while the patrol leader has the great opportunity to see what is in the air, it sometimes happens that a pilot of the formation may catch a speck—a distant plane—before the leader sees it. Diving past the leader, pointing his plane toward the distant one, and returning into formation is a common signal, better than wiggling the wings or shooting a Very pistol, as has been tried, as it is more positive. *In future, the wireless telephone will make formations of Pursuit planes on the lines inestimably more efficient. The possibilities the telephone will introduce are without limit for the development of gang fighting.*

The Germans have cooperated between formations by sending to the line a large "swarm" which on arrival at the center of the sector to be patrolled will maneuver as follows: "Chains," or small formations, will break off and at different altitudes patrol, the mother formation remaining generally in the same locality. Attacking or attacked these small formations will lead the attackers or force the attacked machines toward the main

formation which in one case has wiped out an entire allied formation.... The system is good but requires a large number of pursuit to continue it as a policy throughout the day.

Our pursuit has cooperated most successfully with the day bombers. The Bombers leave their field, telephoning before they start the hour at which they will be over the objective. Our pursuit, carrying small ten kilogram bombs reaches the objective five or ten minutes before the bombers are due. They discharge their bombs on the objective and await the bombers, clearing the region of enemy pursuit. After the bombers have accomplished their mission they are escorted back by the pursuit. These missions were carried out on a large scale, a Group of Day bombers and a Group of pursuit working together.

Lastly, the work of pursuit in attack has been to bomb and straff with machine guns enemy troops and emplacements, and to destroy or force down their balloons. The writer has had little experience in the latter work, and is not competent to deal with the comparative efficiency of various methods of attack. Bombing from low altitude and straffing seems to be best accomplished by crossing the line at a thousand meters, dropping the bombs from 500 to 600 meters, and then attacking with machine gun. It is not desirable or necessary to approach the ground nearer than two hundred and fifty meters when machine gunning troops. The work can be carried out as well from that or a little higher altitude, and the plane offers a more difficult target for the ground fire. Immediately after the mission is performed, each plane, for they, of necessity, split while seeking objectives for their machine guns, will return by the most direct route across the line, unless that route necessitates passing through a barrage. Special conditions decide this, but the object is to get out as soon as the work is completed.

The foregoing has been framed as an argument for collective and cooperative fighting. All examples have actually occurred in the course of the work, the conclusions are based on the collective evidence of eight months of work on the line. In future training, with the aid of the wireless telephone, gang fighting can be brought to a standard of efficiency that will make large formations of pursuit invincible, and that will minimize our losses.

During the last months of the War, the trend of Pursuit Aviation proved that it requires direct cooperation of all parts, as is necessary in an infantry attack. Future training should be directed with the idea foremost that, save for attack on balloons, American pursuit aviation has no place for the individuals.

—10—

Capt. Reed G. Landis
C.O., 25th Aero Squadron

Capt. Landis.

Landis, who had won 10 or more victories while with the Royal Flying Corps, had become commander of the 25th Squadron on 25 September 1918. The squadron, manned largely by officers and men who had trained in England, spent the following month trying to get ready for operations with SE-5's. The planes and pilots were slow in arriving, however, and the first flight over the lines was not made until 10 November, when Landis accompanied Major Biddle, the group commander, on "a hunting expedition in front of Metz."[8] Borrowing three pilots, Landis led an uneventful, four-plane patrol over the lines the following day.

First: All of my experience over the lines was secured prior to the time I was given command of this organization, and during the time I was attached to the British Royal Air Force, both in training and at the Front.

I believe that the lack of well-trained, efficient personnel, well learned and interested in the most up-to-date developments in aviation throughout the world and, particularly, as developed by the Allies and by the enemy, was the most serious obstacle the United States Air Service had to contend with in its organization. This lack of experienced direction reacted in a number of ways in the formation of the Air Service for use over the lines. From the material point of view, it caused considerable trouble when the adoption and manufacture of various types of air-craft became necessary. From the personnel point of view, it seriously handicapped operations at the Front because there was very nearly a complete lack of appreciation of the sacrifices and efforts made by the enlisted personnel and by student aviators, the latter in particular, prior to the time of their commissioning and in fact, up to the time they actually arrived at their Squadrons at the Front, were shown no consideration at all, even after they were commissioned. Their treatment was such that it took a tremendous amount of patriotism for them to keep up their interest in their work. I believe that if the men in command of the training, both at home and overseas, had been more experienced, they would have been able, with their natural tact, to create a much better "esprit-de-corps" both among the pilots and men than actually resulted.

I would strongly recommend that attaches be placed in all foreign countries to keep in touch, as much as possible, with

developments in aviation, and that an experimental department be maintained at home to develop airplanes and equipment, both from their records and reports and from the suggestions and designs of American inventors and manufacturers. In this way, we will not only keep in touch with the physical future of aviation, but we will be enabled to create a considerable number of experienced pilots and directors of production for use in an emergency. It seems very necessary to me, that this experimental board combine pilots, observers, designers, and tacticians, in order to co-ordinate all the possibilities of any one design. It appears to me, most important that the Government should give all possible encouragement to civilian aviation, particularly from the production viewpoint, and with a view to developing the general utility of aircraft. This will assist greatly in securing personnel and equipment, which might be readily turned into the production of Government air-craft in time of emergency.

I would, most strongly, recommend that flying pay be made the same for all ranks engaged in aviation. A 2nd Lieutenant flying over the lines from two to four hours a day is certainly entitled to as much remuneration for his extra hazardous service as is an officer of higher rank, who in the majority of cases flys very little, and then without the hazard of enemy interference.

Second: Since taking command of this Squadron, the Squadron engaged in only two patrols over the lines, prior to the signing of the Armistice, and my recommendations for this period must, necessarily, be governed by that fact.

I believe that a Monoplace Pursuit Squadron can dispense with the services of its Operations Officer, its Engineering Officer, and its Medical Officer without any decrease in efficiency. The Commanding Officer can and should handle operations, with the assistance of the Adjutant and Flight Commanders. The Supply Officer should be able to take the work of the Engineering Officer, in addition to his other duties, if properly trained along that line. These recommendations are made with the idea that the Group Organization will be kept as at present. In cases of detached Squadrons, a Medical Officer becomes necessary.

It is not necessary, in my opinion, that three men should be assigned to the care of a single-seater pursuit plane. The British have operated efficiently with one rigger and one fitter caring for each machine. A careful estimate should be made of the number of nonspecialists needed for regular fatigue duties and a sufficient excess allowed to take care of emergency work. Table of Organization should be so compiled that it would be unnecessary to put members of Squadrons on detached service at Group and other Headquarters to enable them to take care of their work.

It is my belief that co-ordination between the training of line troops and the Air Service would result in a much better understanding between the various branches of service, particularly inasmuch as the difficulties under which each branch operates are concerned. Infantrymen should be given a general understanding of the difficulties of aviation, as applied to cooperation between aircraft and troops on the ground as well as in connection with the engagement of enemy aircraft. Pilots and obscrvers, on the other hand, should understand fully that their primary duty is to assist the Infantry through as many methods as it is possible to develop, and that any possible personal risk is well worthwhile, if it will assist the troops on the ground.

It is vitally necessary that a sufficient pursuit organization be created and maintained in time of peace to furnish experienced personnel, sufficient in time of war, to train and direct pursuit organizations on a scale large enough to clear the sky for reconnaissance, artillery observation and contact patrol machines. If aircraft was important in this war it will be much more so in the future emergencies which may arise, and I strongly recommend that the United States be so equipped with personnel and machines as to be able to efficiently defend itself and its ground troops from the ruinous methods of attack which will undoubtedly result from further developments in aviation.

—11—

Capt. Charles M. Jones
C.O., 28th Aero Squadron

Jones had commanded the 28th during the squadron's operations at the front with the 3d Pursuit Group, from 2 September 1918 until the Armistice.

In order to attain the highest point of efficiency and maximum amount of work from the personnel of an aero squadron, military regulations and tactics etc. should be reduced to a minimum, at the same time enforcing a strict and rigid discipline.

Unlike most military organizations, the nature of the work is such as to call for considerable individual duties and very irregular hours. For that reason the amount of work allotted to each mechanic varies greatly due to the amount of flying, the condition of his plane, and the time of year, accordingly great

tact should be used in the handling of men ih order to obtain their full efficiency without driving them excessively. Reveille should be held each morning for all concerned with the exception of those mechanics who were on duty earlier at the hangers, and a formation with roll call of all mechanics sometime during the day affords a good opportunity of familiarizing them with any rules or suggestions as to their work. Particular attention should be paid that good food and quarters be available for the men, and if possible, short periods of games, such as baseball, football etc., this being their only form of hard exercise.

As regards to the Flight Commanders and the Pilots, as much freedom which will not interfere with their work should be given them. Pilots cannot work at high speed more than a limited space of time, this depending upon the disposition of the pilot, and the more recreation he can enjoy, the longer will he be able to take interest in his work and do it efficiently. When ever possible short leaves of three or four days should be granted, to give the pilots a change of surroundings and cure or prevent staleness.

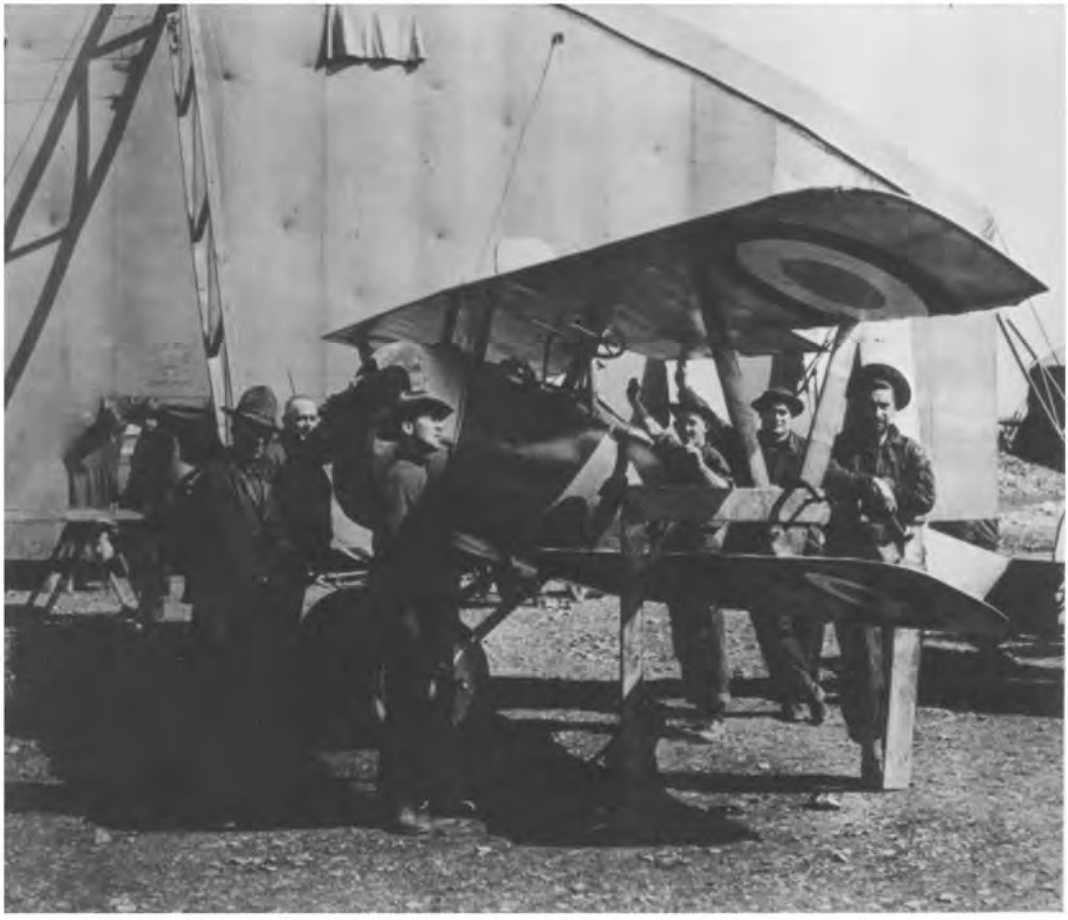
Flight Commanders should be given as much authority as possible and made to realize that their flights are miniature squadrons of which they are in command, and for which they are responsible. Whenever available an experienced pilot should be put in charge of flying with authority to handle all matters pertaining actually to it.

In regards to the assignment of the men to jobs in a pursuit squadron the following system has been most successful altho there are, others probably equally as good. Each plane is taken care of by a crew of two men, a rigger and a fitter, assisting each other, the rigger has an opportunity to learn engine work and vice versa. Each flight is in charge of a flight sergeant, according to table of organization, and the three flights are under the joint command of two or more master electricians. Attached to each flight are two or three so called "trouble shooters," whose duty is to locate engine trouble, and to explain such to the plane's crew. By this system much unnecessary work, due to unskilled mechanic, is avoided, and many unnecessary changes done away with. These "trouble shooters" must accordingly be thoroughly experienced men, and should be picked from the best material of the squadron. They should not be expected to do much work, as their time is well occupied in locating troubles, and inspecting new motors.

A difficulty which has often arisen in an aero squadron, on active duty, is that of waking the mechanics, cooks, pilots, etc. in ample time for a patrol at say 4 a.m. The most certain method is to appoint a man, whose duty is to stay

up at night, and upon receiving the orders of the following day, act accordingly. The most successful manner seems to be in awaking first the cooks, then the mechanics and lastly the pilots. The mechanics should begin getting out the planes at least fifty minutes before patrol time, in order to start warming up the engines, and allow time for any adjustment or trouble which might turn up at the last moment. Pilots should arrive at the hangers 30 minutes before patrol time, and their machines ready to take off five minutes in advance of the scheduled time.

The "trouble shooters" put the pieces together to keep the planes flying.



Summing it up briefly, every mechanic should be encouraged to take a personal interest in his work, and made to realize that he, in his way, is helping the squadron just as much as any pilot. In this regards the pilots should be given to understand that steady devoted attention to duty is equally if not more valuable to the organization than reckless tho successful work, unnecessarily endangering the lives of others.

"A" Flight of the 148th Aero Squadron—all scored victory credits: (l. to r.) Lts. Lawrence T. Wyly, Louis W. Rabe, Field E. Kindley, Walter B. Knox, and Jesse O. Creech.

—12—

1st Lt. Field E. Kindley
C.O., 141st Aero Squadron

Field Kindley, for whom Kindley Field in Bermuda is named, had trained in Great Britain and had served at the front with a British squadron. Later, he had been assigned to the U.S. 148th Aero Squadron, which was attached to the British for service. Kindley, who had become a flight leader in the 148th, did not assume command of the 141st until sometime after the Armistice.

1. . . . I shall give criticisms, as frank as possible upon our Air Service program, from building of aircraft to actual combat.

2. Manufacture.

(a) The greatest failure in our entire air program is that of manufacturing, and because of this failure many of the following criticisms are possible. However I shall make the criticisms regardless of the actual causes.

(b) The probable cause for the production failure is that manufacturers in the States were selfish and tried at first to perfect their own type of machine while later no one seemed to know just what type they wanted and finally through ignorance of those in charge they chose the wrong or I might say an older type.

(c) It seemed they were partial to the two seaters and neglected the scout. This was probably due to the fact that they could appreciate the work of a two seater observation machine, but could not appreciate the work of a scout. They could not understand that a scout was very necessary in order for a two seater to work.

3. Training.

(a) We were very successful in training pilots for the R.M.A. tests but we were very short of schools capable of training a war pilot, and the results are we had thousands of pilots but very few of which were fit for the front.

(b) In many cases the moral[e] of the flying student was very poor, due not only to continual hounding but also to the fact that many instructors discouraged a pilot that was about to go solo. Upon his first solo the pilot did not fear so much the chance of killing himself as he did that of crashing the machine for which he would be punished and in many cases actually taken from the Air Service.

(c) In the case of a crash many are punished by taking

them off of flying for a week or two. This to my mind is a very bad mistake, for I honestly believe that the sooner a pilot gets back into the air after a crash the better it is for him. I have had actual experience along this line.

(d) In many training camps an officer under instruction is made to feel like a third class private and not like an officer in the United States Army. Many think that this has no effect upon results, but I am sure that a satisfied and comfortable pilot will make a better air man.

(e) One of the greatest faults of our advance training is that our instructors were not experienced war pilots and did not know the "game." Many set rules they gave for fighting were incorrect. A good war pilot is of great value at the advance training school than he would be at the front.

4. Discipline

(a) The Air Service is entirely different from any branch of the army and the same should be considered in the required discipline. Of course the men can and should be disciplined as an infantry company but the pilots must have a different kind of discipline and a good name for it is "loyalty." Loyalty can be instilled into them by a good commanding officer. What I mean by loyalty is that the pilot will do what ever work he is ordered to do against the enemy when there is a possible chance of doing it and will at all times attack and destroy the enemy not because he fears his commanding officer but because of respect for him. Loyalty will also demand team work among the pilots in combat.

(b) The best place of disciplining an officer or instilling loyalty is the mess where the pilots collect, where friendship and respect for one another is formed. Understand me I do not mean to say a pilot should be allowed to call his commanding officer by his first name or such as that but I do mean to say the iron infantry hand should not be used.

5. Aerial Tactics.

(a) It seems that we had no system at the front, that is to say we did not keep a consistent patrol on the lines, to work at different heights, nor did the pursuit squadron know just how to cooperate with the observation and bombing machines to the best advantage. They seemed to go to the lines blind folded and butted into the enemy and fought the best they could. In my mind a pursuit squadron can do wonderful work by keeping the lines clear of the enemy even though they may not destroy so many machines. They did not seem to know just how to get the best results with the least possible losses. They did not use the system of trapping the enemy and out-maneuvering him.

(b) Of course lack of machines no doubt is a case for a certain amount of this but it would be better not to send out any machines than to send one or two at a time as was often the case for this caused many losses without results equal to the value of the losses. In March of this year on a front that I am well acquainted with, the one-flight patrol was sufficient to patrol and keep the enemy off of the lines, but in September and October a squadron patrol of three flights became necessary. This as we all know was due to the enemy introducing the Fokker Biplane in such large numbers, but I understand that we sent out the same strength patrol so to speak in September and October as we did in March. To defeat the enemy we must meet his improvement by improving ourselves.

(c) Often officers in the capacity of flight commanders were intrusted with other officers' lives when he himself was not experienced on the front. This was a waste of man power.

6. Care and Treatment of Pilots at the Front.

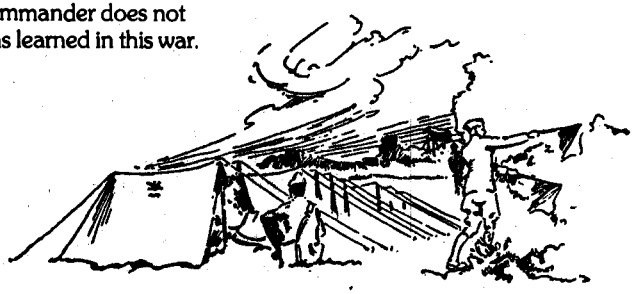
(a) Of course because we were so short of good men at the front they were kept there for very long periods, but every effort should be made to give a pilot the necessary rest in the form of leave or other duties such as instructing or lecturing at the training schools. Many pilots broke down in health and others were shot down because their efficiency had gone down.

(b) There is no better tonic for a soldier than that of promotion on the grounds he had done good work. This tonic was very scarce.

7. The Enemy's Criticism.

(a) I have heard that a German Air Service Intelligence officer even went so far as to criticise our Air Service by telling an American pilot who was a prisoner of war and before a German Officer that "the Americans have the best possible chance of having the best possible Air Service in that they have the material and manhood, but they are making their mistake in sticking to the French machines and French system of training and fighting."

(b) My experience as a squadron commander does not justify me in giving my ideas and of lessons learned in this war.



—13—

Capt. James A. Meissner
C.O., 147th Aero Squadron

Meissner had been a flight commander in the 94th Aero Squadron and had four credited victories when he was selected to replace Maj. G. H. Bonnell as commander of the 147th Squadron in July 1918.

Officers of the 147th Aero Squadron. (l. to r. standing): Maj. Harold E. Hartney (C.O., 1st Pursuit Gp.), Capt. James A. Meissner (C.O., 147th), and 1st Lt. Heyward Cutting; (l. to r. sitting): Lts. Stuart T. Purcell, Thomas J. Abernethy, and Horace A. Andrews.

Probably the most important requirement of an officer commanding an Aero Squadron on active service, is to know and understand each and every one of his pilots. It is very easy for a man, flying on active service, to become discouraged or disgusted with the way things seem to be going and it is especially important that the squadron commander notice immediately any signs of such a condition, and to do all in his power to prevent it. Pilots should always be contented and feeling in the best of condition in order that they may do good work, and it is well in the power of the C.O. to make things interesting and confortable for them.

It also is very important that the squadron commander be experienced in the kind of work his pilots are doing, that he is competent to give valuable advice concerning this work, that he knows as much and more about the work than his pilots, that he is interested in everything each pilot does no matter how many times he has heard of or seen the same thing. But for a C.O. not to be thoroughly familiar with the work his squadron is doing, not to have done some of the work himself, and still to try to force his ideas on his pilots, is most discouraging.

To have his pilots as much like a large contented family as possible, to have them interested in their work, and satisfied with the way things are going, should be the aim of every squadron commander. A good mess and various amusements for "dud" days go a long way to help in this respect.

But in watching the pilots carefully, the C.O. should never neglect the enlisted personnel of the squadron. It is they who keep the machines serviceable and if they are discontented, their work will be poorer than if they were happy and interested. To see that his men get good quarters and good food should be one of the foremost duties of the C.O. If the squadron is modeled somewhat after the British organization, each pilot having his own rigger and fitter, it greatly facilitates the work of keeping the men interested in their work and that is the main

object. If the squadron is divided into three flights, flight sergeants are responsible for their work, it would be easier for the C.O. in that, the flight sergeants will be responsible for the condition of the men under him and he can watch them closely. In this way each man takes a personal interest in the plane he is looking after and with the cooperation of his pilot he will keep the plane in good shape. Keeping the men interested in their work and making them feel that they are directly instrumental in helping their pilots in their work, cannot be too greatly emphasized. Discontent among the enlisted men is a condition to be very carefully avoided.

Keeping the men and officers in good physical condition is another important point to be considered by the C.O. On days when the weather prevents flying, the men usually have plenty of work to do on the machines, but sometimes their machines are in good condition and the men are inclined to do nothing rather than find something to occupy them and give them some exercise. When not flying the pilots are inclined to sit around and do nothing, rather than find some form of distraction to take them away from the usual routine of work around the squadron. But primarily the pilots should be made to oversee any work being done on their plane and to be sure that it is in a serviceable condition.

To understand each man under him and make the work as interesting as possible, a contented and happy squadron will do the best work and to obtain this end the C.O. must see to it that men in charge of the different departments are competent and interested in their work.

—14—

147th Aero Squadron

Successful aerial attacks like all other military offensive maneuvers, depends to a large extent on position and surprise. Other things being equal, the aviator that can surprise his opponent or accelerate his speed by diving from a higher altitude will win the battle. The best possible position to have is to be in line between your adversary and the sun and to be at least a couple of hundred meters higher. An attack on equal numbers from such an opportunity should bring a victory every time.

When a hostile formation is seen below, the leader should start to swing his formation into the sun to get the better advantage of its blinding light. When he dives the whole

formation should go down with him at the same time endeavoring to hold the positions in the formation. It has been found that the Bosche often leave one or two men above their formations ready to dive at an attacking formation when it is mixed up in the melee of the fight. To counter this one of the trailing members of the friendly formation should remain up out of the fight in order to combat any that tried to enter in a surprise attack. Many men have been lost by diving too far through the enemy formation for if not outnumbered several machines will follow on down and with little danger to themselves ride the tail of the man that has gone down too far. Normally, an attack made of diving, shooting, and zooming up to dive again should split up any opposing aeroplanes.

Tightening a formation when the leader gives the Hun signal is absolutely necessary particularly if all its members fail to see the Huns. The Bosches seldom attack an enemy formation even if they have a preponderance of members if it is flying a tight formation. It is about the best protection that a small group of machines can assume. After the formation has closed together the leader will maneuver in order to bring the opposing machines into better view out of the sun. At the same time the formation climbs in an effort to counter the superior altitude of the enemy. To attack from below is dangerous unless the attackers have superior numbers but if attacked the Bosche will lose a lot of their advantage if the enemy formation is climbing towards them, often the speed of the diving machines carrying them through the other formation.

—15—

95th Aero Squadron

Aerial combat presents so many unexpected and novel situations in practice that any attempt to reduce it to a system of rules seems at first glance to be practically impossible, but at the same time there are numerous general suggestions which can be made subject to the changes which must be instantly devised to suit each new development.

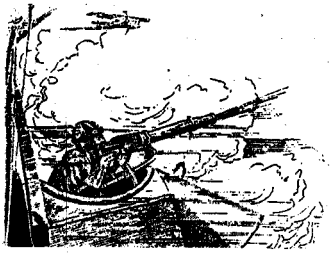
It is no exaggeration to say that three-fourths of the battle lies in seeing your opponent or opponents first and if possible, making a surprise attack. Under these conditions, everything is in the favor of the attacking man and his adversary, if he ever gets into a position to fight at all, is at a tremendous disadvantage. When getting into position for any attack, and especially when a pilot thinks he is catching his adversary unaware, the greatest care must be taken to search minutely for other enemy planes above or nearby. Often an apparently

helpless plane is simply acting as a bait for others lying in wait in some advantageous position. Make sure you see and understand every detail of the situation and then attack with all possible speed.

In any fight in which more than one enemy plane is encountered, make a sharp rapid attack on the highest man if possible and break off the instant he tries to lead you down to lower altitude, even though he appears to be an easy victim. The great temptation is to concentrate one's whole attention on the machine you are attacking, whereas at least half your faculties should be devoted to what is going on around you. Look behind you at least once every 10 seconds. As a general rule, it is advisable to always try to remain above your opponents, but if attacked by surprise or forced into a difficult position by superior numbers, a vertical dive with full motor, especially in a Spad, will often prove to be the surest and safest method of escape, but it should be saved as a last resource.

In attacking a bi-place machine, one should endeavor to maneuver into the blind spot under his tail where the observer's gun is useless. If this position can be attained, he will be an easy victim, but in practice it will be found extremely difficult to do, particularly if you are up against an experienced pilot. If more than one pilot is attacking a single bi-place, one man can easily draw the observer's fire without great risk, while the others close in to the actual attack. If forced to dive on a bi-place alone, try to swing from one side of the enemy machine to the other so as to force the machine-gunner to move his guns continually.

For a good shot, the attack from a three-quarter front and slightly above is an excellent position but can be held for only a few seconds and, hence, is practically useless for an inexperienced pilot. Similarly, a crack shot may do great damage to any enemy plane and even bring it down from a distance of 300 to 400 yards, but the average pilot will find that most of his work will be accomplished from 200 yards up to as close as 10 yards; and on account of the danger of jams, it is inadvisable to shoot from further than 200 yards. When once you fire, keep shooting as long as your tracers go reasonably near or until forced to pull away.



—16—

95th Aero Squadron

Formation flying for pursuit planes was a development of the last 2 years of aerial warfare when the steadily increasing number of machines in the air made it exceedingly dangerous for any but

the most experienced pilots to fly alone.

In all formation work, it is absolutely essential to have a leader who has had sufficient time to be able to see enemy machines in the air, and one upon whose judgment the other members of the patrol can rely. Given this it should be understood that no pilot should leave his patrol, unless unable to keep up, and the strictest discipline while in the air must be maintained.

In getting together at the start, the leader should designate a comparatively small point, such as a village or even a single building, as rendezvous and should circle immediately over that point until all his men have arrived. It will be found exceedingly difficult for one leader to try to assemble more than five planes under his immediate command.

Pursuit formations may be roughly divided into two classes: large formations of 10 or more machines whose mission is to protect observation or bombing planes or, in some cases, to form a barrage against hostile planes; and the small formation three or possibly five planes whose duty it is to seek out and destroy enemy machines. The former type of formation has numerous obvious disadvantages owing to its cumbersome size and the difficulties of cooperation. It is essential that each five machines in a patrol of 10 or 15, for example, should have a separate leader, cooperating with and directly responsible to the patrol leader, but at the same time keeping a sharp eye on the men under his immediate control. It is of the utmost importance for the two rear men to fly close to their formation, as otherwise they are practically helpless if attacked from above. If, due to a bad motor or for any other reason, a pilot is unable to keep in close touch with his patrol he should return to his own lines at once. Either of the rear men on a formation, if attacked from above, should immediately dive into his patrol where an enemy machine cannot follow. To turn in and endeavor to combat under such conditions is fatal, as it breaks up the formation and totally destroys its efficiency as a protective unit.

For pursuit work, the most interesting and efficient unit is the small patrol of three or five in V-shape formation which by reason of its extreme maneuverability and compactness can act almost as one man. Such a patrol if composed of experienced pilots and with a clever leader will be practically immune from attack and will be effective against much larger formations of enemy machines. Isolated bi-place machines of the enemy which would flee before a large formation of pursuit planes may be readily surprised and are an easy victim for the small patrol. When attacking, at least one man should remain detached from and above his companions, keeping a watchful eye on the proceedings, and ready to lend instant assistance to any of his

men who get into difficulties.

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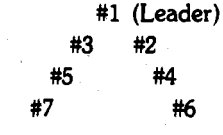
"Skilled Pilot," 27th Aero Squadron

Aerial Tactics and Combat

Scout machines being single seaters fly over the lines in formation. These formations vary in strength from three to seven. It is good practice during offensive operations to fly several formations over a sector at the same time having them constantly in touch with a designated squadron as pivot squadron. Before starting on patrol every member of the formation should know the plan and what to do in case of emergency. It often happens during a fight that the formation is split up and a rendezvous should be arranged before starting out so as the formation can get together again.

A formation patrolling the line must keep in close contact; in other words it is of prime importance that each member of the formation . . . [hold] the position designated to him. The formation usually is in V shape as shown below. #2 man 50 meters above the leader, #3 man 50 meters above #2, #4 man 50 meters above #3, etc.



#2 should be 50 meters behind and to the right of the leader; #4 man 50 meters behind and to the right of #2 man, etc. A straggler in a formation is easy meat for the "Hun." He is always on the lookout for a chance to pick off the end man. It is also a fact that a good formation will scare away a Hun formation of much larger strength. Several cases of formations which have penetrated far into enemy territory and have not been attacked is one proof of this. A man out of formation is liable to spoil the effectiveness of the whole unit. A straggler not only puts himself in danger but reduces the strength of the formation.

The Attack

The leader starts the attack. In favorable circumstances he will have altitude over the enemy and will dive on the enemy

formation or single machine as the case may be. Numbers two and three go down to the attack with the leader. The other members of the formation stay up to protect from attack above. We always try to keep altitude on the enemy during the entire fight. Also keep the enemy on the inside while our machines dive, shoot and pull off to come back again for another shot. It must always be remembered that we are working as a unit and not individually. Do not go down and play around with any individual. The idea is to have planes diving and shooting all the time. If you go down and stay with the enemy at his level you will lose your advantage and lay yourself open to attack by another member of the enemy formation. The easiest man to bring down is the man who is so much concentrated on a single adversary that he either forgets or neglects to watch his tail. The machines which have stayed above to protect will be brought down into the fight by the leader as they are needed but they should use their head and if they see our formation outnumbered and hard pressed go to it.

The Leader

The leader has absolute command of the whole formation. He is responsible for leading his men on patrol, making decisions as to when to attack, preventing the formation from being surprised and having his patrol perform their mission.

Many cases could be cited in which leaders have been called on to make decisions. It is often times a question of snap judgement, but as a rule he has a plan of action formulated as the situation develops. He should be a man of experience who sees everything that is in the sky. While on patrol over the lines a good leader is continually scheming and planning to meet situations which may arise at any time. He considers every machine in the sky as an enemy until he is close enough to tell the type. A leader whose formation is surprised is a failure. Likewise if he engaged in a combat under unfavorable conditions without sufficient reason he is not a success. He must know every part of his sector. Before going into the air he should take note of the wind velocity and direction so as not to be blown into enemy territory during a fight.

It is the leader's duty to take advantage of natural conditions which are favorable for surprise. This includes clouds, mist and sun.

A formation should be continually S'ing and turning and no member of the formation should be flying straight at any time. In order to keep the members of his formation on the move and in position the leader should fly at as low a speed as possible and S and turn continually. Look alive, see everything and jump at

every opportunity to attack.

The Individual

The individual preparation for work over the lines starts on the ground at the hangar. It is taken for granted when a man is sent to the front that he can handle his machine.

Your machine must be in the best of condition, as must be your guns. Live with your machine, get to know your mechanics and let them know that you are taking an interest in things. It is [up] to you to have that machine and its guns in the best of conditions.

Upon your arrival at the front get in touch with the older men and get their advice on how things are done. Keep your ears and eyes open and obey instructions, be keen to learn. Take things easy at first and finally you will be a good pursuit pilot. If you think you know it all and refuse advice and do not do as told you by flight commander and the older men in the squadron you will most likely develop into a first class "Daisy Pusher."

In combat your advantage lies in pressing the attack. Wait until you can see the man's head and then spray him with both guns. If you do this you will get him. If you persist in shooting at long range you will waste all of your ammunition, accomplish nothing, and find yourself out of luck when the time comes for you to save your own skin. Keep after the enemy. Do not give him a chance to fix his guns or to do anything else. However, remember attack from the Front and "Watch Your Tail."

Recommendations

The training schools have not sent men to the front prepared for their work. They have not been taught to fly formation. They expect signals from the leader as to when to turn. This should be instinctive. They have not been taught how to keep in formation.

The combat instruction given them has been based on the wrong idea. They have been led to believe that their combat principles involved individual combat principally whereas individual combat is a very rare occurance.

The main trouble with the training appears to be that the instructors are not men of experience at the front. No man can teach a pursuit pilot who has not been through the mill. The instructor should be a man who has been at the front as a bona member of a pursuit squadron and has been in combats and preferably a man who has been a flight leader as he has already had the experience of teaching pilots from the training school.

The main recommendation would be therefore that a staff of instructors be formed who know the game from every angle and

U.S. Air Service pilots on alert at Toul.

at the same time are able to impart their knowledge to others. This it is believed would fit men for their work at the front in a pursuit squadron. They at least would not arrive at squadrons with wrong ideas and the belief is that they would have the general principles of pursuit work included in their general knowledge.

—18—

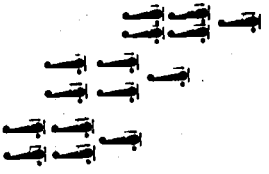
"Skilled Pilot," 27th Aero Squadron

The importance of team-work in chasse flying can hardly be emphasized and is perhaps the hardest thing a new pilot, fresh from training school has to realize. This is without doubt due to the fact that training formations are usually flown in a simple, straight course, never done at the front; and because his final or combat training consists only of endeavoring to out maneuver a single opponent.

Apart from a few individual stars, men of long experience, who operate singly with success, practically all chasse or scout work is done by groups of from three to ten or more planes flying in formation, cooperation and explicit obedience to the signals of the leader being the key-note of success.

Experience of this squadron has proven that a diamond or wedge shape formation, in which the planes are tiered outward and above the leader, to be the best fighting patrol for

the reason that while a compact unit, enemy machines can maneuver in any fashion and have an unobstructed view. Due to the blind spots common to all planes, a zig-zag tortuous course is always flown near the lines, to enable the pilot to have a free vision in all directions, and also to render archie fire ineffective.



Groups of planes patrol the lines, to the end that all enemy aircraft attempting to cross the lines be destroyed or driven back; and by clearing the air of enemy fighting patrols it enables our reconnaissance and reglage machines to operate free from interference. Perhaps the most disliked duty a chasse patrol is called on to perform is to protect reconnaissance or photographic missions far into enemy territory, where they are at the mercy of any large group of attacking fighting planes.

In troop straffing always done during a special drive or push, scouts operating singly or in twos, diving on enemy trenches or supply trains and zooming back into safety, and then repeat the attack at another point. Low fog or clouds at such a time are a great aid.

In any attack it is very essential that the patrol have the advantage of greater altitude than the enemy. Existing weather conditions of course must be taken into consideration. Clouds and bright sun afford excellent opportunities to surprise an enemy group, if properly used; and likewise enable the enemy to obtain the advantage if great care is not exercised in the use of these natural advantages. Thick solid clouds for instance, can be flown directly under with perfect safety, which if there are holes in them there is great danger of an enemy group circling above such a hole and diving on the end men of a formation passing beneath, with every prospect of success, and then zooming back above the clouds unmolested.

To straggle or lag behind the formation is to court disaster, many a man being lost in this manner.

A bright sun constitutes a great advantage if the patrol maneuvers so as to have the sun at its back, thus being in what is known as the enemy's sun spot, it being almost impossible to look directly at the sun and see a machine until it comes within shooting range. Great care must of course be taken that no enemy group obtains a similar advantage by maneuvers, as a surprise attack particularly from above, allows but small chance for escape.

In order that both low and high flying enemy planes be intercepted, patrols are as a rule flown at varying levels, approximately 600, 2500 and 5000 meters as in this manner the upper echelons constitute [protection] to those below. Should the low patrol attack and in turn be attacked by a second enemy group our upper echelon would have every opportunity of diving

in turn upon the enemy, with great advantages. It is in this way that so called dog-fights commence, friendly and enemy groups diving on one another in layers. Here the necessity of vigilance not only ahead, but to the rear, and particularly above, while carrying on, or contemplating an attack.

In attacking an enemy formation equal or slightly greater in numbers assuming that the leader has maneuvered so as to have the advantage of altitude, a favorite method is to have the leader and the right and left hand man dive on the enemy, followed by the next two men at a distance great enough to have the first three chandel[le] up into position again; thus keeping the formation intact, while a practically continuous fire is maintained on the enemy, and the advantage of altitude is not lost. Unless one of those diving gets into difficulties below the end men of the formation do not go down, but remain above, affording protection to those diving. From an attack of this kind there is no escape, other than by diving away, manipulating controls so as to cause the ship to pursue irregular course; commonly known as putting the nose down and walking the rudder, which affords a very difficult target.

In attacking a bi-place machine, containing an observer operating machine guns on a movable turret, the most satisfactory method has been found to be two or three men diving simultaneously from both sides and to the rear. The combined fire would usually disconcert the observer and render ineffective his aim, which at best is difficult because of double deflection. There can be no escape from such an attack if well carried out.

A single scout attacking a bi-place can often, by taking advantage of the blind angles or vision of such a ship, approach it from below and slightly in front with a fair chance of success, in as much as the traverse of the observer's guns is limited. An individual combat between two single seaters often calls into play considerable acrobation, that unless skillfully performed and well timed often proves dangerous.

There is a very great danger of the adversary securing a great advantage in maneuvers of this kind, this is particularly true of the reversement and in fact any maneuver which has a dead point is lost [?] of speed. A vertical virage is without a doubt the most valuable maneuver and by far the most difficult to perform correctly, as in the majority of single combats considerable circling is done before either can get into shooting position. Due to the guns on a single seater shooting straight ahead only, the man who makes the smallest circle or tightest virage gradually gains so as to come on the tail of his opponent and so get in a burst of shots. It is at such a time that a pilot must know and

feel his ship as any tendency to stall or side-slip, with the consequent loss of altitude, would be fatal.

Too great a stress can not be laid on a pilot's knowledge of his engine and ship, his facility to fly and shoot in any position, and familiarity with terrain flown over. He must be able to see and distinguish at great distances all enemy aircraft and to know whether or not he can outclimb or outrun the types of enemy planes common on his sector. Information of this later score is of great assistance during an attack or in breaking off a combat as it would be useless to try to to climb away from an opponent were he in a ship of superior climbing ability. While every type of combat plane has some particular advantage it usually has its disadvantages; therefore knowledge thereof is essential. Much depends on the leader of a formation and his signals should be few and well understood by all members of the patrol, who must follow his lead explicitly. Continuous flying together and discussion of plans for attack are very necessary before any patrol can become an efficient fighting unit; and the present formation flying training might well be extended so as to embrace the more advanced patrol flying so essential in work at the front.

—19—

"Skilled Pilot," 27th Aero Squadron

When orders are received by this squadron to destroy enemy observation balloons, the very great military value of same, to the enemy, necessitates that every possible precaution be taken to prevent failure in the fulfillment of this mission. Only planes with motors of the most established reliability should be employed; first because of the self evident importance of the task in hand, and secondly, because the mission must be executed at relatively low altitude, and well beyond the enemy's lines. The motor and plane should be subjected to the most thorough inspection.

Even more essential is it that the machine guns to be used be carefully tested on the range. There is no time in the attack on a balloon to clear a jam, which, should it occur, would entirely defeat the success of the mission. The plane used should always be equipped with one special balloon gun (Vickers 11 mm) using incendiary ammunition only, for experience in this squadron and the British, has shown that unless the shots are exceptionally well grouped, balloons will not burn when attacked with

Capt. Jerry C. Vasconcells next to a 27th Aero Squadron aircraft.

ammunition of service calibre, even though incendiary ammunition is used in a very large proportion. Also, and this is of very great importance, pilots should be strictly forbidden to attack balloons unless so equipped, for the very great chances of failure otherwise, make the risk, proportional to the chance of success, far too great.

Weather conditions permitting, the enemy endeavors to give very adequate protection to his balloons. In the Chateau-Thierry drive, tri-plane Fokkers were specially detailed to this task, whereas in the Argonne Meuse Drive, Bi-plane Fokkers were nearly always to be found above and in the vicinity of the enemy balloon lines. From the ground invariably his balloons are protected by the so called "Flaming Onions," "Archie Batteries," and by machine gun emplacements. It may be remembered that the latter are by far more dangerous.

In clear weather, the enemy aerial protection is practically certain, it is imperative to give adequate protection to the "Balloon Straffer," and so to enable him to concentrate his entire attention on his task. If the enemy balloon is within 6 to 8 kilometers within his lines, an escort of six to ten planes to fly above, circle during the attack, and accompany balloon straffer back to lines, will usually be sufficient; if balloon is farther back, this squadron has experienced best success with an escort of two echelons of five to six planes each employing same tactics, and flying one 500 to 1000 meters above the other. In case of clear weather, and good visibility, the chances are the balloon will be high (600 to 1000 meters) and consequently enemy protection from the ground is relatively less to be feared.

When clouds are solid at low altitude the Officer selected to destroy the balloon may proceed on his mission alone, for then he may fly just under the clouds and so be safe from aerial attack above. In case of attack by superior numbers he can escape into the clouds and fly a compass course until within his own lines. Also Balloon Straffer may be dispatched alone before dawn, so as to reach his objective at dawn; or before dusk, so as to reach balloon at dusk. In both named cases he is relatively safe from aerial attack, due to fact the enemy aircraft will not leave airdromes before dawn for balloon protection, and will leave in time to return by nightfall. Of course the straffer leaving before dawn must be a most experienced pilot, very familiar with sector, and balloon locations must be definitely given, and the same is applicable to balloon straffers before dusk.

The methods of attack are of course individual problems, and worked out differently by different pilots, but the following principles may be suggested. Above all it is most necessary to group shots well together to insure combustion of balloon.

Fokker Triplane

Especially at dawn is this true, due to condensations of moisture during night upon the envelope. If the balloon is well in ascension do not pass over it after attack, through cone of fire from machine gun emplacements upon ground, but chandel[le] away, gaining altitude as rapidly as possible. If the balloon is in the nest, as is very likely at dawn or nightfall, it is advisable to hug ground as closely as possible after attack, zig-zagging and taking all possible advantage of natural obstacles to enemy fire.

—20—

"Skilled Pilot," 27th Aero Squadron

Lieutenant Luke[a] with fourteen official balloon victories was perhaps the first to inaugurate the successful dusk and dawn balloon straffing expeditions. While returning late one evening from a patrol he attacked and destroyed a balloon. Appreciating the added protection given him by the darkness he continued his future expeditions along this plan. Major Hartney immediately adopted the plan of dawn and dusk balloon straffing for the entire First Pursuit Group as he immediately recognized the advantages of this plan of attack. The results have been far more satisfactory than was at first anticipated.

The plan for the dawn balloon straffing was this—a pilot would

be dispatched from the airdrome before dawn, taking off by a system of lights arranged around the field, the pilot would time his departure so as to arrive at the balloon location at dawn, as the balloons are sent up at this time to begin the day's observations. Often times the pilot pursued a round-about route to the balloon location after crossing into the enemy lines in order to confuse ground observers as to his destination. In case any hostile E.A. were sent up in pursuit of him such an indirect route would naturally make him more difficult to locate. Arriving at the balloon the pilot immediately attacked the balloon, often while a balloon was still in its nest. Immediately, thereafter taking the quickest route for his own lines. The particular advantages of dawn straffing consist of the protection afforded the pilot from possible attack by hostile E.A., since hostile machines are practically never flying at such early dawn. Another advantage is the opportunity of making a surprise attack on the balloon while the enemy fire from A.A. and machine guns is inaccurate due to the poor visibility. The chief advantage is the destruction of the balloon at the beginning of the day as it is practically impossible to replace the balloon for the day's observation.

Practically the same plan is followed in dusk straffing; the pilot leaving just before dusk, arriving at the balloon at dusk attacking it in its nest and at once returning to his aerodrome by the quickest possible route. The pilot is enabled to land by light from the lighting system around the field. Rockets and flares are fired continually to assist him in locating his airdrome. The advantages of dusk straffing consist of the protection afforded the pilot by the darkness allowing him to carry out his mission unmolested by hostile E.A. and due to the poor visibility, A.A. and machine gun fire is necessarily inaccurate. At this time of the day the hostile E.A. usually have returned to their respective airdromes leaving the air free for the carrying out of the mission. The darkness also assists the pilot to make a surprise attack, the value of which can hardly be over estimated.

In successfully carrying out dawn and dusk balloon straffing missions the pilot must study his map well before leaving, carefully working out his route, noting principal water-ways and land-marks that would be plainly discernable in the darkness and having firmly fixed this in his mind, and also the exact location of the balloon. An accurate compass with a radio light face is absolutely necessary as after attacking a balloon the pilot quite often is obliged to return to his lines flying just a few feet above the tree tops; not being able to see the surrounding country he is obliged to rely absolutely on his compass. The sun can often be used to follow direction by, but on the Western Front it is often concealed for days at a time by thick mist and clouds.

Another method of attacking balloons and which was found to be very successful was to send out a large number of planes to form protection for the pilot or pilots designated to attack the balloon. The planes would proceed to the balloon location in formation and circle above and about the balloon, clearing the air of hostile E.A., while the pilot or pilots formally designated dove down and attacked the balloon. This form of attack was found very valuable where orders were received to proceed without delay to destroy some certain balloon that was especially active and troublesome, that was regulating hostile artillery fire, etc. This attack can be carried out at any time of day and is one of the chief points of advantage. The disadvantage of such an attack consists of the danger of losses to our planes or the failure of the attack, due to the possibility of attacks by large formations of hostile E.A. The anti-aircraft and machine gun fire is necessarily much more accurate in broad daylight and where the many planes form an excellent target.

German Drachen balloon.

Oftentimes our pilots have taken advantage of the concealment offered by the clouds. In this form of attack the pilot or pilots approach the balloon, remaining concealed by a cloud or clouds until directly over the balloon, when the balloon would be attacked by diving straight down on the balloon, holding fire until at close range, then opening fire with both guns until nearly on the balloon when he would zoom away and return to our lines as quickly as possible. In this form of attack two attacking pilots and sometimes three achieved better success because the balloon defense could not concentrate its fire on any one attacking plane thus increasing our pilots' chances of setting the balloon on fire and safely escaping. There are instances where one pilot attacked the machine gunners on the ground, who were defending the balloon while the other pilot or pilots attacked the balloon itself. The disadvantage of this plan of attack is the danger of the attack by hostile E.A. in large formations, who would have a distinct advantage over our pilots since they would have altitude for attacking them and would have the advantage of superior numbers.

In the 27th Squadron there are many instances of a pilot crossing the line with no protection and attacking and burning one and oftentimes several balloons. These expeditions have been successful to a high degree due to the superiority of our pilots over those of the enemy. This form of attack is by far the most dangerous and runs less chance of succeeding [due] to the possible interference by both hostile E.A. and hostile A.A. fire.

The armament for a plane attacking balloons, which has been found the most successful in this squadron, consists of 2 Vickers guns, fixed and firing directly ahead shooting through the

propeller. One gun was the common aerial Vickers 7mm. gun firing service ammunition, every fifth cartridge being a tracer. The other gun being the 11 mm. Vickers balloon gun firing all incendiary ammunition. There are many instances of our pilots attacking and firing good bursts into balloons at close range but failing to burn the balloon due to lack of proper incendiary ammunition, but since the introduction of the balloon gun no such cases have been reported. The sights used have been the ring and bead,[b] Aldis,[c] and Reville seville,[d] but they are hardly necessary in attacking balloons due to the large size of the target and the pilots usually regulated their fire by changing the direction of the plane as their tracers indicated the necessity of a change. It is vitally important that the guns be in good working order and that the ammunition has been carefully selected, as a jam at the critical moment may mean the failure of your entire mission. It is obvious that the pilot should be thoroughly familiar with the operation of his gun.

Since in attacking a balloon a pilot is required to penetrate several kilometers into enemy territory; the importance of having his plane in absolutely perfect running order cannot be too highly emphasized. If a pilot desires to fail in his mission and perhaps allow the balloon he was to destroy continue invaluable observation for the enemy, if he desires to spend the balance of the war in a prison camp, let him fly a machine over enemy territory that is not running properly and the chances are big that he will never be able to carry out his mission or ever get back to his own lines. A pilot should thoroughly understand his machine and know that it is right. The American training schools have made a grave error in sending pilots to the front, practically 100% of whom had never flown a Spad, taking the valuable time of the older man as well as their own time in familiarizing themselves with the Spad both in how to fly it and in the handling of the motor to produce the best results. The motors furnished the squadron have as a majority been of a very poor quality and combining this with the fact that many of the pilots had to familiarize themselves with the Hispano-Suiza motor by experience and by continued experiments; the efficiency of the squadron has been impaired and many offers for volunteer balloon straffing expeditions had to be refused, due to the shortage of planes. This shortage being produced by repairs being constantly made on the engine.

In all the forms of balloon straffing the balloon was attacked from above along the top surface from head to tail due to the hydrogen being in the upper part of the bag. The surest method of burning the balloon as carried on by our pilots was this: Diving on the balloon the pilot opened fire at about 100 yards

with the small gun firing the service ammunition concentrating the fire so as to produce a hole in the bag (this is easily done by following the directions of the tracers) allowing the hydrogen to escape and unite with the oxygen of the air. When at perhaps 50 or 60 yards he would open fire with the balloon gun firing the incendiaries, these taking greatest effect now since the HO had united from the hole in the bag and the burning bullet passing through this mixture easily ignited the bag.

After attacking a balloon and when the pilot is returning home is when the enemy fire is the heaviest from the machine guns and "Flaming Onions" (large balls of phosphorous) fired with the intent of setting the attacking plane on fire. The safety of the pilot now depends on his ability to maneuver his plane rapidly and in all directions to frustrate the hostile fire from the ground. Perhaps the most successful maneuver consists of "walking on the rudder" that is, skidding the machine first to left and then to right by pressure on the rudder. A Spad is very easy to skid and when maneuvered in this manner makes a very difficult target.

Capt. Alfred A. Grant, Commanding Officer, 27th Aero Squadron.

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"Skilled Pilot," 27th Aero Squadron

There are several general classes of forced landings but they all merge rather closely. Each and every one is an experience, sometimes pleasant, sometimes exciting and rather dangerous, but more often merely an incident in the every day life of a pilot. The three classes of forced landings which constantly occur are: (1) Those when from some trouble with the motor or plane, it is necessary to land within a limited time but there is still leeway to reach an airdrome or a good landing place. (2) Those where the trouble is very serious and it is necessary to land within a few minutes at the most. (3) Those when the motor goes absolutely dead and you must come down as best you can.

Experience alone will teach you to determine the seriousness of the trouble and to distinguish between the first two classes. Should your oil or water system break you must, if possible, land at once in order to save the motor; but never chance crashing the plane to save the motor. Fuel or ignition trouble is not dangerous to either you or your motor as long as the motor "revs up" enough to keep the plane in the air and bring you home. One important rule at the front is always to bring the

plane back to the airdrome if possible, as a plane "out on pan" means a serious tie up to the flight and squadron. Headwork as well as flying ability is extremely necessary to a successful pilot at the front.

In the third case when the motor stops absolutely or slows down to a point when it is useless, there is only one thing to do, "pique" or dive steeply enough to keep flying speed and land the best available place, into the wind if possible. Never endanger your own life trying to save the plane.

This, so far, is a very general discussion and in order to narrow it we will deal only with forced landings as they occur at the front.

A pilot should know his motor from A to Z so that when trouble occurs he can instantly decide what is wrong and how serious it is. Before leaving the ground the temperature, pressures and the "rev" should be right and the pilot should feel confident that the motor is in as perfect condition as circumstances will allow. I put it that way because many times it is necessary to make a patrol with a motor which vibrates or which, while it isn't quite right, still gets you where you have to go and enables you to do the work required. Should serious trouble occur while taking off there is one valuable rule, the breaking of which has cost many a pilot his life and that is to go straight ahead and land, no matter what you have to land on or into. Here again experience will have to tell you how serious the trouble is while circling around over or near the airdrome as is the custom when forming for a patrol, you have an excellent chance to try out and listen to your motor. It is far better to detect trouble at the start than to have a forced landing in Germany or the shell holes and trenches at the front, just because you didn't notice a leak or hear a miss or discover that when you opened up your throttle the motor choked badly.

When you start for the front with a patrol you should feel confident that unless something develops everything is O.K. The ideal condition of course is when you can forget your motor and attend only to the thousand and one other things that you must watch and think about while patrolling the lines; unfortunately we have run across but few such perfect motors.

During the Saint Mihiel drive we had very little serious trouble from forced landings, due to the fact that we were flying high and also because the country was not badly shot up. If you are high and motor trouble develops there is little difficulty in at least picking out a good landing field and getting down safely. In most cases the pilots were able to limp back to the airdrome because they could lose altitude safely.

Matters were decidely different when the Verdun Argonne

Wrecked airplane, dropped 500 ft. after the motor failed.

drive opened and they grew worse as the Huns were pushed back. Never were we allowed to fly above 600 meters and the country north, northwest, and west of Verdun is a mass of shell holes, barbed wired and trenches and forests. Thus a forced landing instead of being a joke more or less, became a very serious matter so that when the motor coughed or cut out so did your heart and when it stopped dead the bottom sort of dropped out of something inside of you. Fortunately, although many ships were crashed on these forced landings, very few of the pilots were hurt.There seems to be but one way of landing under the conditions met with between the Meuse and the Argonne and that is to head for the best looking spot you can reach and "pan cake" down. By pancaking is meant holding the ship a few feet off the ground as long as possible and getting the tail well down, thus when you have lost flying speed the plane drops and does not roll as far as it would after making an ordinary landing. Only luck will keep you from turning over, but a pan cake landing helps. An interesting book could be written on the feelings, thoughts and sensations that come to different pilots on such occasions.

If you are lucky enough to make a good landing there are several things to be done and determined: First: What is wrong

with the motor? Can it be fixed easily? What parts are needed etc? Second: When the machine is fixed will it be possible to "take-off" from the field you are in or any nearby field? Third: Will the machine have to be wrecked or salvaged? If this is necessary all instruments, sights, guns etc, should be removed and taken back to camp. Fourth: The machine must be guarded as the world is full of souvenir hunters and a disabled plane with its insignia, cocards, number and many removable parts is a choice prize period. Five: Notify Headquarters where the plane is, the extent of the damage and what in your judgment it is best to do.

If a pilot always knows approximately which way the wind is blowing and what direction is towards enemy territory he has little to fear from a forced landing; if he doesn't know these two things he is hardly a pilot.

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Lt. Cassady.

1st Lt. Thomas G. Cassady
Pilot, 28th Aero Squadron

Cassady had enlisted in the French air service in July 1917 and had served briefly at the front before transferring to the U.S. Air Service in February 1918. Subsequently he had been attached to a French squadron before being assigned to the 28th early in September 1918. He had credit for five victories while on detached service with the French and four more with the 28th Squadron. His report, which follows, was entitled "Recommendations for Practical Flying with Military Tactics."

It seems to me that in all American squadrons which I have observed at the front, there is room for improvement in their formation flying. First of all formation should be effected more rapidly. At almost every flight there is some pilot who can not depart at the given hour because of some simple little trouble which could have been arranged if he had tried his motor, say, a half hour before departure. Some pilots are naturally slower in adjusting their helmets, glasses etc. than others and because of all the above reasons I suggest that each pilot complete all his preparations and be strapped in his machine at least ten minutes before the given hour of departure. Any normal motor should be started in five minutes and in the remaining five minutes be warmed up and taxied to starting line.

A very satisfactory mode of assemblement employed in many French squadrons is as follows: Every motor is started before leader taxies out to starting line allowing the ten minutes for each machine. The leader after noting the number of motors turning over immediately takes off and climbs rapidly to 200 meters where he reduces motor to line of flight speed and straightens out continuing straight into wind. Each remaining pilot starts to take off as soon as the wheels of his predecessor's machine leave the ground and immediately climbs to fifty meters above the leader on the side assigned and remaining machines do likewise climbing to 50 meters above their predecessor. As soon as the leader counts all the machines behind him at proper altitudes and positions he performs a vertical turn and passes back through the group, each succeeding pilot forming into exact position by performing a vertical turn in an outward position from leader; that is if he is on the left he turns to left and on the right he turns to right. This mode of assemblement entails high efficiency and co-operation on parts of mechanics and pilots and have not yet been able to make it succeed in the American army, but if it can be accomplished by the French it can also be done by Americans.

The following method is quite efficient: Have all machines prepared as is stated in first paragraph and instruct all pilots to turn in left hand circles, at a given altitude over a well defined land-mark, such as a village, lake or small forest. The leader awaits until all available machines have taken off then climbs to within fifty meters of the circling planes under which he passes in the given direction such as from north to south or east to west and by waving his wings in some distinctive manner attracts the others immediate attention. At periphery of circling machines he reverses and starts in opposite direction, repeating this operation until everybody is in place. If he attempts to form by going in right circles for example; the pilot on the left will find it difficult to retain an approximate position and the pilots on the right will have difficulty in keeping in the leader's rear and the formation thereby retarded.

Unless the mission is urgent the leader should climb at eighteen or nineteen hundred revolutions depending on the pitch of propeller so as to enable everybody to keep in proper position, for all motors are not of equal power and some have a tendency to over heat. On arriving at given altitude the leader should turn his motor at seventeen hundred or seventeen-fifty hundred revolutions depending on pitch or propeller. A great many types of formations have been tried but I think the best and simplest is the V formation. With each pilot seventy five meters above, seventy five meters behind and seventy five

meters to the left or right, as the case may be of the man in front of him. A great obvious fault of our formation is the too great distance between the planes.

To attack a large enemy patrol all planes must act in unison, which they cannot if the formation is uneven. Furthermore the pilot who flies a long distance from his companions is susceptible to an attack without chance of immediate succor from the patrol.

A good protective formation is for the planes on the side next to the lines, to fly twenty five meters below his comrade on the opposite side of formation. If attacked he dives into his own lines and under his patrol which throws the attacking E.A. immediately under the fire of the pilot opposite. The E.A. most often attacks from the side and this is really an effective means of protective flying.

The same formation of pilots should, as far as possible, always fly together, establish a code of signals, and discuss together the mode of attack to be followed on different E.A. formations, the individual part that each is to play, modes of defense to be followed in case of attack from all possible positions etc. This I shall not attempt to describe for it has been very amply done by Cpt. Deullin of the French Air Service and translated by Maj. Bidell [Biddle].[a] Every pilot should have this document and each pursuit squadron have several copies in its possession.

Another very practical practice is a voluntary patrol of three pilots. It is the best method of breaking in the beginner. Two old pilots taking out a new one can give him very valuable encouragement in permitting him to take part in the attack of an E.A. bi-plane several times. I find it distinctly bad to introduce a pilot to actual combat with a large E.A. patrol. He is surely not going to be at his best and in a moment when he is bewilderingly watching the combat some E.A. is quite apt to surprise him. E.A. bi-planes have a habit of coming to the line at certain hours to perform their work, usually when they think our pursuit patrols are not in the air. This hour is often at noon and often just before dusk. By telephoning to our balloon stations one can always gain valuable information concerning activity of E.A. bi-planes and by being on the alert, the voluntary patrol can secure a combat with a biplane.

I think it an excellent suggestion that each patrol that leaves the ground should carry four light bombs and climb to its given altitude cross the lines at once and drop them, not deep within the enemy lines but distinctly on the enemy's side. Of course accurate information as to change in lines must be at hand. No particular spot is to be an objective but any spot in region of enemy infantry. As a rule infantry cannot tell whether or not the

planes above are enemy or friendly and if each patrol would drop its quota of bombs into the enemy trenches the enemy infantry would come to mistrust any plane over-head, even its own, and the moral effect would be tremendous.

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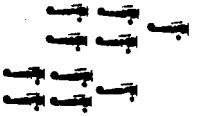

1st Lt. Louis C. Simon, Jr.
Pilot, 147th Aero Squadron

Formation Flying. To begin with, Formation Flying is the key to success of any squadron on the front; this applied to all kinds of squadrons: Chasse, Bombing (day), and Observation.

Flying Formation with Chasse Machines differs in many ways to other types. To begin with, you may be flying, say, a Nieuport where you can only fly at full speed and one machine may be faster than the others, that pilot has to S more to keep in place. The fact is every pilot has to S a certain amount in order to keep his correct position. It also takes a lot of practice to keep formation and at the same time be able at all times to look around in the air for enemy airplanes and also on the ground to try and observe for information which may be valuable for our use. In being able to do all this, it not only takes practice and experience, but a patrol leader who sees everything and can use his head at all times. If a patrol leader does not have these qualifications, he cannot keep his patrol together, cannot maneuver for best position of attack and most likely will be attacked by enemy airplanes and suffer heavy losses. Before going on patrol, you must always have a deputy leader with equal experience in case the leader drops out. From experience, enemy airplanes will not attack if you are in formation whether you have an equal number of machines or not. Formations in chasse machines does not mean flying wing to wing but about 200 yards above and 100 yards back of the pilot in front, this distance giving you room enough to maneuver in case of being attacked or attacking.

Method of Attack. First, patrol leader should maneuver to get all his patrol in formation. (This should only be necessary when you have a new pilot or a pilot with something wrong with his motor.) Always maneuver to get the sun at your back if possible. When attacking, always attack in formation, but all machines must not go down into the fight. Always have at least two machines above in case there are more enemy airplanes around,

to prevent them from diving on your tail, and you always find that upon attacking or being attacked the enemy airplanes try to climb above you and get on your tail. So by having two above, you will not have to worry so much about your tail. The average fight lasts from 2 to 5 minutes. When you break off, get into formation as quickly as possible and prepare for another attack or move towards home, as the patrol leader deems fit. Always have some point where you can rendezvous. (This is in case a pilot loses his formation.) One of the strongest points that all young pilots should have beaten into their heads (I use the word beaten because it is just about what you have to do) is never leave a formation or attack unless the patrol leader signals you or leads the attack himself. I can't emphasize this point too strongly because in my squadron 50 percent of our casualties were caused by pilots either losing their heads or leaving a patrol and going off alone. They may get away with it for a while, but sooner or later they will be missing.

At the beginning I spoke of the Nieuport 28 machine, because it has the rotary motor and is the hardest to fly formation with because you can't regulate your speed, but those with stationary motors, formation flying is easier because of not having to S so much, but you always should do a certain amount in order to know what is around. In closing I'll say, never take anything for granted, trust no planes till you are positive what they are, and by all means follow your leader in all cases whether you think he is doing the right or wrong.

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Maj. George E. A. Reinburg
C.O. 2d Day Bombardment Group

The 2d Day Bombardment Group which was organized on 1 November 1918, was Reinburg's first Air Service command at the front. Assigned to the Second Army, the group had two DH-4 squadrons, the 100th and the 163d, ready for operations by 9 November, but bad weather prevented them from flying any bombing missions before the Armistice. Reinburg's "Lessons Learned from the War in Aviation" was submitted with the group's history just before Christmas 1918.

A. Aeroplanes.

1. Types. The war has shown that there is no universal or

Caproni biplane.

multiple purpose plane, which can be used for pursuit, reconnaissance and bombing work. Each particular work calls for a different type of plane, specializing either in speed, maneuverability, climbing ability, carrying capacity, or long distance range. In order to embody one of these characteristics in a plane, others must be sacrificed.

2. Construction. Certain planes, such as the Spad for pursuit, Breguet for bombing, and Salmson for reconnaissance, are the results of years of experience in designing planes and combine the maximum factor for safety with best features of plane performance. These planes have practically become standard and the principal improvements to be made lie in the motor, inasmuch as a greater speed and a higher ceiling are desirable for all of these planes.

Other planes, like the Handley-Page and Caproni and others of the night bombing type, are susceptible of considerable development for long distance and weight-carrying purposes. All of these multiple-motored planes may be altered to fit the special purpose desired.

3. Use of Aeroplanes in warfare. The principal and primary uses of airplanes are for observation, destruction of property, and attack upon ground troops, and the secondary or defensive uses are for pursuit and protective purposes. Observation and bombing were both developed greatly during the present war, the

former including both visual and photographic reconnaissance. Pursuit and "Strafing" units were wholly a development of the present war, the former being used against enemy airplanes, and the latter against ground troops.

4. Limitations of Aviation in Warfare. The principal limitation of the aviator lies in his inability to conceal himself from the ground troops hence the latter are always forewarned of his presence. Another limitation (especially in observation and bombing) lies in the difficulty of picking out the finer details of the ground landscape from a height, and especially in cloudy or hazy weather. For photographic work the weather of France is very adverse, except for a couple of months in the summer.

B. Essential Requirements of a Successful Day Bombing Plane.

1. Good visibility. Speed being but a minor consideration if a plane can be flown well in a tight formation and inasmuch as no bombing plane can hope to run away from pursuit planes, its defensive power lies in the strength of the formation. Good visibility is necessary for this work. A good formation of bi-place machines can fight off double the number of pursuit planes.

2. Carrying capacity. No Day Bombing plane that cannot carry five hundred pounds of bombs is worth calling a Bombing plane. If less than this is carried the Pursuit and Observation type of plane can as easily do the work.

3. A Wide Fuel Range. To bomb behind the range of present day artillery and to reach strategic rail-heads, not less than four hours of fuel should be carried by each plane. If tactical bombing is desired the same planes can do the work, carrying less fuel and more bombs. By Tactical Bombing is meant Battle Field Bombing.

4. Great Wing-Spread. Unless this is maintained for bombing planes difficulty is found in maintaining a tight formation at high altitudes, for the plane must be stalled thru the air with its heavy load of bombs.

5. Detachable or Protected Fuel Tanks. Inasmuch as a bombing formation does a great deal of defensive fighting and has limited maneuvering ability this seems absolutely necessary. It has been found practical.

6. No Exposed Controls. They are very apt to be shot away by the observer while attempting to shoot under his tail.

7. Armored Pilots Seat. Many occasions have shown this to be responsible for the safe return of the plane.

8. Universal Bomb Racks. Bomb racks should accommodate any size of bombs for the same total aggregate weight. This is very important as object bombs are practically worthless against troops and shrapnel bombs are useless against railheads,

factories, etc.

9. Both pilot and observer should be as comfortable as possible. Four hours of flying is wearisome at the best and the best work is not done by a wornout man.

C. Why the De Haviland, Liberty Four, is a Poor Airplane for Day Bombardment.

1. It is not fast at great altitudes with a full load of bombs.

2. For a bombing plane it carries to any altitude an inferior quantity of bombs.

3. The fuel tank placed between the pilot and observer is the target of every pursuit plane that attacks it.

4. The fuel tank is unprotected, works by pressure and explodes when shot up.

5. When a bad landing is made or the plane crashes the tank leaves its bedding, having nothing to keep it there, and crushes the pilot against the motor.

6. The pilot and observer are too far apart. Team work is necessary in a bombing plane and is impossible in this type. Speaking tubes help some but are not the remedy for this situation.

7. The observer's cockpit is too low and the seat and belt provided are useless for active fighting. Any observer finds great difficulty in swinging Twin Lewis guns in the blast of a Liberty tractor.

8. The controls are exposed and liable to be shot away by even a careful and conservative observer.

9. The arrangements for the throttle and switch are badly placed. They should be on the same side, thus making it unnecessary for the pilot to change hands on the stick while landing.

10. The engine bed is weak.

11. The tail is weak and must be braced. Bracing is never as reliable as substantial construction in the making.

12. The king posts on the elevator are weak and no wires (on the white ships) run from the king post to the trailing edge of the elevator.

13. The plane is blind both from the pilot's and observer's standpoint.

14. The Liberty motor is too heavy and powerful for the De Haviland 4. Anyone who has flown one can tell this by the vibration of the machine under full power.

15. The rubber connection on the gasoline line running parallel to the exhaust becomes heated and so works loose. This causes a flood of gasoline over the exhaust and a resultant plane burned in the air. Have seen this happen on the ground.

16. The undercarriage is weak. In a crash there is a tendency for the motor to leave the plane; have witnessed at least one death as a result of this.

17. The plane is not so constructed that a bombing sight can be used thru the floor of the fuselage. This applies to carrying large camera as well. It is possible but not practical.

18. The gravity tank placed in the wings is not necessary and is dangerous.

19. The all-wood construction of the fuselage and wings tends to loosen more easily than a metal connection. The metal construction is used by both the French and Germans and is found practical.

20. The bomb racks are not dependable, are capable of carrying only large bombs. If small bombs are used only a small

Breuget.

number can be accommodated by the present bomb racks.

21. On the Liberty Motor the position of the spark plugs on the inside of the cylinders makes it necessary to wait for the engine to cool before changing the plugs. This means that a plane starting on a raid and finding a plug missing cannot get away on the raid, but if the plugs were differently situated, the plane could return to the field, change the plug and still catch the formation. This is very practical and often occurs.

D. Why the French Breguet Bomber is a Successful Day Bombing Plane.

1. It is fast at high altitudes on account of the large wing surface and will carry three times the load of the De Haviland to a higher altitude. Have been to 6000 meters with 12 Michelin 90mm bombs.

2. The Breguet Squadrons can operate regularly at an

ordinary altitude of 10,000 feet with 600 pounds of bombs, an armored seat for the pilot, twin Lewis guns, 6 drums of ammunition and the regulation front gun and ammunition.

3. The fuel system is divided into two tanks, the lower of which can easily be dropped in case of fire, and the upper so protected that it is very rarely set on fire. These tanks are in front of the pilot and do not tend to crush him in case of a crash.

4. Pilot and observer are close together so that conversation is easily carried on.

5. The observer's cockpit is deep so that the guns are easily swung and the observer requires no belt.

6. No controls are exposed.

7. The throttle arrangements are conveniently situated and excellent for the pilot.

8. The engine bed is strong. In our experience we have never seen the engine leave its bed in a Breguet crash.

9. The metal fuselage is strong, so that the plane does not get out of line easily. Have seen a longeron entirely shot away and the plane return safely.

10. Both pilot and observer have good visibility enabling good formation work and protection.

11. The entire floor of the fuselage can easily be opened thus giving excellent visibility below and making practical an accurate bomb sight.

12. The Michelin bomb racks are adjustable to any size bomb and still carry a full capacity load.

13. The struts cannot be shot apart by an explosive bullet.

14. From a standpoint of construction no stronger ship has probably ever been subjected to hard active service and given such good results.

15. We believe it possible to install a Liberty Motor in a specially designed Breguet and as a result have a plane close to the ideal bombing plane.

16. The present Renault Breguet carries five hours fuel in addition to its capacity of bombs.

17. At a high altitude it is just as easy to fly as a De Haviland since no stalling is necessary to hold the altitude once gained.

Note: These observations have all been substantiated by experience and many more could be added.

E. Flying Personnel.

1. Choice of Fliers. Altho for the most part the fliers have been proved as excellent material, a certain proportion have

been somewhat below par. From observation a large proportion of these cases have been due to the individual indifference of the fliers in question rather than to any actual inferiority.

2. Manner of Choosing Pilots for the Front. In some cases the best fliers have been kept at the various schools instead of being sent to the front, with the result that when fliers were sent out in squadrons operating at the front, some of those fliers were apparently stigmatized as being inferior to the flying instructors in the S.O.S. This was especially true when promotions were given to flying instructors in the S.O.S., whereas at the front a flier must be given command of a squadron before any promotions were given.

F. Operations.

1. Size of Formations. It has been learned that no hard and fast rules can be laid down for the size of formations. Each unit must regulate the size of the formation to the importance of the mission and to the degree of resistance offered by enemy aircraft. This proved especially true in the Chateau-Thierry, St. Mihiel, and Argonne operations, where the enemy amassed a large number of pursuit flights. In a case where two formations met, each one consisting of planes of equal fighting power, the advantage of the larger formation over the other is in about the same ratio as the square of their respective numbers. Assuming that in the first round of fire that each side downs the same number of opposing planes, the smaller formation has by this time lost a bigger proportion of planes than the larger and stands a good chance of being wiped out altogether.

2. Area of Operations. The least loss is experienced to aviation when the enemy is fooled as to the target chosen. If he can guess the probable area and time of aerial attack, arrangements will doubtless be made for some counter attack, but when operations cover a wider area and are constantly shifted, his patrols must either be increased all along the line, or he must wait for word of our planes crossing the lines before sending up fighting planes.

In the case of an army attack when it is necessary to reach certain objectives regardless of enemy opposition, much better results have been gained and with a considerably smaller loss of planes and flying personnel when extra groups have been brot in to equalize the odds of the Air Service of the army attacking.

G. Results of Bombardment vs. Expectations.

1. Expectations of Bombardment Aviation. Due to considerable newspaper talk it was popularly thot that bombing aviators would bomb enemy trenches and distant objectives such as Berlin, etc. These writers showed a lack of appreciation of the limitations of the planes available and of the military importance

of the objectives thus popularly assigned.

2. Aims of Bombardment. Speaking for a military standpoint the principal aims of bombardment have been to destroy enemy works beyond reach of artillery fire, to disperse enemy air forces, and to undermine the morale of the enemy by such hostile demonstrations.

3. Actual Results of American Bombardment Aviation. Resulting from the bombing of principal enemy railroad centers, the traffic at those stations was so tied up, that trains had to be rerouted thru other channels, causing considerable inconvenience and delay. The morale of the railroad workers was considerably lowered, judging from testimony received after the Armistice. As a result of the bombing of enemy concentration several enemy counter-attacks were said to have been checked at the outset. During enemy retreats the bombers caused considerable confusion along the route. Aside from these considerations the material damage done by bombers during their raids was considerable and has not even been calculated.

The indirect results affecting the morale of the enemy and our own troops can scarcely be estimated, but helped considerably towards a successful conclusion of hostilities.

H. Relative Values of Different Objectives.

1. While it was necessary at all times to maintain a certain amount of secrecy concerning the operations of the bombardment squadrons, yet a more complete summary of intelligence concerning the damage done on the various raids could have helped out wonderfully. It was found out afterwards that some of the raids which were listed as unsuccessful were successful in wiping out a part of a machine gun training school for German officers.

2. Changing Objectives Enroute. In the case of a cloud completely obscuring the region of the objective, it was sometimes found necessary to bomb another objective or return home. The leading team then had to judge from their limited knowledge of the situation on the ground which course to follow. In the course of an army attack, it was impossible to tell within five miles of the position of the front line and unless specific objectives were given out, the leading team would pick some center sufficiently far from the actual front to be on the safe side.

I. Value of an Efficient Intelligence Section

1. Group Intelligence Office. Aside from furnishing the pilots and observers suitable maps of the sector and maintaining up-to-date wall maps the Group Intelligence Officer provides all available data obtainable concerning the enemy air forces and a full series of maps indicating the principal road and railroad

Intelligence office of the 1st Day Bombardment Group.

communications, aerodromes, anti-aircraft batteries, factories, ammunition dumps, supply depots, narrow gauge railroads, forts, reserve trenches, and photos of the principal landmarks of the sector. All available pamphlets and magazines relating to aviation and secured. Drawings, sketches, and graphs of enemy planes, group operations, etc., are drawn up. Everything of this nature stimulated and encourages the fliers to better work, especially when information of their own operations is brought to light. Anything in the nature of a competition keeps up the interest of aviators, who might otherwise become weary and indifferent in the work.

2. Special lectures and demonstrations for new pilots and observers were held in favor by the Bombardment Groups. These were not so much along the theoretical as along practical lines of aviation in active service. New types of formations were discussed and tried out. Different observers were tested from time to time in regard to their bomb-dropping accuracy, sense of direction, and knowledge of the enemy sector. Numerous discussions were held between the observers and the ordnance officers and a number of the theories of the former were put in practice, evolving such innovations as ring sights and straight sights on the Twin Lewis guns, mud guards on the landing wheels (permitting planes to take off on a muddy day without having the propellers broken by mud), special locking device for Twin Lewis guns, different arrangement of instruments, Very cartridges, and maps in the plane.

3. Spirit of Competition. The various pilots and observers were checked up when flying in new positions and changed around until the formation was able to perform most efficiently. The Intelligence Officer would suggest certain observers to fly where they could devote a large proportion of their time to ground observation, and those better adapted to aerial gunnery would practice upon the enemy planes from time to time. The leading teams were chosen in accordance with their value to the squadron and not according to the ranks they held.

4. Increasing Value of Group to the Army. The Intelligence Officer by increasing the number and value of observations made by his group would enhance the value of that group to the Army; instead of accomplishing merely a series of bombing missions, the group would act also as an observation unit, its ability in this line being limited only by the experience of the observers, the area covered by the bombing unit, and the freedom of the bombing unit from enemy attack.

5. Information desired by a bombing group. All information concerning its immediate objectives, enemy aircraft located in the opposite sector, anti-aircraft locations, weather reports, changes in disposition of enemy forces at the front is necessary to a bombing group. Desirable information includes; damage done by raids, changes in enemy transportation, new works, localities of maximum activity.

—25—

Maj. George E. A. Reinburg
C.O., 2d Day Bombardment Group

1. . . . I am submitting herewith such tentative changes in the Air Service tables of organization (approved by G.H.Q., A.E.F., Sept. 8, 1918), as I believe to be desirable for the efficient functioning of a Day Bombardment Group.

. . . . . .

3. It is believed that the commanding officer of a Day Bombardment Group should be a full Colonel and that a Day Bombardment Group should correspond in that respect to a regimental command, as a tactical unit. It is not likely that a Day Bombardment Wing will ever be utilized within an army and that the day bombardment group will be the unit employed. The tables of organization provide for 156 officers and 749 enlisted strength (exclusive of Air Park personnel), in a day

bombardment group command. This together with the large property responsibility calls for a commanding officer, an active flyer, of the rank of Colonel.

. . . . . .

6. With reference to officer personnel, I am of the opinion that the development of bombardment aviation in the army will render advisable the discontinuance of commissioning as officers, all pilots and observers. The British and French Air Services have adopted the plan of using non-commissioned officers, but I believe the most practical system for day bombardment in the United States Air Service, would be to commission as officers, flight leaders and leading observers and to create the grade of Pilot 1st Class, Pilot, Observer 1st Class, and Observer, with commensurate pay for the several grades. The presence of so many commissioned officers in a squadron, whose military training has been subordinated to flying training, is complicating and tends toward relaxation of military discipline. As this is a matter affecting policy I am not incorporating this in the table of proposed changes.

. . . . . .

8. An increase should be made in the number of non-specialists allowed for a squadron. Experience has shown that specialists can not at times be used for ordinary fatigue and for duties of a nature calling for unskilled labor. I have therefore increased the number of Privates in the squadron. . . .

. . . . . .

—26—

Capt. Charles L. Heater
C.O. 11th Aero Squadron

Heater, who had been placed on detached service with the British, had served with No. 55 Squadron, a D.H.4 unit of the Independent Force, Royal Air Force, from 1 July to 20 September 1918.[a] With a recommendation from General Trenchard, commander of the Independent Force, Heater had been transferred to the 11th Squadron following the loss of the squadron's commander, 1st Lt. Thornton D. Hooper, on a bombing mission on 18 September 1918.

Command. Squadron commanders should direct operations of own squadron, based on orders from group. They should be

intimately in touch with all officers of the squadron and should have sufficient rank to carry weight. Should be experienced and be able to explain experience to those in their command, but also should go on raids occasionally with squadron, for morale, experience and supervision.

Squadron Commanders should have more authority to direct conduct of officers at all times.

Flight Commanders should hold rank of Captain and should lead raids. They should be directly in touch with officers and men of their flight, should make recommendations regarding matters of promotion, discipline, etc., in their flight and should take care that all pilots and observers are properly instructed in the duties, customs or tactics peculiar to that squadron.

Equipment. Changes in operating equipment have been suggested; a more satisfactory bombing plane than the D-H 4 should be developed, but during such period as this development is taking place, it is essential that the machine in use should be used to the best possible advantage. This has not been possible in the operations undertaken in the past.

The machines arriving from aircraft depots were equipped with only a few of the necessary instruments; motors and their accessories were not finely adiusted, armament equipment was not complete, nor in best possible condition; and rigging was poorly adjusted. In some cases machines were delivered as being serviceable, when they were totally unfit, there having been, apparently, no thorough inspection of them at the advance depot. In order to do away with a part of this, squadrons should be permitted to make more repairs upon machines instead of salvaging, since repairs require little more time than overhauling new machines from depots.

Crew services a DH-4 engine from an oil supply wagon at the 1st Air Depot.

The transportation question suggested in revised Table of Organization No 27 would care for the needs of a squadron, but this quota has never neared fulfillment. This lack hampered operation to a great extent.

Organization. The organization has been well planned, except that not enough general utility men are provided and the Armament Department is not large enough for emergency operation. The Armament should be at least 30 N.C.O.'s and men.

Pilots and observers of the 24th Aero Squadron: (l. to r.) Lts. Lawrence M. Selleck, Roy O. Kennedy, Raymond P. Dillon, Sidney V. W. Peters, Walter O. Lokey, Norman W. Hall, Waldo E. Tuttle, Hendrick M. Search, Capt. Harry T. Wood, and (sitting) Lt. Sidney B. Wertimer.

—27—

Capt. Harry T. Wood
C.O., First Army Observation Group

Wood, an observer, had served at the front with the 24th Aero Squadron and later would command the squadron in the Army of Occupation.

I strongly recommend that Aero Squadrons be made units of great mobility and independence. I mean, a complete unit in itself in every particular.

To elaborate, Aero Squadrons during the present war were very immobile. When moving, they had to depend on Air Park Squadrons, which were seldom equipped to handle the movement, or to call for transportation from an Air Depot or Air Service Headquarters.

Air Park Squadrons should be abolished. In their place there should simply be salvage squadrons, and Air Depot Squadrons to handle replacements.

The Service Squadron should be made complete. The ideal squadron would be one with sufficient transportation to move bag and baggage at a moment's notice, and one which could draw its own supplies.

There should be sufficient transportation at least to move one flight. For instance, during the last ten days of the war this Group found itself suddenly one hundred kilometers behind the line. It would have been a matter of days before we could have moved the Group into the Zone of Advance and have been able to operate. The same trouble was complained of by the Commanding Officer of the First Pursuit Wing.

Some modification should be made in the present equipment. While hangars can be moved, it is a lengthy affair. The only solution is to design some sort of tentage which can be used in emergencies for hangars. Then if the Squadron should be there for a protracted period, the more unwieldly hangars used at present could be brought up and established.

Tentage should be supplied the enlisted personnel for those men who could not sleep in emergency hangars, and for headquarters, the officers' mess, and the enlisted men's mess. Tentage was supplied here for the E.&R., Ordnance, and Supply tents.

In place of the present method of handling supplies through the Air Park Squardon attached to the Group or through a Group Supply Office, Service Squadrons should draw all their supplies direct. In the Air Park system, it is seldom that these units have in their stock the articles urgently needed, at least in amount. In the Group Supply Officer system, it is a case of an officer who could be dispensed with. It would be much better and simpler for the Squadron Supply Officer to submit his requisition direct than the present roundabout system. At least there could be no cry of favoritism. In my own experience, I can quote such a case. My crew chief requisitioned for a Wasmer prop. The prop was obtained by the Group Supply Officer, but instead of it being placed on my ship it was turned over to another Squadron which always had the first call on new material.

A service Squadron with these modifications would be of much greater utility, and in fact the only Squadron which could be efficient in a war of movement.

—28—

Maj. Joseph T. McNarney
Corps Air Service Commander, VI Corps

A graduate of the U.S. Military Academy in 1915, McNarney had received his Junior Military Aviator badge at the Aviation School at San Diego in April 1917. The following month he had joined the 1st Aero Squadron at Columbus, New Mexico, and in August 1917 he had sailed with the squadron to France. He had flown at the front as a flight commander of the 1st Squadron before being assigned to the staff of IV Corps Observation Group in the Toul Sector at the beginning of July 1918. Afterwards (as he indicated in the report which follows) he had commanded first the I Corps Observation Group and then the Air Service of III Corps at Chateau-Thierry, IV Corps Observation Group in the Battle of St. Mihiel, and V Corps Observation Group in the Meuse-Argonne Campaign. He had taken command of the Air Service, VI Corps, Second Army on October 1918.

.....

1. I have been the Commanding Officer of the 1st, 3rd, 4th, 5th and 6th Corps Observation Groups and in each case during

their first large scale offensive action.

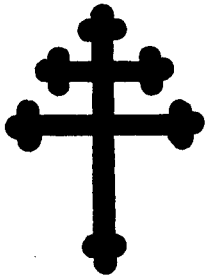
2. Liaison. Without constant and efficient liaison with the units for which the Observation is working, nothing worth while can be accomplished.

(a) Liaison with Corps and Division Staffs.

(1) Corps. Liaison with the Corps Staff is comparatively simple, and in nearly every case has been very good, except that there is a tendency to neglect the Corps Artillery Commander, the liaison with the artillery being all accomplished through subordinate commanders. In many cases, especially with new divisions, it has been very difficult to get fugitive target batteries assigned,and in many cases each battery commander will insist on his own method of adjustment. I believe that in every case if properly presented by the C.A.S.C. the Corps Artillery Commander will, if necessary, order the fugitive target batteries assigned, and a uniform method for adjustment put in force throughout the entire Corps. It is also very necessary that the C.A.S.C. be in such close touch with Corps and Division Staffs, and the general operations of the Divisions, Corps, and the Army, that when called upon to write an annex to Corps Field Orders, he can write one which will not only be in proper form, but which will provide for the proper use of the Air Service by all branches. If the Corps finds it necessary to send your annex back for revision two or three times a very bad impression is made with a resulting loss of confidence in the Air Service. This is a small but very important point.

(2) Division. It has been the general practice both of C.A.S.C.'s and Group Commanders to leave the liaison with the Divisions almost entirely to Squadron Officers. This is a great mistake. During active operations Staff Officers are usually overworked and quick tempered from lack of sleep and a 1st Lieutenant will often not even be received and seldom listened to, while a field officer, especially if he be a regular, will always be given an opportunity to make suggestions and explanations.

Again very few of our Division Staff Officers had any conception of the use of the Air Service and did not know what we could do for them or what was impossible. During the operations of the 1st Corps at Chateau Thierry neither the Air Service or the line knew just what they could do. We had never been in active operations, liaison was poor and until the last week of the operation no attempt at liaison with divisions other than an occasional visit of the Squadron Commanders was made. Consequently very little work of any value was accomplished, the Air Service executed a great number of missions, with very severe losses, but due to the lack of proper ground liaison, and communications the work had little value



other than educational.

In order to give the divisions the full benefit of the Air Service it will nearly always be found necessary to suggest how the Air Service should be used. In case Field Orders are prepared a sufficient length of time before the impending operations it is desirable that the C.A.S.C. or Group Commander after consultation with Division G-3 write the Air Service annex to the Division F.O. using your Corps Annex as a base, but going more into detail. This will be found to be a great help especially for the first time. For the St. Mihiel offensive I wrote the annexes for both the 42nd and the 89th Divisions. They were very grateful as they said they had no idea as to what the Air Service could do.

In connection with liaison with the division I wish to state, that I believe that squadrons should be assigned permanently to a single division. The personnel come to know each other and trust each other, how each one works. After a division has been pleased with the work of a squadron small difficulties and misunderstandings are easily cleared, staffs are always ready to listen, and the work steadily improves. This was very clearly demonstrated to me before and after the St. Mihiel offensive. Before the offensive the 1st Division had success with the C.42 French Squadron and was willing to cooperate with the 8th. The 42nd Division had had very poor work from a French Squadron, and said they were still open to conviction but didn't think the Air Service was any good. The 89th had had no experience except in Sector warfare and didn't know. Afterwards the 1st said when they moved they would request that the 8th go with them, the 42nd said they considered the 90th as a part of the family, and the 89th had the Division insignia placed on the planes of the 135th to show that they belonged to them. The change in the way the Division received the Air Service officers is significant. Before you waited for an audience, stood up while there, and never got an invitation to a meal. Afterwards you were immediately received, invited to sit down, pressed to stay for a meal, and always asked to drop in any time. Difficulties in liaison disappeared as if by magic, they were willing to try anything you suggested, but unfortunately the divisions moved and the Squadrons went to other divisions. In my opinion the Service would be benefited if squadrons, as far as possible, were kept with the same divisions even though it necessitated the squadron changing Corps often.

3. Education of Line Units. Except in a few of the older divisions, our line troops have no conception of the use of the Air Service

(a) Staffs. As I have stated it is very necessary to suggest to

Corps and Division Staffs how the Air Service can be used, and in many, in fact nearly every case I have found it necessary to order out over 50% of the missions without being asked to do so by the divisions, in order that the Air Service be used to its full capacity.

(b) Infantry. In many cases the infantry did not know how to place panels, and in many cases used them for dish rags and shoe cloths. Battalion P.C.'s very seldom communicated with the planes, and very few knew why they should show their panels except that it was orders.

In this connection I wish to say that it is a great mistake to ask for the panels promiscuously. A good observer will pick up advancing troops without calling for the line and advancing troops will not show the panels. If possible never ask for the line more than three times a day, once in the morning, the last thing in the evening and one time in reserve. If asked for every hour or six or seven times a day the infantry becomes indifferent, and often will pay no attention at any time. This is a very important point, and from my experience in every important offensive in which the American troops have participated am fully convinced that by not asking more than three times per day your infantry liaisons will be 100% more successful.

(c) Artillery. Radio and panel operators need a great deal of instruction for increasing speed, the length of time wasted has caused many failures in artillery adjustment.

(d) General. All branches of the line need instruction in maps and codes. In many cases units never heard of the key and band code, Lists 1 and 2 (Liaison for all Arms), etc.

(e) All the above faults can be overcome in a great measure

Radio operator at the switch.

by Liaison Schools at the Airdrome. . . constant participation in manouevers, and talking to Junior Officers.

4. Communications. Too much stress cannot be laid upon the necessity for keeping up communications from the airdrome to Corps and Division headquarters. In every case after an advance telephonic communications break down with the division and often with the Corps and the only thing left is courier and radio. Courier messages take often 24 hours for delivery, and then the wireless is the last resort.

The operators furnished the Air Service are not sufficiently trained and there are not enough of them. All messages are in code and excellent operators are required to take them correctly. In every group I have been it has been necessary to comb the squadrons for operators, the results have been very poor. In several cases I have had important messages come in and when decoded did not make sense, by the time they had been repeated the requests for work would often be from four to six hours too late.

In every case Division Commanders, Air Service Liaison Officers and Group Commanders have failed to make sufficient use of the Radio, and nearly always failed to take into account that an average of two hours is necessary to get a message through. Not enough use has been made of advanced landing grounds. When communication is bad the surest and quickest way is dropped messages. This will always work from Groups to Divisions, but necessitates an advanced field from Division to Group.

When communications are poor and the Group has been left behind the use of an advanced and a base field becomes imperative. This phase of the move has been almost entirely neglected by the American Air Service. A detailed account of how relations between Corps, Division, advanced, and rear field should be coordinated is too long to be gone into in this statement. It will suffice to say that the Group Commander, B.I.O. and photo section with a radio outfit should be pushed up to within 10-15 K.M. from the front, and three individual hangars erected. All except three ships and three teams remain at the base field during the night and come up only 30 minutes to an hour before scheduled missions. This is equally valuable in case of advance or retreat, and in case of a retreat is the only way to save much of your material.

The unequal distribution of codes, when changed, has caused the loss of an entire day's work in more than one case. Codes have been changed and the Air Service received the new codes 24 hours in advance of line units, consequently the units could not decipher messages or map references. This can be obviated

Interior of a wireless truck.

by having codes not go into effect till a certain time well in advance of the time the distribution is started.

5. Within the Group.

(a) In many cases not enough attention has been paid to keeping up the observers room. During an advance it is very difficult to get the information but if some one observer is charged with it for each squadron, and if the information brought in by each observer as well as that obtained from the Corps and Division is posted, the maps can be kept up to date. . . .

(b) It has been a mistake to have the B.I.O. a ground officer. The full information gathered by an observer can only be drawn from him by careful questioning, this has been the duty of the B.I.O. A flying observer has not a great deal of confidence in a ground officer, no matter how well he knows his duties and always has a secret disrespect for a ground officer who tries to question him. I have noticed this in many cases, especially during very active operations, and have often taken over the cross examination of the observer myself.

(c) Group Commanders. Group Commanders have been too prone to occupy themselves only with administration and technical questions. It is a prime essential of a good Group Commander that during active operations he spend his entire time from daylight till dark in the observers room, and that he occupy himself with tactical questions only. To question every observer and keep himself informed at all times of every bit of information that comes in. Only by this keeping in touch with events will he be able to get the full efficiency from his Group. He must decide whether or not conditions warrant sending out missions in very unfavorable weather, what information should be checked, [and what] additional missions ordered. He must take the initiative and not wait for requests from Corps and Division. After two or three days of hard work with losses he will find the morale of his fliers lowered, he should then fly himself on the daylight missions and he must compliment every observer and pilot who does good work. He must personally see that pilots and observers go to bed early and do not sit up all hours of the night gambling. Work will fall off 25% if pilots and observers do not get proper rest.

6. Dropped Messages. Enough attention is not paid to proper instruction of observers in writing clear and concise messages. Often very valuable information has been lost due to failure to write messages properly. A good illustration follows:

A Corps plane of command went out to locate if possible any bridges over the Vesle which had not been destroyed. The mission was accomplished and the following message dropped. "Three good bridges over the Vesle." The entire value of the

message was lost as he did not say where or what kind of bridges, foot bridges or larger. They could have been any place on the Corps front of 16 kilometers. Telephonic communication was down and it was four hours before the proper information reached the Corps.

7. Within the Squadron. Only by specialization of teams on certain kind of work can high efficiency be obtained. Squadrons in which as far as possible the same pilot and observer work together, and on one kind of work, such as Infantry, Artillery or photographic, are always more efficient than squadrons in which everything is run by roster. Observers should be capable of doing any kind of aerial work, but should specialize on one certain kind.

8. During the period covered while in command of the 6th Corps Observation Group due to poor weather conditions and a quiet sector, very little hard work was accomplished. No special lessons can be drawn except the necessity for constant liaison and the education of the Staffs, Infantry and Artillery in the use of the Air Service.

9. It has been impossible in a statement of this kind to go into detail on the faults or the means of correcting them. A detailed report with examples would necessitate a month or two of uninterrupted labor.

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Lt. Col. John. F. Curry
Chief of Staff, Second Army Air Service

Col. Curry.

Curry, a graduate of the U.S. Military Academy in 1908, had been attached to the Aviation Section in August 1915 and graduated from the Aviation School at San Diego in May 1916. After eight months with the 1st Aero Squadron he had been sent to Hawaii to organize the 6th Aero Squadron. Returning to the United States in mid-1917, he had held various training positions, including Chief of the Training Section in Washington and Commanding Officer of Ellington Field, Texas, before being sent to France in the summer of 1918.

Curry had been at Tours, in the Training Section of the Air Service, AEF, when selected to be Chief of Staff of the Air Service, Second Army. He had reported to Lahm on 23 October and had been shot down over the lines three days later. The DH-4, in which Curry had been flying as observer, was hit by fire from the

ground and forced down in No Man's Land. Both Curry and his pilot, 1st Lt. L. L. Smart of the 135th Aero Squadron, had managed to make their way safely to the Allied trenches. On another flight, on 3 November, Curry and his pilot, along with pilot and observer of another DH-4 of the 168th Squadron, had been credited with the destruction of a German balloon.

. . . submit herewith the following suggestions, all pertaining entirely to my experience in the Second Army. . . .

Organizational. . . .

The Corps Air Service Commander and the Commander of the Observation Group attached to the Corps should be one and same person. The Corps Air Service Commander, in order to efficiently do his work must be in close relation with the working of his Group, which he can only be by being in direct command of that Group.

Wing Commander Army Observation Group should be abolished. He exercises no useful function and is only an extra link to slow up work. This is the opinion of all Observation Group Commanding Officers with whom I have talked.

There is a constant tendency for the work done by the Operations and Information Sections to overlap where there was no clearly defined line. Close liaison is needed between these sections but the work should be clearly differentiated. Operations confining itself to strictly operations work, statistical, tactical, planning, training, etc., while the information should closely follow the lines of G-2. All information covered by the Air Service and its photo missions, etc., the sending of these missions and reporting of same should come directly under the Air Service Information Section and not under G-2 as at present.

Reports. Strong tendency to place too much value on certain reports which are necessarily routine. The Operations report would on an active day require the services of too many members of, and would occupy too much time of the Operations Section, it being featured to the exclusion of everything else while in reality it is a routine report and should never be allowed to interfere with constructive planning. The time of rendering the Operations report should be from noon as in the rest of the services and not from daylight to dusk as in the Air Service. Due to the time of the reports not coinciding there was always a possibility of error in reading the operations report of the Army and the Operations report of the Air Service.

Liaison. The necessity of close liaison between the Air Service and ground troops and between different Air Service Units was extremely evident. The needs of liaison were met in the Second

Army by the establishment of Corps Liaison Schools where details from the different divisions of the Army were given a short course of instruction in Aviation, its possibilities, limitations, infantry liaison work, etc., while Observers and Pilots from the different Observation Squadrons were sent to the different Brigades and Regiments for short periods of time, there to learn what the ground troops had to do.

—30—

Capt. Stephen H. Noyes
C.O., Corps Observation Group, First Army[a]

Noyes had commanded the 12th Aero Squadron at the front from 1 June until 24 October 1918, when he left to take command of V Corps Observation Group.

This report expresses the opinion of the undersigned on the most important points of criticism regarding Corps Observation, Air Service, under conditions that existed during the latter part of the present war—i.e., troops in open warfare practically untrained in the use of Air Service and artillery little accustomed to adjustment by airplane.

Army Corps, C.A.S.

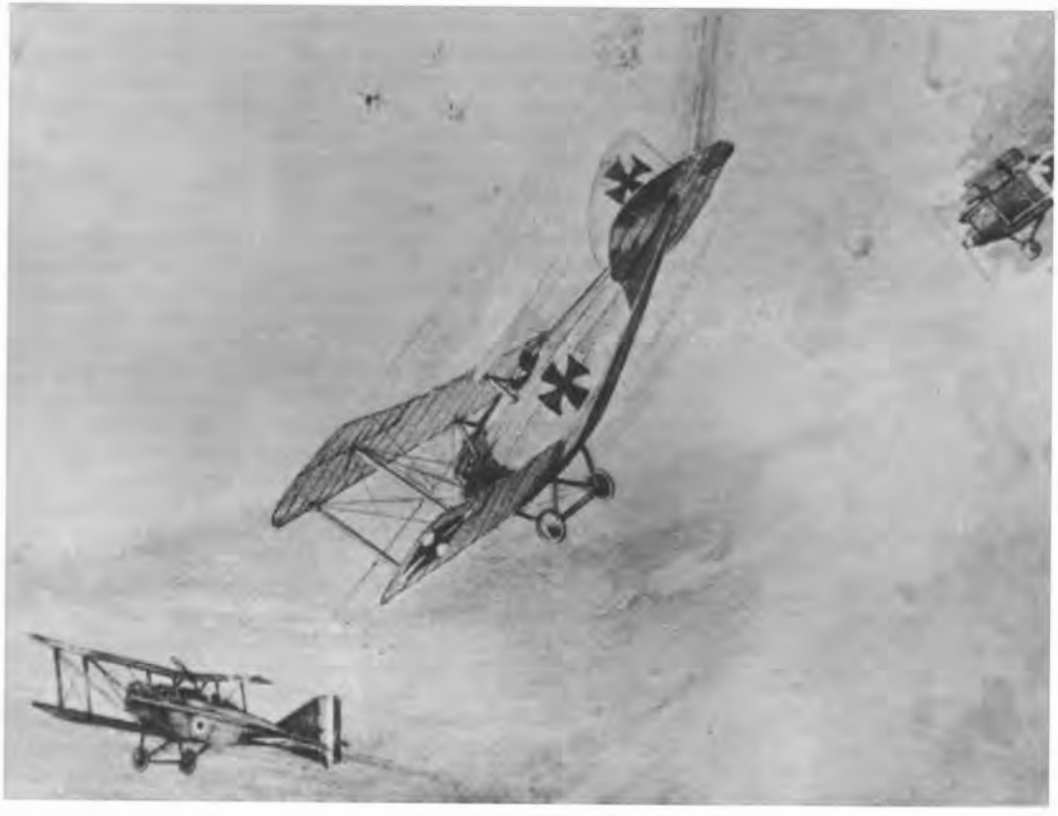
The Chief of the Air Service of an Army Corps should be an officer who knows the difficulties of certain types of missions; he should be throughly in sympathy with the work of pilots and observers by personal experience as such; he should have a prestige that commands the respect of those that do the work he assigns, otherwise the work will be done half-heartedly or not at all, as the opportunity to find trouble with the weather or motor are far too easily found; the pilot and observer ordered out should know that the order came from one who realized the possibilities of being outnumbered by the enemy, the risk of storms, the chances of motor failure, but who knew that the risk was justified by the possibility of a successful mission. If the C.A.S. is the proper kind, the average pilot and observer will not only do what they are told but endeavor to do *more*.

With one or possibly two exceptions, the undersigned knows of no C.A.S. of a Corps who ever seriously flew over the lines. Officers were promoted to these positions at first, when our Air Service first started functioning, for their knowledge and previous

training in military organizations (which of course was entirely proper), but were kept there later on when other officers with the actual experience in aerial warfare became available. The truth in this connection is that there have been many officers of the rank higher than any attainable by the original reserve officers for whose opinion pilots and observers who did actual flying soon learned to have no respect. The result was that the squadron C.O.'s were continually searching for excuses in the weather for the failure to carry out the daily program that would have quickly washed out their squadrons without a commensurate result. The continued failure of the Air Service to do the impossible resulted in dissatisfaction of divisions with their squadrons. Examples of orders emanating from the office of the C.A.S., Army Corps:

1. "Reconnaissance planes continually over the lines the hours of daylight" (16 hours) or say 20 sorties for 10 protected missions of two planes each—this is about double the number of Salmson airplanes that can be sent out day after day out of a squadron that will average 15 planes available.

2. "Infantry contact missions, dawn, noon, and evening." An infantry contact mission is the most difficult and dangerous flight made. The type of pilot and observer that can successfully find the frontlines when the infantry is poorly trained is so uncommon that a squadron would be fortunate to have one quarter of its personnel available for this kind of duty; it takes a long time to train a new man; therefore, the squadron should be called on for this kind of work at the time only when it is imperative to know where the advanced elements are and only when every other means of liaison with those lines, has failed. To call for such missions by schedule from the day before is to be ignorant of this fundamental principle and is a *useless* sacrifice of officers; when called for, even when the troops are not advancing, as it has been is simply to invite the squadron C.O. refusal under any pretext he happens to be able to think [of] at the time. This matter of excuses for failure to send out missions has, in some cases, made the Air Service appear ridiculous; bad weather and heavy fields are two which are most used [by] C.O.'s who lack imagination; the former should be used with care as the Boche may be flying, the latter is, therefore, better although in truth the slight additional danger (except to the propeller) in taking off on a muddy field is negligible. The superior officer who gives direct orders to a squadron should be one who knows the difficulties of a mission, who is familiar with the internal condition of the squadron, who will give the order only when the chance for fulfillment is at least fair and justified by conditions, and then who will listen to *no*



excuses. However, as recommended further below, the C.A.S., Army Corps, is not thought to be ever the proper source or channel for, direct orders to Divisional or Corps Artillery squadrons, and that orders should not emanate here except in the special case of command planes. The function of the Corps C.A.S. should be advisory to the Corps C.G., and not administrative. For example: One of the reasons why the spirit of an Aero Squadron was so high during the Chateau Thierry drive was that orders for missions came to the squadron C.O. direct from the Division; their needs were known, and the pilots and observers made the corresponding efforts; the same squadron during the Argonne Meuse offensive was low in morale because all orders came from or through the C.A.S. Corps. By the time the Division had called for a plane through the liaison at Division

Headquarters, and he had telephoned (by instructions) to the C.A.S. Corps, and the clerk or adjutant had relayed the message to the Group, who in turn passed the order to the squadron, the meaning of the original message was usually garbled beyond understanding. Officers consequently never know whether their mission was important or even necessary.

The Group

In grouping squadrons, the individuality of the squadrons should be emphasized and not the Group. There are occasions when it is important that squadrons cooperate, but it is not one of the essentials. Were it not that a Group operation officer, responsible for the dissemination of knowledge of the units adjacent to the one a squadron directly works with, is a help (not an essential), the ideal condition for a Divisional squadron is to be alone; here the esprit of a squadron is best fostered, its initiative developed, and interest in its work advanced; if, in addition a direct liaison with the C. of S. of the Division (properly advised by the squadron liaison officer) is furnished, the Divisional squadron stands under the best advantage for its usefulness and development.

When squadrons are grouped, it is of course necessary to have a Group Headquarters, to take care of camp work, common to all units on the post; it can be of service in the matter of supplies, transportation, and can promote cooperation of squadrons in their work when the occasion arises, but the Group C.O. should suppress his authority as much as possible, issuing as few orders as possible instead of as many as possible. Orders to properly working squadrons for missions over the lines should never emanate from a Group Headquarters, neither should these Headquarters be a channel through which orders come.

Source of Orders

The officer to give orders to a Divisional squadron is the Divisional C. of S. or his assistant. A means of *direct* communication with the squadron C.O. is the great essential, so that a clear understanding of the importance of the mission can be gained and so no time will be lost in transmission; the C. of S. should be told what the internal condition of the squadron is at the time (reports are valueless) so that he may realize that if he calls for a mission at one time, he may have to do without an airplane later. The C. of S. may lay the situation before the squadron C.O. and, the latter being an expert in such matters, may advise the C. of S. what he can do for him; if he knows the needs of the troops for an airplane he will know whether or

not to send a good observer or if a new untrained man will be sufficient. With a direct means of liaison information is always at hand concerning weather conditions near the front (through liaison officer at Division Headquarters), the latest reports concerning enemy aerial activity, but above all there will be available to a pilot and observer which are going on an infantry contact mission the latest information and the judgment of the C. of S. as to where the frontline troops can be expected (without this, no infantry contact mission should leave the ground—this kind of work will comprise 90 percent of the usefulness of a Divisional squadron in open warfare, it is [in] this work that the bulk of the casualties occur and therefore it is here that the greatest precautions against extra risk should be taken).

Means of Communication

Ground radio had proved a complete failure as far as a means of communication to Divisional squadrons is concerned; even if it worked quickly and perfectly, it would not be satisfactory as it does not afford an opportunity for complete understanding, to the squadron C.O. of the needs to the C. of S. of what he could rely on getting.

Telegraph and couriers as means of communication have proved also a failure, and, for the same reason, would never be satisfactory.

Telephones. If Aviation is to be used by Division in any way efficiently, a direct telephone wire from Headquarters to the Airdrome must be provided. If this is provided, the writer believes the usefulness of an aero squadron would be doubled with the same number of missions sent out. Every mission would leave the field with a clear conception as to what was wanted

and what to look for especially; on its return, the C. of S. could talk directly with the observer, clarifying his dropped message, and questioning him on points not therein mentioned; pilots and observers would thereby appreciate more fully the value of their work, with the obvious results. For example, a squadron C.O. made it a practice whenever possible to send the observer immediately on his return from a mission up to Divisional Headquarters; it was found that G. 2 or G. 3 always asked questions, but the most important result was that the observer learned to see the value of his work and *what was important to report* and what irrelevant (the observer gets no training in this important branch of observation at schools).

The Squadron

To command a squadron so that it functions with average efficiency is a simple matter for an officer accustomed to command men. To run a squadron efficiently, however, during open warfare, demands, primarily a C.O. who takes an active part in flying; in this way only can the C.O. expect the pilots and observers to do their missions to the best of their ability, and in this way only will he himself be able to talk intelligently of what is going on at the front to higher commanders. He can leave the details of operation to his operations officer, but the C.O. with his broader knowledge of the conditions of the squadron will have to modify operations to the squadron resources. If the C.O. does not (as he commonly cannot) take his turn in routine flying, he should hold himself prepared to fly a mission when a specially difficult one is called for. A C.O. who has earned the suspicion of dodging danger behind his rank should be summarily relieved from his duties. No amount of military discipline among the enlisted personnel which calls simply for an obedience to orders will be sufficient in a squadron if results are to be obtained. To develop a squadron whose mechanics will work night after night on motors so that they will be ready in the morning for a flight, and to do this to the absolute limit of their knowledge and ability can only be accomplished by fostering their pride in their organizations. Close order infantry drill does not go far enough in this direction. The emphasizing always of the squadron as the unit (as opposed to the Group, for example) the provision of letter paper with a good squadron insignia, a squadron baseball and football team, squadron guidon, and a special squadron chevron are among some of the things that would help in this direction. Experience shows that the factor that most commonly limits the resources of a squadron as far as sending missions over the lines goes, is the number of planes that will run without motor failure; conscientious mechanics who can keep up their planes are the

direct issue in this respect.

A C.O. who takes an intense interest in the work his squadron is doing and can impart some of his enthusiasm to his pilots and observers, raises the value of every mission in direct proportion. A not unusual attitude in squadron C.O.'s has been to hold on to pilots and observers whose ability and experience justifies their appointments to command other newly formed units. This prevents a normal, healthy promotion in responsibility of all officers and soon reacts on the esprit of the squadron (to say nothing of the harm to the Service as a whole). Recognition and reward should follow meritorious service—above all in the case of squadrons in open warfare, where the officers and enlisted personnel must be kept at top pitch. In this connection, the undersigned, is of the opinion that decorations such as the D.S.C., are an incentive to greater effort on the part of pilots and observers, and that if properly awarded are for the good of the service; but that the way they have been given out has done more harm than good. Too long a time has always elapsed between the action and the reward, and the recommendations for decoration have not been kept sufficiently secret; too much has depended on how the recommendation had been written.

Another common mistake that squadron C.O.'s make is the ordering out of *as many* planes as possible each day, in order to make a good showing on their reports. It should be their attitude to send out *as few* planes as possible, compatible with achievements of the result; nothing but a reasonable chance of success in their mission justifies flying during open warfare. The C.O. will find that with a month of open warfare expected ahead and the usual call on its services as made by an American Division he should start with about the following: six experienced teams (pilot and observer) who can conduct an infantry contact mission, two good photographic teams, four good teams experienced especially in artillery adjustment. The rest can be inexperienced teams, in training for one of the specialties, but still useful only for protection. With the supply of replacements as it was during the latter part of the present war, a squadron could keep up its work day after day for a month or 5 weeks. At the end of that time, the mechanics would creep into their work with a consequent loss of confidence of pilots in their motors; moreover the older observers and pilots would be nervously exhausted—such men are easy marks for the Boche—and the work of the squadron as a whole rapidly deteriorates.

Liaison Officers

Ignorance of the use of airplane has marked the attitude of the line troops toward the Air Service. To counteract this an

interchange of officers from the infantry and artillery units to the airdrome and permanent liaison officers at Division and Brigade Headquarters as well as pilots and observers (who need a day or so rest) on visits to the front is necessary. This would not only create a sympathy between the two branches of the service . . . [but] is as much value to the squadron officers as [to] the line officer.

The Future of Observation

Of all branches of Aviation, the field for development and usefulness is widest in observation work. Two new types of mission should be added to the duties of a Divisional squadron.

1. Early Morning Reconnaissance. A plane should leave the airdrome before dawn in time so that it would reach the lines at the critical moment when guns flashes from enemy emplacements are still easily spotted and there is just sufficient light to distinguish roads and the outline of woods so that the gun position can be marked on the map. Furnishing many targets coordinates for friendly artillery is better time spent than attempting, later in the day, a few of the usual accurate [?] adjustments. Shooting volumes of shells with fair accuracy where the volume will be shot anyway in open warfare, is better than shooting at two or three targets, well, and all the rest of our artillery shooting blind. Evening reconnaissance are for a like reason important but the morning one always furnishes more useful data. For this work special planes with special night landing lights and airdromes fitted in anticipation of such flights, must be provided, otherwise the wastage in planes and personnel does not warrant the practice.

2. Planes Which Will Work in Conjunction With Frontline Troops on the Advance. With modern open warfare, means of liaison from Division or Corps Headquarters to frontline infantry is so when troops are advancing that, after the general order of battle is given, success depends entirely on the smaller units; helping the smaller units by detailed information of the enemy in front of it is therefore of greater importance than simply keeping Corps or Division Headquarters informed as to the position of its advanced elements. A low flying plane communicating information as to enemy strong points, machinegun nests, consolidation for counterattack, occupied trenches, and villages, etc., directly to an advancing battalion p.c. is the object of this type of mission. The mission is one of great danger and therefore everything should be done to minimize the risk—such as the use of armored planes. Troops watched by such a plane, gain confidence and a great impetus is given to the attack. It is possible that troops might even be directed from the air, instead of simply supplying intelligence concerning the enemy.

Organizations of the Air Service as affecting the supply of pilots and observers has been one of the handicaps under which observation has worked. The lack of recognition of the ability of some (particularly observers) has been a gross injustice. Example: The two best observation squadrons that have been in the First Army have for operations officers, 2nd lieutenants who have proved by their efficiency the propriety of their appointments as such in spite of this handicap.

No matter how simple it was to get rid of unsuitable pilots and observers, according to higher command, it has been found that their relief from duty with a squadron was a matter of the greatest difficulty—this has resulted in officers, who could not be used over the lines, being recommended for positions in schools, when names were called for by higher commanders.

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Capt. Stephen H. Noyes
C.O., Corps Observation Group, First Army

Herewith a collection of notes and extracts from squadron orders bearing on the subject of biplace fighting, gotten together by the undersigned as a result of his experience and that of others on the front during a period of 8 months activity.

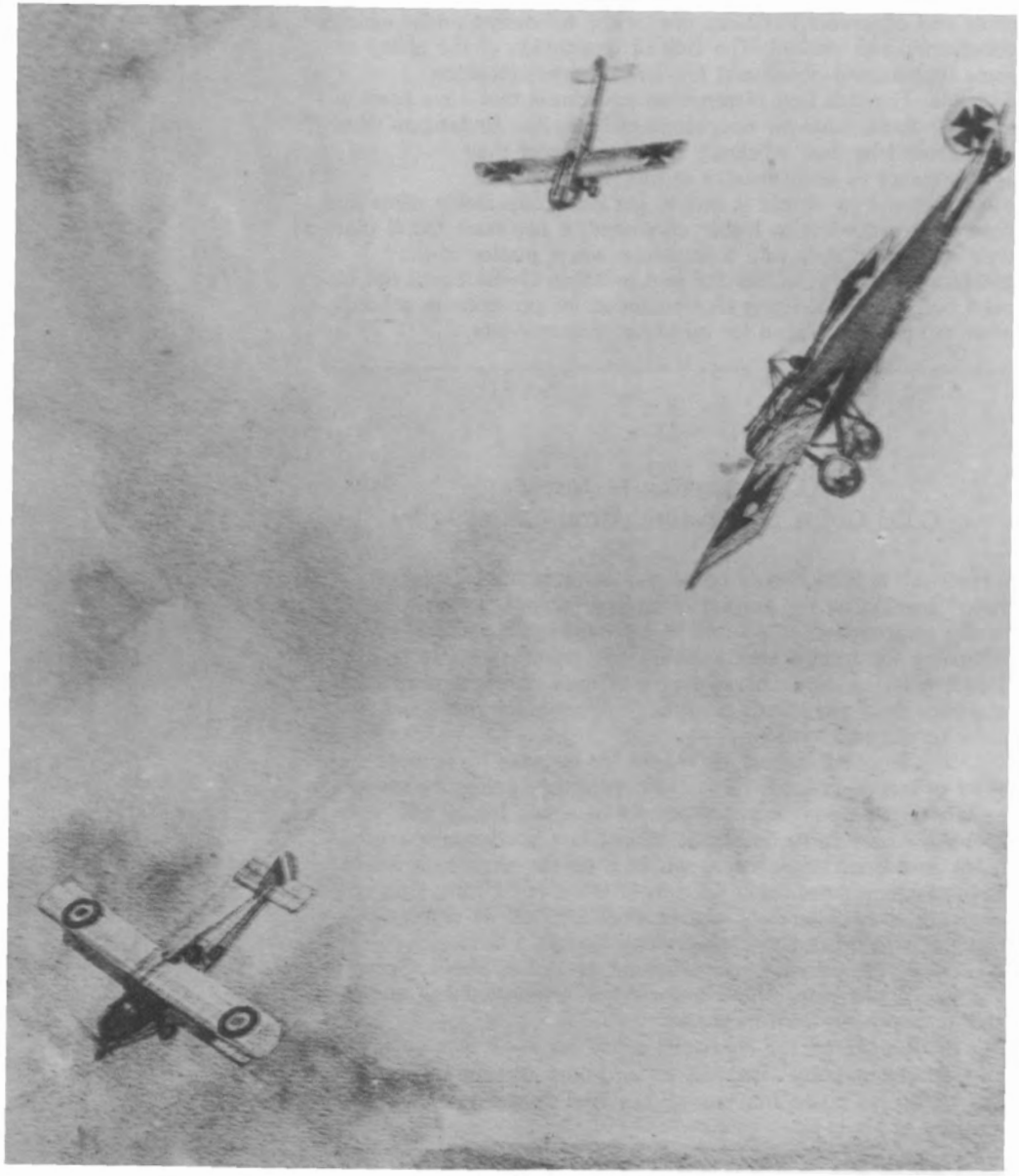
1. It must be remembered that a bi-place observation machine is always on a mission to bring back information and never to provoke a fight.

2. The Boche is (either by nature, or because he is under strict orders) a coward; he will seldom attack unless he thinks he will surprise you. A patrol say six or seven Boche will probably never carry on attack against one good double-seater (such as a Spad or Salmson) which is on the alert, to a finish. Each machine more likely will simply fire a burst from long range and turn away. Therefore, the cardinal principle of bi-place defense *is to be constantly watching the air.*

(a) Watch *beneath* your machine as well as above. Some of the new Boche planes have unexpected climbing ability; and are able to approach from below.

(b) Remain on the alert until safely home—it was by waiting until an enemy plane was near its airdrome and the observer entirely off his guard that one of our best chasse pilots got the majority of his bi-place victims.

3. If approached by a Boche patrol, try out your guns immediately. This shows him that you are alert and perhaps he



will turn away far out of range to await a more favorable opportunity, giving you added chance to fulfill your mission. If he comes close in, fire bursts of two or three shots when he is still at long range, increasing the number of shots in a burst as the target approaches, always shoot on whatever plane in the patrol is shooting at you at the time being and let nearer and better chances to down a plane go by; shooting at the Boche usually makes him stop shooting at you.

4. Save ammunition; in the excitement of a fight you will fire *two or three times* as often as you estimate.

5. A very common trick of the Boche is to distract your attention with a small patrol which he hopes you will keep constantly watching, and have, by prearrangement, another single plane (or patrol) attack you from the direction of the Sun. Therefore, if you see Boche *look for another Boche.*

6. The pilot and observer should be in perfect accord, and this cannot be the case unless they practically always fly together. From the point of view of aerial combat, the necessity of teamwork, is most imperative; simple signals to suit their fancy should be prearranged (such as tap on the pilots head to mean "Boche").

7. When attacked by a single Boche (or patrol) seek the safety of your own lines at low altitude; you are perfectly (?) safe at 500 meters near a balloon defense battery.

(a) If suddenly attacked over the lines the pilot must immediately start down in an irregular spiral say banking about 25, and descending say 15. This will continue making yourself a shifting, difficult, target and still be a stable platform for the observer to shoot from while still making it hard for the Boche to keep under your tail where the observer cannot shoot him.

(b) If suddenly attacked beyond your lines bank immediately then maneuver down towards your own lines keeping the Boche always where the observer can shoot.

(c) If the pilot can maneuver to keep the Boche (this applies to single seater or patrols attacking) so that the observer need never shoot except in the two rear quadrants of fire and have his guns point a little up it will be found that the observer can shoot better and the pilot follow the position of attacking planes better. In order to preserve the principle of making yourself a difficult target, the pilot can swerve from one bank to the other placing the attacking planes first in one quadrant and then in the other, making this turn when the observer is not shooting for the time being; this shifting of turns is a delicate proposition however, as while it is taking place the tail for a moment will blind the target, and what's more the observer must change the position of his guns or the turelle.

(d) *Never pique* straight down in a straight line, obviously this is just what a Boche fighter would like.

(e) If you see a steady line of tracers coming near you, remember that the quickest way to change your relative position is a jerk on the stick—not too strong or you will disconcert the observer.

8. Never fly just underneath the clouds, you will have no warning of an attack; it is, of course, a very common trick for a fighting machine to lie in wait behind a cloud for an unsuspecting two-seater whose attention is riveted on his mission.

9. Never dive on another machine even though you know he is friendly, and for the same reason, never let another machine (even with allied cocards) get very near you, unless positive he is friendly—warn him away with a few close bursts—he may be Boche.

10. A pilot should be always picking out very obvious landmarks because it is very common for a fight to be carried down too close to the ground, and when it is over, for the pilot to have completely lost his sense of general direction.

11. It is very common for the French AA batteries to warn a

A Lewis gun mounted on a DH-4.

friendly plane of the approach of a Boche by shooting two bursts of shrapnel, which gives white clouds of smoke, in front of you.

12. In ordinary flight the observer's guns will be carried on right side of fuselage pointing back and up. This should be constant practice in a squadron.

13. Turelle elastics should be loosened at all times, when plane is not in flight.

14. Lewis machine gun ammunition drums of 97 cartridges are found to be the most practical.

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Capt. John Gilbert Winant
C.O., 8th Aero Squadron

Winant, who had been a member of the New Hampshire House of Representatives before the war and who later would be governor of his state and U.S. ambassador to Great Britain, had enlisted in the U.S. Army in Paris in 1917. Later he had been commissioned and had flown at the front with the 1st Aero Squadron before being transferred to the 8th Squadron in July 1918. Winant had commanded the 8th, which flew DH-4 Liberty airplanes, during the Battle of St. Mihiel and in the Meuse-Argonne Campaign.

1. . . . the few practical suggestions that are here submitted might lessen some of the present difficulties and dangers encountered in D-H 4 Observation Squadrons serving on the front.[a]

2. The first D-H 4 aeroplanes sent to the front were provided with one oil tank. This supply of oil was not sufficient. The shortage was done away with by the use of a second tank of equal size. All new machines coming to the front are so equipped. It would be a simple matter to make this change, if the oil tanks and brackets were supplied. These have not been furnished this Squadron.

3. Because of enemy planes, it is necessary to fly "close formation" on photographic missions. The upper plane in the American D-H 4 blinds the Pilot and prevents such formations. By removing the Norris[b] tank an opening can be made over the Pilot's head which would give good visibility. If this is done it is necessary to substitute for the Norris tank the British streamlined gravity tank, placed under the right or left upper wing,

depending on the talk [?] of motor. These tanks should be furnished.

4. At present it is impossible to obtain the necessary number of different sized carburetor jets to make a fine adjustment of gas flow. This stops the use of the compensator and reduces the maximum flying time at high altitudes, one hour or more. Request that Squadrons at the front be supplied with these jets.

5. The only two planes of this Squadron shot thru the main tank, both fell in flames. A large tank *under pressure* is dangerous. Lieut _____of Colombey-les-Belles gave me a British Selsdon to use for experimental purposes. This pump has been successfully installed in the main tank of one of our planes. It displaces the old pressure system by a suction system (however we have retained intact the pressure system so that it can be used as an emergency reserve, the shift from the one system to the other is accomplished by simply turning a petcock.) If Selsdon pumps could be provided for all D-H 4 planes on the front, I believe the number of these planes brought down in flames would be cut in two.

6. The most serious defect of the D-H 4 as an Observation aeroplane is the distance between the Pilot and the Observer. This difficulty has in part been done away with by the Interphone. The supply of these phones has been limited—many planes have not got them. Successful cooperation between a Pilot and an Observer in a D-H 4 without one is almost impossible.

7. The pressure from the wind stream is very great in this type of aeroplane. An improved windshield would enable the Observer to do better work.

The British rudder with the 2 extra arms is an improvement on the one used by us.

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1st Lt. Robert C. Paradise
C.O., 12th Aero Squadron

Paradise had joined the 12th Squadron on 25 June 1918 and had succeeded Stephen Noyes as squadron commander on 25 October.

Suggestions and recommendations from Squadron Commander:

1. That Squadron Commander be grade of major. A commander of an Observation Squadron has 42 officers under him and often these officers are his senior in rank. To command

the respect necessary, the Commander of an organization should be senior officer. It is recommended that provisions be carried out that Chief Observer be a captain and that the three Flight Commanders be captains.

2. Recommend that airplanes be furnished to keep organization up to full strength. It is impossible for a fighting unit to be efficient if it is below strength in men and airplanes. Under the order of six airplanes a month per squadron, the 12th Aero Squadron found it impossible to keep up to full strength; much of the time of the Engineering Officer was taken up in fighting to get ships.

3. Better cooperation between Chasse and Observation Squadrons.

4. Better liaison between Infantry and Aviation. The 12th Aero Squadron found its efficiency greatly cut down because of the failure of the Infantry to cooperate with us. There was an apparent lack of knowledge of what aviation could do and could not do by Infantry Officers.

Insignia of the 12th Aero Squadron.

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2d Lt. Eugene E. Stuck
Operations Officer, 12th Aero Squadron

(1) The Squadron Commander should be of the rank stipulated by the table of organization. It has often occurred where an officer commanding a squadron composed of 40 officers has the rank of first lieutenant, . . . [he has] in his squadron officers of higher rank. A Squadron Commander is necessarily coming in contact in line of duty and operations with officers of much higher rank, consequently he cannot command the same respect. The Operations Officer should also be of the grade stipulated by the table of organization. He is constantly associated with officers of superior rank in line of duty and operation of the squadron.

(2) The training of observers by a corps of instructors who have seen service on the front under conditions that every observer will see. Improperly and insufficiently trained observers coming to a squadron takes up much valuable time of the personnel in training these men before they can be of much value to a squadron and can accomplish a successful mission. The facilities in a squadron is not sufficient to further the training of observers.

(3) There has been in the past lack of cooperation between observation squadron and the infantry and artillery units. This can be bettered by having training squadrons attached to Divisions in their training area. Lack of knowledge of the infantry

in working with airplanes has been the cause of many unsuccessful missions. Suggest that an aerial observer of some experience be attached or assigned to the Division staff as a permanent member of the staff, his duty to take charge of all operations and liaison between a Division and the Air Service.

(4) Recommend that all pilots before being assigned to an observation squadron be given a course in observation, thereby eliminating much time in doing a mission over the front. In this way, a pilot will know how to fly so that the observer can accomplish his mission in less time and with better results.

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Capt. Clearton H. Reynolds
C.O., 104th Aero Squadron

Reynolds had been the first pilot assigned to the 91st Aero Squadron after the squadron's arrival in France late in 1917. He had served temporarily in January and February 1918 as commander of the 91st and later as its adjutant. When the 91st had begun operations at the front in June with Salmson 2 aircraft, Reynolds had become leader of the squadron's first flight. Reassigned on 26 July, Reynolds had commanded the 104th in the Battle of St. Mihiel and the Meuse-Argonne Campaign.

1. It is my belief from experience, that Infantry Contact work as performed by an Observation Squadron has not been as efficient and successful as the needs of the service demands. The chief difficulty seems to have been in getting line troops to properly designate their front line when called upon. This may have been due to faults in the present system, or to lack of proper training and co-ordination between the line and aviation units. I would personally like to see the following experiment tried. Believing that a good pilot desiring to become something more than a chauffeur for an Observer, can with proper training do nearly as much observation on infantry contact work. Use an aeroplane like the Salmson equipped with a high horsepowered motor of small horizontal surface, and place the pilot's cockpit back of the wings to offer greater visibility, and armor the motor, gas tank, and pilot's seat with a weight of armor equivalent to the weight of the Observer, extra guns and ammunition done away with. This plane should fly very close to the ground. The pilot would indicate on a map in front of him the position of the

Salmson.

front line and points where he actually sees friendly or enemy troops. Flying low, such troops could easily be seen. The protection of the armor and the difficulty of hitting a swiftly moving object at low altitudes would give the pilot little to fear from ground machine gun fire. A chase patrol 1000 meters higher than this plane would prevent attacks of enemy avions and would permit the Pilot-Observer to give his full attention to activity on the ground. In my experience as a Pilot on Infantry Contact work, I have been able to personally locate the front line during the attack without aid of panels from the troops on the ground by flying low and observing the action going on and drawing machine gun fire from the enemy. It is believed that outside of heavily wooded areas, it is possible to locate in this manner the front lines without the aid of panels or flares, thus permitting the troops to give their entire attention to fighting.

2. An Observation Squadron with 18 Pilots and 18 Observers is believed to be unnecessarily large for Division work. A Squadron of the size as used in the French Army is believed to be more practicable and more easily trained organized and efficiently operated. With a smaller Squadron, however, it would be necessary to readily obtain trained pilots and observers for replacements.

3. Observation work as carried out in the past is in constant need of protection by pursuit planes. Co-ordination between Pursuit and Observation squadrons in the past has been unavoidably poor. The reasons for this are better known to higher command. I personally believe that to each Observation squadron there should be attached a small Pursuit Squadron, possibly of fifteen planes with ten pilots.

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Capt. Clearton H. Reynolds
C.O., 104th Aero Squadron

Recommendations:

1. That the present inefficiencies in Infantry Contact work, due to inability of observers to get Infantry to respond to signals to locate their lines and to lack of coordination between the two arms, can be improved by the use of single-seated planes, lightly armored, in which the pilot could fly at a low altitude over the lines with a protection plane above him, and locate friendly troops without the aid of panels. For this, Capt. Reynolds suggests a plane of the Salmson type, with high-powered motor of small horizontal surface, the pilot's cockpit to be placed back of the wings for greater visibility.

2. That a squadron of 18 pilots and 18 observers is too large for Division work and that greater efficiency could be secured by conforming to the size of squadron used in the French Army.

3. That, in order to improve coordination between observing machines and protection pursuit planes, a small pursuit squadron of possibly 15 planes with 10 pilots be attached to each observation squadron.

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1st Aero Squadron

1. Contact Missions. It has been found good practice to approach the lines at near the extreme altitude at which necessary visibility is possible, which varies with atmospheric conditions and the character of the terrain covered. On a day of average fair visibility in fairly open country troops can be seen in shell holes or behind natural protection at an altitude of 300 to 400 meters. Patrols and isolated bodies of troops often fail to catch the eye at even lower altitude. Entering at as high an altitude as possible, it is well to nose over a bit for added speed and cover the front to be covered, coming out at a lower altitude. Flying a zig zag course helps to avoid machine gun fire from the ground. It is very often necessary to fly in foggy weather or in such poor visibility that it is necessary to fly as low as 50 meters.

Signal rockets and pistols often fail to function but in no circumstances should they be carelessly handled nor should pistols be loaded beforehand. It is the practice of many

Capt. Arthur J. Coyle and 1st Lt. Arthur L. Easterbrook prepare for flight in one of the 1st Aero Squadron aircraft.

observers to throw away a Very pistol which fails to fire. This is hardly necessary but great care must be exercised in unloading immediately *over the side of the fuselage.*

It is often possible to help the infantry, especially in very open warfare, by dropping messages, telling of the presence or absence of enemy in front, directly on our front line troops or patrols rather than on Headquarters panels.

2. The adjustment of artillery is about the only work which can be studied with much benefit away from actual conditions of combat. Personal liaison between the observer and the battery officers is of greater benefit to the observer than to the battery.

3. Photography requires some practice, but is in the main a matter of getting in exactly the right position and then cool

headed operation of the camera. It is probably more dangerous work than other missions and the operating plane should be heavily protected preferably by both observation and chasse planes. Practice in flying these formations would be useful and methods of irregular flying to avoid anti-aircraft fire while still keeping some sort of formation.

4. Miscellaneous. A protecting or alternate plane prepared to take over the mission should always, when possible, be employed. The observer of this protection plane should make note of what he can, but it must be impressed on him that his real object is to protect. *But* in foggy weather protection planes should return. Observers sent up to protect must remember that they may do more harm than good when fog makes danger of collision.

Map boards are a matter of individual taste and ingenuity.

We have found that the dropping of newspapers and cigarettes was greatly appreciated by the Infantry and would like to see this sort of service made general, rather than an exception.

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90th Aero Squadron

1. Air Service Telephone Net. Past experience shows that the Air Service, like the Infantry and Artillery, should have its own telephone net connecting all groups and squadrons, chasse, observation, and bombardment, with the office of the Chief of Air Service and leading forward from him to the division P.C.'s where a representative of the Flying Corps should be on duty. At present, all communication from the front goes over already congested Infantry and Artillery nets and is thereby rendered very difficult at best and more often almost impossible.

2. Air Service Liaison Officers. During the last few months of hostilities, squadrons working with divisions have assigned observers to act as liaison officers with the division commanders, whose duties have been to keep the squadron informed on the situation at all times and to give as many suggestions and as much help as possible to the unit commander with whom their squadron was working. This is a practice which should be made permanent and which, with the direct communication spoken of in the preceding paragraph, will add appreciably to the results obtained.

3. Exercises With Infantry. More exercises in which planes and infantry can work together will tend to remedy several existing conditions.

Observers of the 90th Aero Squadron take aboard a basket of carrier pigeons which will return messages. Working with the 22d Infantry Division near Ourches, France, 14 July 1918.

The troops can become acquainted with and recognize the types of planes which are flying above them and will not hide from nor mistrust every passing plane, as has been the case upon repeated occasions during our various campaigns.

Commanding officers can be brought to realize the possibilities and limitations of the airplane and will not call for nor expect missions to be carried out under conditions which are impossible.

4. Accustom New Men to Enemy Craft. New observers coming for the first time to the front have absolutely no idea what an enemy plane actually looks like, for the reason that they have never seen them. Hence, if all new observers, before being assigned to active flying duty at the front, could spend a certain amount of time with the infantry, artillery, or better the Anti-Aircraft Batteries, they would be better able to meet the situation in the air when they begin to encounter hostile aircraft. Old pilots and observers spend a great deal of time watching planes in flight and thereby come eventually to know friendly

from enemy planes by their shapes, while the new men who have never had even that opportunity are often caught unaware, waiting to identify another plane by its markings.

5. Instructors Men of Experience. As far as possible, it is to be recommended that instructors in Schools of Observation be men who have been at the front and seen the conditions as they actually exist. New observers are continually joining squadrons absolutely ignorant of the most important points a flier has to know, where flying over country patrolled by hostile scouts and protected by hostile A.A. batteries.

6. *Testing Pilots and Observers.* In observation squadrons working in active sectors, pilots and observers should be teamed up and only fly together. The pilot should have his own machine and fly no other, except of course under exceptional conditions. The reasons are obvious. First, when combats are frequent, teamwork between pilot and observer is very essential. If two men who have never flown together are engaged in combat, neither knows what the other will do or wants to do, while two men who have continually worked together know each other, trust each other, know their machine, and usually study their missions and maps in common so that usually their work and the work of the whole squadron will be of much greater value than that of a squadron in which pilots and observers are continually going out together for the first time.

7. Signal Equipment. The grade of Very pistol signals and Very pistols has been very poor for many months past. Misfires, delayed discharges, and failures of the rocket to explode after leaving the pistol have added greatly to the difficulties of the observer. In several cases, faulty pistols and hang-fires have resulted in almost fatal fires in the planes. If possible, improved pistols and ammunition should be provided even if special material has to be used for airplane work.

Signaling with pistols.

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91st Aero Squadron

It is natural that months of flying over the lines should teach valuable lessons and in studying the papers submitted by pilots and observers on what they have gained by their experiences it is interesting to note their unanimity on the importance of three points: Watchfulness, knowledge of one's sector, and cooperation. There are other things of importance, too, as what follows will show, but these three must be the basis of all good work.

There is an old saying that eternal vigilance is the price of peace. In air work it is the price of life. One's safety and one's usefulness alike demand absolutely that pilot and observer should both be everlastingly on the lookout for enemy planes. Half the planes brought down, one pilot ventures to suggest, are brought down in surprise attacks, and this is probably true. It is essential that pilot and observer practice "picking up" and reporting to each other any planes that appear, always remembering to keep an especially sharp watch under the tail of the machine and in the direction of the sun; for that, above all on hazy days, is the enemy's best friend. He will use it if he possibly can. It is to be remembered that all planes are enemy planes until one has been able, by their appearance or their cocardes, to distinguish them as friendly; and any plane that dives on one out of the sun, even though it be an allied plane, as happened once in this squadron, must be considered an enemy plane and so treated.

If the pilot and observer are to do satisfactory work, perfect familiarity with one's sector and its main features is vital—not simply the knowledge gained by constant flying over it, but by continuous study of maps, intelligence reports, and photographs, made real and vivid on each trip by comparison in one's mind with the sector itself. Each member of a team should keep in touch with what the other knows, or learns from day to day, and especially before going out on a mission the two should talk over the important points to be observed on the trip. The pilots, except under unusual conditions such as severe anti-craft fire, can always give a moderate amount of attention to the ground, and just as four eyes are better than two, so should all information, no matter how trivial it may seem, that has been gained on the trip be [given] to the observer on returning, to be included in his report.

The third essential, cooperation, is the lesson which will perhaps be the most valuable to us, in our life back in the States, of all that we have gained from this work. It is the lesson of our college athletics, and we can now understand better why the authorities were so interested on that score when we applied for enlistment in the Air Service. It is the Keystone of all effective work. Cooperation between pilot and mechanics, between pilot and observer, and the ordnance officer and his men, cooperation between the different members of the individual flights, and most important of all, between each pilot and observer working together. These are the qualities that produce a smoothly working whole, and get results.

Other lessons, such as the necessity of dressing warmly, for even in midsummer it is sometimes bitter cold at 5000 meters; and as the preparations to be made in the machine before

91st Aero Squadron insignia.

starting on a mission can be learned on the job and need not be repeated here. It may be of interest, however, to mention a few scattered hints, each itself the fruits of experience. Such is the need for close flying in formation—not seventy-five or a hundred meters apart, but twenty-five or closer, if need be. A lagging machine is a liability, and is easily brought down in a fight, being beyond the protection of the leading machines; and for this reason the observer in the leading plane must keep his pilot informed at all times of the position of the other planes in the formation. Such is the necessity on the observers part of constant readiness for combat—not to be confused with watchfulness. It is told how one observer lost his life because he forgot to put the magazines on his machine guns, and when attacked had no chance to; another was killed because he forgot to cock his guns, and when surprised lost the few valuable seconds he had in which to defend himself. So easily do details forgotten become matters of life and death.

This summary would be incomplete without a mention of that constant companion on almost all missions, whose sharp short cough, with its accompanying puff of black smoke, has been a greeting from the Bosche at all altitudes and in all weathers, and has silvered many a hair before its time—the Archies. Not alone for the devilish accuracy and persistence of the Bosche gunners, for the damage they have done our planes and the brave men whose lives they have taken from us, have we disliked and dreaded them; but because they have brought, time after time, swarms of enemy chasse planes to the attack, and thus added to our worries. "When the Archies stop, the Bosches appear," one flyer writes, and it is safe to say that seldom except out of respect for the approach of their own planes have the Bosche gunners failed to shower us, literally, with their attentions throughout the whole course of the mission.

The importance of bringing back the desired information, regardless of temptations to attack an enemy formation which chance may have put in a position favorable to us, or to "strafe" trenches, deserves mention; and through all the papers of which this is a summary runs the realization that no chances are too great, no dangers too formidable when instructions have been received that "the information wanted *must* be obtained." Had that knowledge not been evident, the missions performed at all altitudes, even at 100 meters, in the face of enemy formations superior in numbers, in all weathers—going up in rainstorms, landing after dark, on strange fields sometimes, in machines not intended for night flying—would show how deeply the men felt this to be a principle in their work.

Such are the lessons learned in observation work—a work that has, it is safe to say, made over all the men engaged in it; has

taught them the priceless value of team play, has shown them in their friends depths of cheerfulness, forgetfulness of self, and bravery, whose greatness they had never appreciated, and has left them an affection for these friends so strong that it will be always a part of their lives.

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2d Lt. Sidney V. W. Peters
Flight Commander, 24th Aero Squadron

Peters had joined the 24th on 8 September 1918 and had served with the squadron during the Battle of St. Mihiel and the Meuse-Argonne Campaign. The 24th Squadron had flown Salmson 2A2's at the front, but after the first of October it also had one DH-4 with Liberty engine.

The Liberty motor in itself has proven to be all that its builders predicted. Excellent reliability with a continual flow of power equal to any emergency. In fact, its power in full cannot be used with its pursuit plane and it has an excess of 250 rpm over the strength of the wing surface.

With a few minor changes which have been made by field mechanics under working conditions at the front, the motor has given a very creditable account of itself. These changes were mostly in the ignition system. When trouble with the motor has been encountered, its cause has generally been the unfamiliarity of the mechanics working on it.

Lts. J. Dickinson Estes and H. C. Boricon, the first pilots of the U.S. Liberty plane in France. Taken at the A.S. Production Center #1, Romorantin, 8 June 1918.

From the plane's first appearance on the front, it has been looked upon unfavorably from the pilot's viewpoint. Its greatest criticism has been the lack of features of safety. The wing construction and fuselage is admittedly weak, and pilots undergoing instruction are warned against steep dives and vertical virages. It has not been advisable to put the ship into loops or subject it to any strain that is not absolutely necessary. It is not difficult to imagine the frame of mind of the pilot over the lines in a ship he has little faith in the construction of.

Probably the most objectionable feature is the gas tank and its construction. There is not and has not been any covering or safety on the tank. The French practice has been to use asbestos and rubber so that when a bullet enters the tank in combat, the hole is automatically sealed and no fire results. A bullet hole in the Liberty gas tank, in most cases, has resulted in a fire and the death of the pilot and observer. With a gas tank unprotected, the pilot cannot possibly have the proper mental attitude, nor can an observer properly do his work. They also face the probability of fire in a crash in a Liberty without a protected tank that would be greatly reduced if the tank were properly covered as is the case in the Salmson or S.P.A.D.

There have been numerous examples of Liberties falling in flames from the hits of "Archies" in the recent bombing raids, and in many instances the fatal result has been attributed directly to either the flimsy construction or the unprotected gas tank of the Liberty plane.

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2d Lt. David S. Kennedy
Deputy Flight Commander
24th Aero Squadron

Criticism, adverse or favorable, of the Aviation Instruction Schools, must be concerned chiefly with the personnel and organization rather than with the course of instruction offered. The latter seemed in most instances adequate and as complete as the newness of aviation in the United States permitted.

One exception to this is that many flying students graduated from schools in the States have been deficient in familiarity with stunts. Apparently this was due to fear on the part of authorities of adverse public opinion if the number of casualties from this cause showed a marked increase. As a result many flyers were graduated and actually sent to the front to fight without ever

having been in a tailspin, a loop or other air maneuvers. While these are actually little used in fighting and especially in reconnaissance or bombardment work, nevertheless a certain knowledge of them greatly increases the confidence of the pilot in himself and his machine and might in many instances furnish the reserve of morale necessary to turn a defeat in the Air into a victory.

In many of the schools in the States stunting is forbidden. I myself repeatedly asked for instruction in stunts at various posts but my request was never granted. My only familiarity with them is due accordingly to my practicing alone, out of sight of the field, without instructions and without the sanction of the authorities in charge. I do not regret this disregard of regulations and believe that my assuming of the responsibility in doing this resulted in better service in my work at the front. It should not be necessary for a flying student to undertake this essential part of his training under such circumstances.

Another criticism of the training schools, and particularly of the ground schools, is that undue insistence was often placed upon subjects not essential to success as a flyer and that in consequence the United States Army lost many good men. As an instance, at the ground school at Cornell University, many promising men were discharged because of failure to pass the examination in radio telegraphy. Many of these went to Canada, enlisted in the Royal Flying Corps and subsequently became efficient aviators in the British service. Some of them became well known aces.

My twelve months experience as a flyer have convinced me that sufficient attention is not given to the physical condition of the Aviation Student. I myself have not received a physical examination since first enlisted in the service nearly eighteen months ago, though in that time I have been flying constantly, and at altitudes as high as 19,000 feet.

It is my belief that many of the accidents in training are due to lack of proper physical attention. The senses of a student almost exhausted or under undue fatigue do not react as rapidly as under normal conditions. The eye is apt to misjudge the distance from the ground, or the feel of the machine under the control of the student is likely to be blunted. This is shown in the fact that many students are killed by slipping off on a wing in a turn near ground, especially when the motor has cut out or lost power from any cause.

Skill in the co-ordination of the muscles is absolutely essential in the making of a flyer. My observation has been that men who have this ability have made good flyers, whether this faculty has been shown in athletics, or in some other accomplishment as

piano playing, juggling or the like. I have noticed the officials in charge of flying fields try for weeks to make an aviator out of a man whose whole difficulty lay in inability to co-ordinate his actions quickly. Accidents to planes and in some instances deaths of the men would have been prevented if this inherent disqualification had been recognized.

Boards examining candidates for aviation attempted to obviate this difficulty by selecting men who had shown an aptitude for athletics. This care was not followed up in ground school and flying school by proper training in this direction, with efforts to eliminate the unfit.

Keen eyesight in aviation cannot be too strongly insisted upon. The flyer at the front who can pick up enemy planes a few seconds before he himself is seen has a great advantage in determining whether to accept or refuse combat, as his judgment may dictate. Otherwise this advantage passes to the enemy.

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2d Lt. David S. Kennedy
Flight Commander
24th Aero Squadron

Maps. The Air Service is now using maps constructed for the infantry and artillery. Maps made especially for the use of aviators would greatly simplify many of the difficulties now encountered in visual and photographic reconnaissance.

Especial attention should be given to the landscape as it appears from the air. Among a multitude of small villages and roads it is difficult for an aviator to find his position on the map. On the contrary there are always many distinctive landmarks which immediately catch the eye from the air but which cannot be found readily on the maps now in use.

Water is always distinctive—lakes, rivers, and canals should be more strongly marked, with particular attention to form and direction.

Peculiarly shaped woods are readily seen.

Unusual angles and bends in roads are picked up readily.

Hills and valleys are not readily distinguished from an altitude, but frequently hills have tops of unusual earth covering or exposed stone, while valleys often contain marshes or ponds which stand out from the neutral coloring of surrounding ground.

Railroads are hard to see above 15,000 feet and do not afford landmarks as good as commonly supposed.

The roofs of buildings are good landmarks.

Visibility. Good visibility for the pilot simplifies visual and photographic work, especially when it is necessary for the pilot to fly over a prescribed course.

When it is impossible for the pilot to be seated ahead of the wings, it is desirable for him to be placed just behind and with the upper [wing] slightly above the level of his eyes.

A small shutter door in the bottom of the fuselage is necessary and visibility would be improved by an arrangement of two mirrors giving a view to the side and beneath each wing.

Controls. It is desirable to have the plane sensitive on the controls when this can be obtained without sacrificing more essential features. The rudder should be particularly easy to permit the tail to be switched aside quickly to uncover an enemy plane of greater speed which may be approaching for an attack.

Quick response to the ailerons may be obtained by eliminating the dihedral angle. A skillful pilot does not need this feature of inherent stability so long as his controls are not destroyed, which infrequently occurs. The plane should respond easily to the elevator.

Speed. A difference in speed of ten miles per hour often means the successful return of an observation team with information, as against its destruction. A speed range of fifty to one hundred and forty miles per hour would permit the motor to be throttled to slow speed for the purposes of observation and to [high speed to] draw away from enemy planes in case of attack.

In a machine of greater speed than enemy planes, observation far into hostile territory could be carried out at lower altitudes with impunity. Under present conditions it is necessary for long distance reconnaissance to be accomplished at high altitudes to take advantage of the extra wingspread of observation planes.

Wings constructed with a variable camber would be of enormous importance, allowing slower landing speed and slower speed over an objective, while at the same time permitting greater speed in case of attack.

Machines for long distance reconnaissance should be strongly built so that it would be possible to return home even with bullets in vital parts. It frequently happens that observation

planes are attacked by superior numbers of the enemy and are considerably shot up before escaping.

Armament. Protection of the gas tank and of vital engine parts is of great importance and should take precedence over protection of pilot and observer when both are not possible.

Training. Pilots of reconnaissance planes should be thoroughly trained in close formation flying and in "S-ing" in formation. The latter is the only maneuver required in observation work and is necessary to escape from anti-aircraft fire. Attacks from enemy planes often follow an "Archie" barrage and it is essential that the formation should not be scattered.

Pilots should be familiar with stunts and should know how to recover from a tail spin.

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1st Lt. Allen T. Bird, Jr.
Flight Commander, 50th Aero Squadron

The flight commanders of a squadron should keep in close touch with the work in their respective flights both of the pilots and observers as well as the mechanics, also to know each day the condition of every machine in the flight and to watch the motors closely.

Finally, whenever necessary to make suggestions or criticisms to both pilots and observers (observers, more particularly on their requirements of pilots in working) regarding their methods. It is needless to say that under the prevailing table of squadron organization usually such suggestions or criticisms were not received in the spirit they were given and little heed paid.

In the work of an observation pilot caution and good judgment should be the primary requisites. As the successful accomplishment of each mission is due to a great extent upon the flying ability of the pilot he should at all times maneuver his machine so that the observer can carry on his work most effectively.

Before going on a mission it is absolutely essential that pilot and observer talk over the work to be accomplished and lay their plans of cooperation accordingly.

Contact Patrol: To successfully accomplish such a mission there are several vital factors and situations to be considered, upon which the method to be employed depends. The area to be covered: wooded, broken and open country each require

A German antiaircraft gun in action. The photo had been taken by the gunner's German comrade, who was later captured.

different tactics in flying. In a wooded area such as the Argonne Forest low flying was absolutely necessary in order to identify panels, flares or our infantry; and at times it was difficult flying at less than one hundred feet to accomplish such contact throughout the area. But low flying is extremely hazardous for two reasons: First, surprise by enemy aircraft. Both pilot and observer are apt to become engrossed upon their task and attracted by the panorama passing underneath, which situation would give the enemy aircraft the opportunity they are so eager to take advantage of: Surprise Attack. Second, machine gun fire from the ground. In working over this area on Contact Patrols those two factors were continually borne in mind, and the missions were flown accordingly. On reaching the scene of operations I would fly into the enemy country at an altitude of between 3000 and 4000 feet until anti-aircraft fire was drawn, turning and flying at a right angle to my previous course I would get an approximate idea of the enemy AA line. Then would fly back and begin searching for our troops at a low altitude working toward the AA line, and when the approximate location of our troops had been determined I would give the observer the signal and would drop to the altitude that was necessary for positive identification of the advanced line of infantry. Then flying at the low altitude I would run the motor 150 to 200 revolutions faster than at higher altitude, depending upon speed to carry me by any enemy fire.

By locating the enemy AA and probable troop positions and searching for troops at the altitude mentioned the possibility of a surprise attack from enemy aircraft was overcome and the danger of any extensive ground fire practically nil.

On the low flying work over the area there was only the danger of machine gun fire from the ground and before attempting it would make sure there were no enemy aircraft about.

From the beginning of our operations I have been of the opinion that with an airplane such as the Liberty motored DH 4, with its speed and abundance of power the chance of being hit by machine gun fire from the ground were very small if the advantage of speed and power was taken, and so I depended upon speed alone to successfully conclude the work, reserving however an abundance of power to be used should any unexpected difficulty be encountered.

In broken country such as that in the area north of the Grand Pre-St. Juvin Line, it is to be expected that the enemy will take advantage of all high ground to mount machine guns for use against aircraft. In working over an area of that description it was necessary to keep this fact in mind and fly the mission accordingly. Flying at various altitudes and a very irregular course with good speed, flying directly over the heights in order to make the gauge of deflection more difficult.

In open country, the danger from machine gun fire increases as the gunners have ample opportunity to gauge deflection and to throw up an intensive fire so that speed and incessant changing of both course and elevation is vitally necessary.

Reconnaissance: On working on such a mission the observations of the pilot are equally important as those of the observer and the pilot can constantly bring things to the observer's attention that otherwise would escape his notice. Enemy aircraft among those things. On several occasions while flying over villages in enemy areas I have noted, beyond the possibility of a doubt, that they were occupied by troops. After accomplishing the mission and while talking over incidents of the trip it developed that my observer had not seen any signs of troop occupation. The practice of pilot and observer comparing their impressions of the observation immediately after each mission is of great importance and should be done on every occasion.

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Flight mechanics use a Ford tractor to pull a Liberty plane off the field for maintenance at the Air Service Production Center #2, Romorantin, France.

—44—

1st Lt. F. M. McCook
Flight Commander, 50th Aero Squadron

The efficiency of the enlisted personnel of any flight depends chiefly upon the ability of the flight-sergeant, whose main prerequisite must be leadership, combined with a sound mechanical mind. A good flight-sergeant need not necessarily be a Master Electrician, it being a grave mistake to place an M.E. in charge, per se, for regardless of knowledge if his leadership qualities are poor, he will never get the best out of his men.

Considerable leeway should be permitted the flight-sergeant especially as regards matters of discipline. Men desiring passes, leaves etc., should first submit them for his approval. They should know also that promotions will be made only with his recommendations. As regards to promotions, they should be well merited and few. Nothing disturbs the harmony of a flight more than an undeserved promotion, and the greater the premium placed on rank, the harder it will be worked for and appreciated.

The consistent worker is a good man to place in charge of a ship while the good engine, magneto, etc., man should be encouraged to specialize. The flying officers should have immediate authority over their crews, their attitude being friendly but firm, care being taken lest it approach the familiar. The men should be taken up as passengers as often as occasion permits and it is recommended that after every rigging job, the N.C.O. in charge be ordered to accompany the pilot on the first trip. The

flight commander's authority over the officers in his flight should extend only to flying, ground and flight rules—matters of discipline, program, etc., should be dealt directly by the squadron Commanding Officer and Operations Officer.

Observations—Active Service. The greatest value of the aviation reconnaissance service in the battle of the Argonne laid [in] its ability to locate and report the position of the front line. Very low flying was done with extremely few casualties. As to modus operandi, the writer employed two methods depending on the positions or progress of the forward elements. Should the front line be more or less stable, the advance being slow and its location somewhat definitely known before leaving the airdrome the approach was made at an altitude of from 800 to 1000 feet in a series of wide circles the general progress being toward the line. On the farthest point of each circle the observer would fire his pistol and the maneuver was continued until the call was recognized and answered by the Infantry. The flying consisted of dives and climbing turns.

The value of the above maneuver lies chiefly in the fact that this does not permit the pilot to over-fly and become out of touch with his troops; it also eliminates much machine-gun and rifle fire, as in most cases the machine and its purpose has been recognized from its preceding circles, the panels and flares are already laid out and can be picked up out of range of the hostile anti-aircraft barrage. Another decided advantage is that it affords the pilot an opportunity of keeping a constant lookout from all sides and above.

Should the advance be great and no definite information as to the whereabouts of the line, the flying should be done at about 2000 feet. Troops should be looked for near or along the roads, railroad tracks and hill sides, it is advisable not to continue in any direction where there is no activity—the last soon will generally be your most advanced patrol. Flares or panels in an advance of this kind can not be expected as the infantry will generally throw them away to lighten their load. Never fly over the same place twice and regard clumps of trees and edges of forests with the greatest respect.

Hostile Aircraft. Extreme care should be taken in approaching the line, carefully note the aerial activity and the planes working in adjacent sectors. A large number of friendly balloons at a fair elevation is a good sign of a peaceful sky, although this should not be depended upon. Always regard with suspicion the plane or planes that seem to have nothing to do or who appear unaware of your presence. The sun and clouds are your greatest friends and greatest enemies. Beware of an attack from their

direction and in case of trouble you will find them your greatest refuge.

The first dive is always the most to be feared—a good maneuver is to wait until he is just within range and then go up in a sharp climbing turn. The enemy plan of attack on two seaters is to take them by surprise. A short burst of tracers by the observer will often forestall combat.

After an attack or low flying venture, great care should be taken in the handling of a machine until it is safely landed on the drome. A ground inspection of a plane after a "job" often causes cold perspiration. As a last remark, it has been the writer's observation that those with the greatest "wind-up," whether in training or in service, are the first to go.

—45—

1st Lt. Merrit O. White
Flight Commander, 90th Aero Squadron

Training of pilots for observation work has been very much underrated and therefore neglected. So much so that at chasse schools we were threatened with observation work if we fall down in chasse.

Our experience has taught us the importance of thoroughly trained and skillful pilots for observation work if they are to be successful in working with the observer. Only two pilots of the 90th Aero Squadron had ever received any training in observation work, and this would have proved a distinct setback if they had been obliged to start hard work immediately upon their arrival at the front. Fortunately, all of them had completed the entire course for chasse pilots, including gunnery, and for the first two months on the front were able to do easy work on the lines and get plenty of practice with the Infantry in the rear. This gave them the much-needed experience so that by the St. Mihiel drive, they had become expert observation pilots. The work done and the losses sustained from this time to the end of the war bear this out. Our loss over the lines during this time was one man who had practically no previous experience.

All observation pilots should go through the regular course of training, including acrobating, then through a course in observation work, actual practice with the Infantry of course being the most valuable.

Infantry contact work, one of the most important, hazardous, and interesting, requires most expert piloting and perfect

cooperation with the observer to be successful.

First, the pilot should study his maps carefully, the situation thoroughly, and get from his observer a perfect understanding of where he is to fly, where to go through the barrage and at what altitude, so that no further instructions will be necessary from his observer during the execution of the work.

Too much emphasis cannot be placed upon the importance of the facts. While making a contact, the pilot has three important things to watch out for mainly—attacks from enemy chasse, anti-aircraft fire, and maneuvering of his plane over the right territory. He must never for an instant fly in a straight line, neither must he circle over one place constantly. Constant swings and unexpected turns keep gunners on the ground guessing and seems to work out successfully.

The pilot must be 90 percent of the eye of the team against enemy chasse planes for the observer is busy with his work, and a live pilot enables him to do just so much more.

In case of attack, he should immediately maneuver in a position for his observer to do the shooting, as his two guns are more than 100 percent more formidable than his own.

We believe the experience of the 90th Aero Squadron has proven conclusively that a thoroughly trained observation pilot and one who is interested in his work is the only type who can constantly and thoroughly do the work assigned to them.

—46—

1st Lt. George S. Clark
Flight Commander, 104th Aero Squadron

1. The best and most successful work will come from the Observation Squadron in which there is the greatest cooperation between the entire personnel of the squadron and especially between the pilots and the observer.

2. In the first place, pilots for this work should have a minimum of 100 hours of flying experience including at least 25 hours of aerial gunnery (actual time in the air), with fixed gun both photographic and shooting at targets. After his gunnery course he should go to a school where he can get some idea of the kind of work going on at the front, preferably an observer's school. In this work he would find that he could work with some observers a great deal better than with others. In this manner the teams could be formed and if sent through the rest of their training together, they would be able to enter their duties at the

A number of officers in the 90th Aero Squadron appearing in the photo contributed to the "lessons learned" in the postwar review. Left to right: Lts. Bertrand Neidecker, Wilbur Kinsley, Alan Lockwood, Merritt O. White, William Lowe, John Wallace, H. H. Cowle, Arthur O'Connor, Clive Lacy, Norris Pierson (Squadron C.O.), Loren Roher, Valentine J. Burger, Capt. William G. Schauffler, Jr. (Group C.O.), Lts. Henry Ellis, John Sherrick, Van Hayden, Arthur W. Parr, George Dorrance (behind Parr), Harold Greist, Horace A. Lake, Henry Borden, Floyd Hart, Fred Tillman, and Alexander Grier. Bethelainville, France, 11 November 1918.

front almost immediately upon arrival there, and would do the work in a very satisfactory manner without friction among the teams.

3. In Infantry Contact work if two planes are sent out together and upon crossing the lines one flies at about 500 meters for protection alone, and the other below 500 meters to get the information desired, the Observer in the lower plane can do his work knowing that he has the protection above him and will not have to be watching for planes most of the time. It is best for the pilot to fly lengthwise across the front but not to fly a straight course, nor one at a definite altitude, but keep changing both to keep out of machine gun fire from the ground.

4. In adjusting Artillery, the two planes can work to better advantage than one as the Observer must spend quite a little time watching the shots. The Pilot should fly between battery and target in a large "8" or in a circle, depending upon the wind.

5. In photographic work at least three planes should be sent

out, the leader carrying the camera. The successful outcome of these missions depend upon how the pilots can hold their formation, the closer the formation, the less danger there is of attack. If attacked by large numbers the best practice is for the plane on the side where they attack to dive down under the loader, thus allowing all Observers' guns to come into play. The pilots should get in as much time as possible in close formation flying.

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1st Lt. James S. Roberts
Flight Commander, 104th Aero Squadron

It is recommended that:

1. Training of Pilots. Pilots receive 30 hours of preliminary training of flying alone, followed immediately by 20 hours of aerial gunnery. Gunnery to consist not so much in the ground work, but all aerial practice to be emphasized. Single and formation combat work with camera guns to be chief feature of work.

Pilots to be sent to the front with from 50 to 100 hours flying. Those who have been used as instructors and having more than

Class in artillery reglage at LeValdahon.

150 hours flying to their credit to be kept as instructors whenever practical. Pilots who have 300 hours to their credit before going to the front are not good material for work over the lines.

Pilots be trained on as many different planes as possible.

2. Operations in Field, General. All missions be under strict supervision of Operations Officer and chief pilot or Flight Commander, between whom the greatest coordination is imperative.

Pilots work with the same observer at all times.

Infantry Missions. Infantry missions be flown by single plane whose altitude over the lines should never exceed 300 meters. A straight course while over the lines is always to be avoided and a very crooked course of short turns, skids, and sharp changes of altitude be at all times employed when over the lines. In case Infantry plane is attacked by enemy chasse, it should at once dive to lowest altitude possible towards our lines, returning to its work when enemy chasse has left the flight.

Artillery Reglage and Surveillance. Be flown by a single plane behind friendly chasse patrols at an altitude from 600 to 1500 meters. Care be taken to avoid going directly over battery in which reglage is being done except when absolutely necessary. Surveillance missions be sent out just before dawn and just at sunset, as this type of mission can work far more effectively at these times. In case of attack by hostile chasse, a tight spiral with side-slip be used to get down close to the ground as the machine is behind its own lines and is best protected by ground fire at low altitudes.

Photography Mission. Be flown by three planes, one plane taking pictures, other two planes acting as protection. Mission to be flown in a tight three point formation with the protection planes flying about 50 meters above and just behind the photography plane. That in cases where mission is to go more than 10 miles over lines, chasse protection be always given and in other cases chasse protection be furnished whenever possible. In case of attack, that under no circumstance is formation to be broken, but if force of attacking chasse is in great numbers, an effort should be made to finish pictures and get behind our lines losing altitude in doing so. In case it is important to finish the pictures, the formation should get behind its own lines losing altitude and then return to finish the pictures. This type of mission be flown above 3500 meters.

That liaison be kept with the nearest chasse group at all times. That chasse groups at all times be nearer the lines than observation groups. That up-to-date chasse patrol schedules be furnished observation group.

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1st Lt. Dogan M. Arthur
Pilot, 12th Aero Squadron

1. Before leaving the aerodrome study your map carefully. Make sure of the lines as last reported, the next objective, and as near as possible where the Infantry front lines will be at the time you should reach the lines. When near the lines orient yourself carefully before going over. Pick out a prominent landmark. A high hill, a large town, highway, stream, lake or wood. Note the position of this landmark as it appears when you are headed towards the enemy lines, flying parallel or away from the enemy lines. Note the position of the sun. If it is at your back as you go in, then you will have to face it to come out; if it is on your left or right going in then it will be on the opposite side when you start out. This is very important, for you quickly lose sense of direction when you start looking for our infantry, enemy planes and panels, and if attacked by superior number of enemy airplanes or motor fails, then you must find the direction of friendly territory without losing even one second. No matter what is occupying your attention, always keep in mind just which way you have to turn to head towards friendly territory, one second's delay may prove fatal.

After you have oriented yourself then start in at one end of your sector and fly to the other end. Never cut in deep or fly into enemy territory far. It is not necessary. Fly back and forth along sector, gradually working in. Fly level if possible, that is do not bank up any more than is necessary. To bank up exposes a larger surface for enemy ground machine guns and rifles to hit. Do not race motor but run normal, and keep nose of plane down a little, thus getting a large amount of speed without straining your motor. When it is a case of life or death, then is the time you need all your motor, and will have some reserve speed. When near or over our front lines you are constantly under fire from enemy machine guns and rifles from the ground, so keep plenty of speed, skid the plane from side to side by using rudder. When you have to turn at the end of sector, do a half vrille turn; all this tends to make you a very difficult target for the enemy gunners.

Help the observer all you can by watching the ground for our troops, but do not neglect your watch in the air for enemy aircraft. The observer usually lets the pilot know when he is going to call for panels from our infantry. Then keep him in best position to observe panels. This is the time to keep a very sharp

watch for enemy chasse for if there are any near they will be attracted by the rockets, and will attack them if they are near enough, for they know that when rockets are fired, the observer is busy watching the ground and his watch for enemy aircraft is therefore impossible. Try to locate the front lines first; then verify it by calling for panels with a rocket, thus keeping from making infantry as well as yourself conspicuous.

Friendly troops can usually be distinguished easily from about 200 meters by the color of their uniform, but weather conditions and heavily wooded territory at times makes it necessary to fly as low as 50 metres. When flying as low as this, always try to keep back of our lines as far as possible to avoid enemy fire from the ground, but at the same time keeping near enough front lines for the observer to see panels plainly.

When on contact patrols the enemy archies cause very little trouble as you are so low and behind our lines they have to fire laterally and their aim is usually poor. If they come near just change direction about 45 degrees and altitude without banking up any. But should they come too near or get you bracketed then side slip out of them and resume work at some other point along sector.

Pilot and observer should have utmost confidence in each other. Try to team up with an observer that you know is reliable, that is that you don't mind doing as he tells you to. For instance, if he should try to tell you to fly over a certain place within the enemy lines at a very low altitude, and even though you knew it was extremely dangerous, and thought it wasn't necessary, you wouldn't hesitate a second but would do as he asked, for you have full confidence in him; knew that he knew what he wanted, and it was necessary to do as he asks in order that he may secure the desired information. Just remember that he knows what he is doing. Knows the danger and is taking the risk as you, even more, for if he is killed you can get the plane and yourself back, but if you are killed then the planes goes down, and therefore he is taking a double risk.

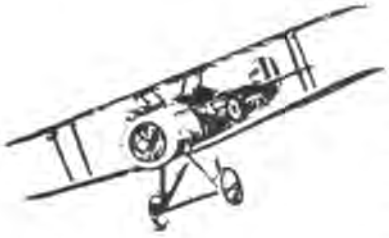
Never depend on your observer to keep your direction, that is the pilot's business. The observer's time is fully occupied in watching the ground and for enemy aircraft, and is not expected to keep the direction, so it is up to you, as the pilot, to do this, for nine times out of ten the observer is so busy that it would be impossible for him to know whether the plane was flying north, south, east or west. In order to fully carry out his missions he had to have full confidence in the pilot and he knows he will keep himself oriented.

It is not advisable for the pilot of an observation plane to strafe enemy troops, transports, etc. His gun is fixed and he

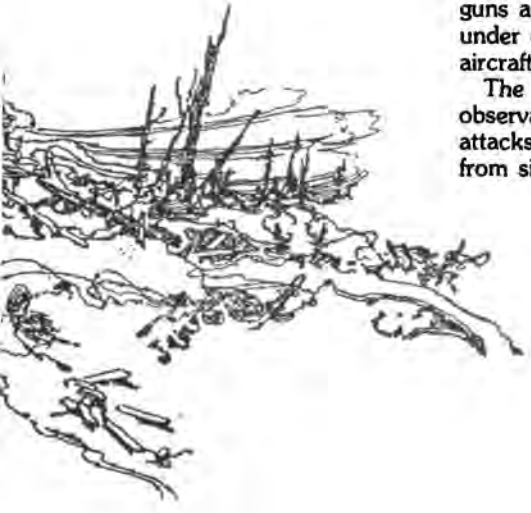
would have to dive his machine to strafe and as an observation plane is large it cannot be controlled as easily as a chasse plane. Let the observer do the strafing when there is any strafing to be done, as he has two guns mounted on a movable tourelle, and can strafe while plane is on a straight line of flight.

Try to remember direction of wind at all times, for if your motor fails you haven't enough altitude to look around to find the direction of the wind, and to land with the wind on a shell torn field, in a woods or among wire is far more dangerous than if you landed against the wind and had it to help check your ground speed.

The Boche seldom attack a bi-plane machine unless they have it outnumbered three or four to one. They usually wait until they think the pilot or observer or both have their attention on something else other than the air. Their favorite mode of attack is from the rear with the sun on their back. One or two of the enemy aircraft usually try to get beneath the plane they are attacking, thus making it impossible for either pilot or observer to return their fire. The only thing for the pilot to do in this case is to dive down and fly so close to the ground that it is impossible for the enemy aircraft to stay beneath you and maneuver. When diving down, kick the rudder from side to side, skidding the ship and making it more difficult for the enemy aircraft to score hits. Another advantage in getting low is that it gives the friendly infantry an excellent chance to help you out with machine guns and rifles. When attacked and outnumbered always make for the rear of our lines as I have found the enemy aircraft will not follow you very far back of your lines at low altitude. In a fight always give the observer a chance to shoot; he has the advantage over your fixed guns, with his movable guns and wind vane sights. It is best for the pilot not to attack under ordinary circumstances unless he can surprise the enemy aircraft or has other advantages.



The foregoing is drawn from my personal experience as an observation pilot on contact patrol missions and I escaped from attacks by enemy aircraft several times when I was outnumbered from six to eighteen machines.



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1st Lt. Robert L. Davidson, Jr.
Pilot, 12th Aero Squadron

Every pilot has his own peculiarities in flying the different missions over the front, but at the bottom of all observation flying there are certain basic principles, which, if followed, will make the work less hazardous. These principles are:

1. To remember that you are sent out to accomplish a mission and not to seek combat until that mission has been accomplished. When outnumbered to withdraw and attempt to elude the enemy so as to be able to finish the mission later.

2. When flying over the lines to constantly maneuver the plane in order to dodge the line of fire, either of machine guns or anti-aircraft depending upon the altitude. Gentle side slips and flat skids prove very deceptive to marksman on the ground.

3. To never go deeper into enemy territory than successful completion of mission requires. Certain missions can be done without crossing the lines.

4. When anti-aircraft becomes too dangerous, withdraw and come back at a different altitude, causing battery to find new range.

What to do when attacked depends on many things; type of plane, number of enemy, altitude, clouds, etc. If the enemy is seen in time and the altitude is low it is best to fly towards our lines, and after crossing, hug as close to the ground as possible. The enemy will soon give up the pursuit. Many high altitude observation planes can outclimb, outmaneuver and outfly the chasse planes above 4,000 metres. One observation plane, if skillfully handled can make a warm combat for two chasse planes. If the observation plane is surprised and hopelessly outnumbered, a combination of skid and gentle side slips make a very difficult target. If the plane dives too steeply in attempting to escape, the attacking planes can get under the tail and riddle it. A tail spin is very impractical as a means of escape as it can closely be followed. A steep bank should never be used in combat. In combat with more than one plane, the shooting position of the observer should be considered as of utmost importance.

On infantry liaison work the altitude depends on the visibility. 500 metres is advisable if the work can be done at that height. While flying, the machine should be kept constantly side slipping and skidding to avoid the machine gun and rifle barrage.

An artillery reglage is the easiest to fly, hostile aircraft being

the main worry. The plane needs to be within a range of the anti-aircraft only a small portion of the time. This is usually flown in circles between battery and target.

Photographic work necessitates the ship being flown in a straight course. Generally the anti-aircraft will permit a straight course being flown into enemy territory. Then the pilot may dodge coming out. Often a complete round trip may be made in a straight line. If the anti-aircraft becomes too dangerous the course may be broken. Then go away for awhile and let the battery lose its range. Come back and continue work where it was left off.

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1st Lt. Kenneth M. Holden
Pilot, 12th Aero Squadron

1. *Infantry liaison protection.* Circumstances sometimes necessitate two planes to successfuly accomplish a single mission, one plane to do the work and the second to act as protection. In this protection work you are largely responsible for the success of the mission, for you must not only fight off enemy aircraft but be in a position to carry on the mission itself should the other plane fail. The pilot must have his map marked with the probable location of the lines, must keep himself located at all times, so that he can be able to glide into friendly territory in case of engine trouble, and must always be in the best position to defend the mission plane. When the mission plane starts working over the lines, for example, at one hundred metres, it is best for you to stay several hundred metres above him and not attempt to remain directly on his tail, or in case of attack you are then able to warn the mission plane by diving on him and then climbing back in a defensive position in the shortest possible time. In this work it is necessary to be wide awake at all times for you are not only on the constant watch for enemy aircraft but at the same time are being constantly fired on by machine guns on the ground. The best possible way to avoid these is by skidding, for where a machine is flying in this manner it is a very difficult target to hit. Never fly in a straight line and skid most of the turns for when a plane makes an ordinary bank into its turns, it becomes an excellent target and an easy one. Always stay with the machine which you are protecting no matter where he may go and if the mission plane should become lost, which you will know by the fact that in this

work, you are never far in enemy territory, dive down in front of him or attract his attention in some way or other and then head him back to our lines when you again take your position of protection.

Protect the machine that is doing the work at all costs and if you find that you are not able to ward off the attack by yourself, close in nearby the leading plane and let him help you.

The success of the mission depends upon you. Do your work so that the leading plane can accomplish its duties in the least possible time and with the best results. Be wide awake and fully aware of the fact that something else is at stake outside of your own personal safety. Do not encourage a fight but rather seek to avoid it, for the reports of the enemy [?] infantry planes are more important than the destruction of enemy aircraft. Remain constantly on the alert until your return to your own aerodrome and thereby you have done all in your power to accomplish a successful mission.

2. *Protection for artillery missions.* In protection for this work your machine must be equipped with wireless reels, maps with target locations, and in fact with all the necessities of a mission plane. Before leaving the ground arrange a set of signals with the pilot of the leading plane so that in case of attack you can easily attract his attention. When in the air take your position above and to his rear and then look out for trouble.

The thought must always be uppermost in your mind that the observer in the mission plane is watching his target and the bursting of shells and consequently is depending almost entirely upon you for his protection. In this work you are most always flying at an altitude of several thousand metres and in consequence the only trouble you will come in contact with, is anti-aircraft and enemy planes. The best possible way of avoiding the former is by continually changing your line of flight as in this way you become a very poor target while in the case of attack you must at all costs, protect the leading plane. Remember that the pilot in the machine that is doing the work must keep his ship in the best possible position to afford his observer a clear view of the target and even though his action may at certain times seem a trifle peculiar that is no affair of yours. In case of attack remember that your observer has guns as well as yourself and therefore keep your ship in a position so that he can use his guns to the best advantage as he is able to do more efficient shooting than you. Watch the blind angles of your machine and if possible never let an enemy plane take advantage of them. Always remember that the enemy plane knows the location of your blind angles as well as you know theirs, and therefore you

must keep constantly shifting the position of your machine. In a fight never let the enemy separate you from the plane which you are protecting for if they succeed in this, your mission as a protection machine has been a failure. Above all watch the sun for it is the best possible hiding place. The enemy will get directly between you and the sun if possible and if successful in this, is able to dive directly at you and it is almost impossible for you to see him. No matter how difficult always keep the leading plane, the sun, and yourself at an angle and never in a straight line. Be sure not to fly below and directly behind the leading plane as his wireless wire is out for perhaps a distance of sixty or more metres and you are liable to run into the same. Always be in a position to carry on the mission should the first plane go down, for in observation a mission must be accomplished no matter what the cost may be.

3. *Protection for photographic missions.* The first thing a pilot must realize before leaving the ground is that he is in for a fight with the odds against him and consequently must have a thorough understanding with the other pilots in the formation as to mode of defense when attacked. A photographic mission is something which must be accomplished at all costs and in view of this fact, one must be prepared for all emergencies. The leading plane is the one which generally does the work and as it is necessary for him to fly in a perfectly straight line he is consequently exposed to direct anti-aircraft fire as well as being an excellent target for enemy aircraft. Therefore, as nothing can be done to protect the mission plane from archies or anti-aircraft fire, the protection planes must devote their entire attention to enemy aircraft. It is a common trick of the enemy to fly over your formation at a safe altitude with a single plane, hoping that someone will dive at him. If he is successful in this and you should leave your formation, you are immediately jumped upon by the formation above and you are lost. In falling into this trap you not only lose yourself but weaken your formation and if this should be repeated, the formation would soon be broken up. Another favorite trick of the enemy is to fly over you and attempt to attract your attention while at the same time another formation attacks from below. This is used to break up your formation and unless all planes in your group are working together and carrying on a cross fire which will keep the enemy off from your tail, it is generally successful. Therefore, you must always remember that even though your own chances of living seem to be awfully small, you cannot under any consideration leave the formation, above all keep your head and never for a single instant let anything detract your attention from the protection of the leading plane. A few bullet holes in your plane will do no harm while on

the other hand a single bullet might hit the camera and cause the mission to be a failure. Do what is asked and expected of you. Keep your eyes open wide at all times and remember that the success of the mission depends upon you and your ability.

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1st Lt. Robert M. Anderson
Pilot, 50th Aero Squadron

To make a reconnaissance or a contact patrol, it is necessary to get to the lines which are in contact with the enemy. In order to get to the lines, it is the duty of the pilot to get his observer there, the result being that the motor must be in perfect condition before leaving the ground. It is better not to go on a mission than to go on with a missing motor as the chances are that the plane will have to land between the airdrome and the front. In case the plane should come down, it would probably be hours before the pilot could get word to the squadron that the trip had been a failure. The motto should be remembered by the pilot that while 5 minutes are wasted, six lives might be lost.

With the motor turning up properly, it is then time to leave the ground. The wireless is checked up while flying over the airdrome. Protection planes falling in on the flanks as the checking out is carried on, providing the latter is furnished. To get to the place where the mission is to be carried out, it is best to follow a certain route, observing the terrain on the right and the left of the course to facilitate the time which will come when lost in the clouds or fog.

Beginning the contact patrol the observer will direct his pilot to the spot where he wishes to fire his rockets, or where he thinks the line is located. He will then fire a six star rocket which is the signal for the infantry to show up the line. If the first rocket does not bring results, he will direct the pilot to fly farther toward the enemy's positions. He will then fire another rocket with the same number of stars. As soon as seen from the ground, the infantry will put out panels of white cloth. These series of panels are the front lines. The observer then records the line on his maps and the mission is complete.

The visibility is the chief factor in flying infantry liaison. If the clouds are low, it is sometimes necessary to fly the patrol at a hundred feet, but, when the visibility is excellent, the mission can be carried out between 2000 and 3000 feet. The higher the panel

can be seen, the easier it is to get the coordinates in their proper places. There is one disadvantage in flying contact patrol at high altitudes. It is more a menace than a disadvantage and is known among fliers as "archy." This form of artillery is very accurate, making it necessary for the pilot to change his course frequently but not with the same regularity. If the course is followed, say a thousand yards in one direction at 45° to the right, then 45° to the left the anti-aircraft gunners will make the correction to meet you before the turn is made. A gentle side-slip deceives those on the ground, and if carried on it will be only a short time until the shrapnel will be bursting at your old altitude instead of your lower level. The six star rocket having been fired, the infantry will place panels of white strips on the ground showing up their front line. As soon as the observer records this line on his map, he then fires a two star rocket which indicates that the line has been understood. The panels are then quickly taken in, for if allowed too long on the ground, hostile artillery fire will be the result.

While the mission is being carried out, it is absolutely necessary to watch the skies for hostile planes. Increased vigilance is necessary after the mission has been completed as an enemy plane might slip down, making the trip a failure, as a plane shot down with information is as good as no plane sent out at all. It is the enemy's method of attack to get in the sun, where he hardly can be seen. He will not attack unless he has the advantage; altitude and a superior number of comrades is his advantage. If he does not surprise his opponent, he is easily driven away with a few bursts from the rear guns. If he gets under your tail, it is best to spiral with about 1100 revolutions of your motor. It is then impossible for him to continue in so good position. But the spiral of this kind it should not be tight, but loose enough to allow the observer to shoot. When tracer bullets come his way, he will leave without hesitation. The plane returns after dropping its messages at previously designated points.

A reconnaissance trip should be carried out in a similar fashion although altitude is then advantageous. The observer records movements back of the enemy's front lines, such as convoys, trains, ammunition dumps, and any information of value. If the hostile parties are retreating, it is good policy to dive down upon them with machine guns open. It will delay his retreat, making it possible for our infantry patrols to capture prisoners and material.

If a target presents itself of great value, the observer will send back by wireless the coordinates of same and request artillery fire. He will then adjust the fire to destroy the target. Fires and

large explosions are recorded and sent down in his written report which is dropped similarly to the infantry contact patrol report.

All things of importance recorded, the plane returns to the airdrome to await a later mission.

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1st Lt. Floyd M. Pickrell
Pilot, 50th Aero Squadron

That the plane should be [in] perfect working condition in order to carry out a successful mission is obvious. Therefore, it is the duty of the pilot to study his plane and motor very carefully. He should inspect thoroughly before and after each flight. He should discuss with the crew chief the running of the motor with each flight, be present when repairing is being done and know as far as possible the cause for a bad motor. Each motor has a personality, so to speak, and the pilot must know his motor in order to handle it successfully, for it can be death when it goes bad in the air. A bad motor shakes the morale [of] both the pilot and the observer, for the observer with experience can detect a missing or sputtering motor as quick as can the pilot. His mind is then taken off his work, because he does not know exactly what the pilot can, or will do, and since his life depends on such, he has cause for worry.

I have found the Liberty Motor to be a wonderful piece of machinery, but it is light and powerful, and consequently delicate. Therefore its usage should be according to directions. Particularly do I mention the fact that it should not be run at high speed on the ground until the temperature is 70° centigrade.

Before attempting flight everything should be inspected to see that it is in perfect working order, particular attention being paid to the guns and the 'C.C.' gear.[a] The pilot must know the sector as well as does the observer and it should be necessary for them to agree on the altitude and the course to be pursued. If the mission is Infantry Contact the altitude should be from three to six hundred meters, depending of course on the weather and the kind of terrain. One can sweep down and pick out uniforms in an open country, but it cannot be done in a forest like the Argonne. When an Army is advancing rapidly in the open, as in our advance toward Sedan, it is necessary to pick out friendly patrols in order to locate the lines.

Mechanics servicing a French Nieuport.

In flying along the line get in the sun and come with the wind if possible. Come with the wind preferably because speed is your best defense against anti-aircraft batteries and machine gun fire from the ground, and you are bothered more by them by flying Infantry Contact than by enemy planes.

Division Reconnaissance Missions should be flown at an altitude of from eight to fifteen hundred meters, depending of course on the visibility. It should not be flown higher than that as objects on the ground cannot be distinguished [even] when the visibility is perfect. One should not play around over his sector, but dart over and take a look and then come back over your own line. Repeat this until the sector has been covered thoroughly.

The best way to get away from enemy machines is to do an easy spiral with the motor turning about 1200 [revolutions per minute] or to do a gradual climbing turn. The former is best if you are close to your own line and the latter if you are far over enemy territory. In each case the attacking planes have to get inside the circle to shoot at you and if he does the observer has an unobstructed line of fire. These turns should be first to the right and then to the left in the general direction of your own line. That attacking planes will try to get in between you and your lines. It is needless to mention that this must not be allowed. Also, do not allow the enemy to surprise you.

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2d Lt. G.T. Lindstrom
Observer, 90th Aero Squadron

All the photographic missions on which I was sent were in the St. Mihiel sector, and were done during the preparation period before the attack and also during operations. These missions were for the benefit of the division with which the squadron operated, and were taken at an altitude ranging from 2000 to 2500 meters, and from the enemy front line to a distance of about 15 kilometers to the rear. I was also sent on several missions before and during the attack to take oblique photographs of the enemy front line position at an altitude of about 350 meters.

On some of the missions (when taking vertical views) I had two biplace planes from our own squadron for protection, and on several missions, the various pursuit squadrons operating in the same sector furnished the protection planes.

The equipment during these operations consisted of the 52 cm camera, without the automatic magazine, so a great deal of the observer's attention during the time he was actually over the course to be photographed was occupied in manipulating the camera.

During these missions (the vertical) I was chiefly concerned about four points, the course of the plane, enemy pursuit planes, anti-aircraft fire, and the whereabouts of the protection planes. Owing to the method I pursued in minimizing the danger from anti-aircraft fire a great deal of attention had to be confined to the course of the plane in order that the wind did not affect its course so as to blow us away from our objective, as the pilot had great difficuty due to his position in following the course true and allowing a proper amount for "drift". No especial difficulty was encountered in regard to following the course.

It was found that so much attention was required in manipulating the camera and watching the course of the plane, that it was comparatively easy for an enemy patrol of pursuit planes to come within striking distance before the observer was aware of their approach. With an automatic camera [which] was later used in the Argonne-Meuse operations, this danger was greatly minimized, as the observer's attention was not required so much inside the fuselage in operating the magazine. The greatest advantage a pursuit plane can have in attracting a biplace observation plane is to surprise the observation plane. The protection planes may see the enemy patrol and yet not be

able to communicate to the photographic plane except by machine gun fire close to it, unless the observer who is taking the photographs is ever on the alert. The photographic plane may also bring the whole mission to grief by continuing on a course which soon will place them in the midst of an overwhelming enemy pursuit patrol. One such instance occurred during the St. Mihiel operations. The photographic observer's attention was occupied in manipulating the camera magazine and did not see an approaching enemy patrol which outnumbered the photographic plane with its protection. Machine gun fire from one of the protecting planes, very close to the photographic plane, very quickly attracted the observer's attention to the impending danger and the quick maneuvering of the photographic plane with its protection planes, saved the mission from probable disaster. If all photographic planes were equipped with the automatic camera, this danger would be greatly minimized. Too much emphasis cannot be placed on the caution to all pilots and observers to be ever on the alert for enemy pursuit planes.

In regard to anti-aircraft fire, which an observer is bound to encounter on every photographic mission over the enemy's lines, I have found what I believe to be the best course to pursue in order to minimize the danger of a hit. In planning my missions I followed the course here given. Before leaving the ground plan the flight so that the course to be followed in flying over the objective is at a sharp angle to the approach at the beginning of the course, and if the mission is several kilometers behind the lines, it is advisable to fly at an altitude of 110 to 150 meters higher than the required altitude. In this way while the A.A. battery is figuring its data and getting the correct altitude the plane has time to fly some distance before the bursts come dangerously close and by the time the beginning of objective is reached the battery is firing with data which is entirely off as soon as the plane makes a quick turn and loses its extra altitude and is flying over the objective. Before the A.A. battery has had time to observe the change, in both direction and altitude, changed its data, and placed the bursts dangerously close, the end of the objective has been reached and no longer is it necessary to fly in a straight line.

The greatest danger from A.A. fire is while flying in a straight line without changing altitude. A gentle sideslip to a lower altitude has been found to be a very effective means of getting out of dangerous fire.

We experienced a great deal of difficulty in our attempts to take oblique photographs. Our first attempt was to suspend the

Aerial view of trenches.

camera on the inside of the fuselage but this proved to be very unsatisfactory, inasmuch as the oil from the motor could not be properly guarded against causing the lens to become dirty and fogging the plates. With this method of suspension great difficulty was experienced in securing a sufficiently small angle with the horizontal. The photos did not give the proper perspective. After several attempts at getting a suspension to fit the machine gun turelle so the photos would be taken over the side where the observer could see what he was photographing, and also he could secure a proper angle for the perspective.

This later arrangement gave excellent results after a yoke had been made which absorbed all vibrations from the plane. However, besides being very hazardous to fly at very low altitudes over the enemy lines with this suspension instead of the machine guns it was also very difficult to manipulate due to the

blast of the propeller coming full on to the camera, making it extremely difficult to swing the camera towards the side. In changing magazines difficulty was also encountered with the shutter in the camera. Nevertheless several successful missions were accomplished with this camera.

Some of these missions were sent out with protection planes as the photographic plane was practically undefended, and some were sent out without protection. Due to the extremely low altitude, protection was hardly necessary as no enemy planes were encountered at that altitude. The anti-aircraft fire was also rather inaccurate at such low altitudes and without protection, the photographic plane drew less fire than it would have had protection ships gone out with it.

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2d Lt. A.W. Parr
Observer, 90th Aero Squadron

To properly discuss the question of cooperation of aviation with artillery we must divide it into two parts: work in a quiet sector with the warfare of a stationary nature, and condition of the war of movement.

With well trained artillery personnel and good communication artillery reglage is highly successful in a quiet sector, or any sector where the lines are not changing rapidly. But it should be remembered that aviation should only be resorted to in directing artillery fire when terrestial and balloon observation fail, on account of obvious reasons—i.e. greater expense, uncertainty of communication, intermittency of observation on account of enemy planes, and the very fact that the plane moves thru the air so fast. In general, the methods as laid down in the regulations are adhered to in firing. Of course the standard panels and letter and number signals are used and they are ample for most conditions. It is imperative that the reglage be personally arranged preferably by the observer who is to run it, as that is sometimes impossible the observer on liaison with the division may arrange the details. After a number of reglages with the same battery this is not so necessary as both parties become accustomed to working with the other.

The average battery commander prefers to follow the book but is generally willing to modify some of the methods. For example the B.C. may prefer to do amelioration by piece which from his standpoint is better than amelioration by salvo whereas the

A 75-mm field artillery gun in action.

observer may prefer to do it by salvo on account of the intermittency of observation. He generally is willing to let the observer choose the method.

It is rare to run a reglage clear thru for effect. An observer can economize time by firing two batteries at once, altho this practice too is rare.

In the war of movement reglage plays a different roll than in stationary warfare. It takes the form, during an attack, of fugitive target work in which batteries specially assigned to the work are brought to bear on chance targets, which the observer might see, such as a convoy on a road, a column of troops, an anti-tank battery, any battery in action, machine guns, etc. Generally you have one 155 battery and one or two batteries of 75's. It is best to call on the 155's for counter battery work as they are more effective. Also it is easier to observe for them so it is to the observer's advantage to use them. It is necessary to remember the field of fire and range of your batteries. I once tried to get a fugitive target battery to fire on a very fine target without result. When I landed and measured the distance accurately on my map, I found it to be just a kilometer out of range. The B.T. line looked very short at 1200 meters in the air but in reality it was too much for the 75's and I had no 155's at my disposal.

Fugitive target work in time of battle is generally pretty offhand work. You give them one correction and then go to

some fire. No one wants to make a complete adjustment to a target when you have to get in the barrage all the time as you frequently do on account of low clouds. Also you want to keep your eye out for other targets, to fire on. It has been our experience that reglage during an attack is not very satisfactory altho it should be attempted in many circumstances. The batteries are on the move, and their receiving stations are often in bad working order; at least they don't get our signals altho we test out our wireless at the squadron. In any case knowing the location of your batteries you can drop them a message giving the coordinates of enemy targets and they can fire if need be without further assistance from you. But in every case communicate by wireless if possible.

While each observer may have different ideas about flying a reglage, here are some suggestions which have proven useful: Call your battery on the way over and while getting your battery ready, cross the enemy's lines to reconnoiter the target after that you can keep on our side of the lines, unless you have to fly very low and the visibility is bad. In making your circles or eights don't fly exactly the same course twice in succession, thereby making impossible for anti-aircraft to lay on you by knowing just when you are due to reach a certain spot. It is necessary to zig-zag more or less to dodge archies but unless you turn sharply your wireless will be received. While sending, keep a close watch in the sky; also just before your shots are due to fall look around for planes.

—55—

2d Lt. William Bolt
Observer, 50th Aero Squadron

Too much emphasis cannot be placed upon the importance of the liaison between the ground and the air. Good ground liaison between the various units engaged during a battle is very essential but there are certain pieces of information that can be more quickly found out and sent to the proper authorities by the aeroplanes. The aeroplane, equipped as it is with wireless, flares, V.B. rockets and dropped messages not only affords a rapid means of communication, but many times the only means by which certain information can be taken from one unit to another.

The location of our advanced troops, enemy troops, batteries, machine gun nests, convoys, counter attacks and train

Laying out panel markers.

movements can be quickly sent to those in command. Ground liaison is essential and likewise liaison by means of the aeroplane is essential. To get the best results close liaison between the ground must be maintained. This is very true when working with the Infantry. Infantry Contact Patrol work will under the most favorable conditions present unexpected difficulties. In order that Infantry Contract Patrol work be successful it is necessary that the Infantry know the meaning of their panels, flares and rockets and also the insignia of our planes. The Infantry should not only know the meaning of the various signals used, but when and how to use them. The observer on his part must know his sector thoroughly. He must know his map so well that he can at any time while in the air tell exactly where he is without looking at his map. This is very necessary in Infantry Contact work, because the observer is under ideal situations kept very busy.

The clouds, poor visibility, the nature of the terrain, enemy anti-aircraft, machine guns and enemy planes prevent the observer from devoting his entire time to looking at the ground. He must be constantly on the alert and as his time is limited, it is necessary that the most information possible be gathered in the least possible time. If when the observer by use of the V.B. cartridges calls for the line the infantry do not show their panels and flares, Infantry Contact Patrol work, cannot be successful. Experience has proven that many times the panels and flares are not displayed and if they are not it is practically impossible to say exactly where the advanced troops are. If the panels and flares are shown the work is much more accurate and easier. In case no flares or panels are shown, there is only one thing to do; descend to an altitude from which men on the ground can be seen.

The way to do an Infantry Contact cannot be laid down definitely by a set of rules. The way to do an Infantry Contact depends upon the conditions at the time. The visibility, enemy

planes and the terrain make the method of flying different on each occasion. The pilot and the observer must understand each other and work together at all times.

Reconnaissance work differs greatly from Infantry Contact. Here too, the observer must always be on the lookout for enemy planes. In reconnaissance one flies several kilometers into the enemy territory hence it is more probable that he will be attacked by hostile aircraft. The observer must not allow the enemy to surprise him. He must remember at all times that he is sent out to get certain information and it is his duty to get that information and return with it. Under no circumstances to return without doing all within his power to fulfill his mission.

—56—

1st Lt. Howard C. French
Observer, 50th Aero Squadron

Safety over the enemy lines for Observation Planes depends mainly on the watchfulness of the observer. If enemy planes are seen soon enough on nearly all occasions the observation plane can get away, even if the enemy has large numbers. A good observer should see enemy planes in time to have his guns trained on them long before they are in range.

If on observation for a Divison, where the distance to be covered is only a short distance behind the enemy lines, the enemy is encountered in larger numbers than yourself, the Observation Plane should return to its own lines. You can then enter your sector from a different place. If chased out again continue to return and you will gradually cover your sector and get the information to the rear without engaging in a fight.

On entering the enemy territory immediately start to side slip, change direction, etc., even if the anti-aircraft guns are not firing at you. They will allow a plane flying a straight course to get within good range before firing. In this case the first shots they fire are the most accurate.

If attacked by a small number of the enemy, it is best for the observer to begin firing at long range. The enemy will know that you have seen them and are on your guard. Knowing this they will hesitate to close in. However, if the enemy is in large numbers he will attack anyway and it is best to wait until he is within 300 yards before firing so as to have full magazines at an effective range.

If two or more biplace planes are attacked while flying together, by closing in very close to one another and protecting each other's dead angles they can hold off a large number of the enemy.

Reconnaissance. When flying short distance reconnaissance, on a clear day, it is possible to stay directly over your own front lines at an altitude of about 4000 feet and still cover your sector four or five kilometers to the enemy's rear. To do this, while looking at the ground you must not cover too much territory at a glance. Watch particular spots and gradually cover the sector this way.

This is also a good position to spot enemy batteries in action. The flash of a gun can be seen as far back as eight or ten kilometers. It is possible to locate batteries from this position which would not [be located] if they saw a plane overhead.

On a day with poor visibility, after ascertaining that the air is clear of enemy aircraft, it is a good plan to cross the lines at an altitude of about 3000 feet and when four or five kilos behind them to come down to 1000 feet or lower. In this way the machine guns on the front line can be avoided. In the back areas, machine guns are not found so thick and it is possible to get valuable information at this low altitude.

Infantry Contact Patrol. While flying Infantry Contact Patrol I have noticed that the infantry seem to think that all planes are enemy and on several occasions have fired on their own planes. This I believe is due to some extent that the Infantry does not know the American insignia. While acting as a ground liaison officer with the Infantry, I encountered infantrymen who were still looking for the star in our insignia.[a] This was as late as October, 1918. They said they got the idea from looking at pictures in American magazines showing the old insignia. Not recognizing our planes causes the infantry to be slow about showing panels and flares.

In calling for the infantry line it is better to fire the rockets ahead of them rather than directly overhead. They are more likely to see the rockets.

Six-star rockets, which are the ones most frequently used, are very often faulty and do not show the full number of stars. I believe it would be better to use a rocket with a smaller number of stars, in calling for Infantry line, as they are more accurate and burn longer.

During very open warfare, as during the last phase of the advance on Sedan, it was possible to locate the extent of our advance by the formation our Infantry were moving in along the roads. This could be done from a high altitude of 3000 feet. Often, knowing the approximate location, the observer could

descend to a very low altitude to get more accurate information without the danger of being over the enemy lines at a low altitude for any great length of time.

When flying low over woods occupied by enemy troops, a plane appears to be a better target at an altitude of 1000 feet than at 100 to 200 feet. When real low it is a fleeting target for the men among the trees. Tracer bullets from the ground are the most accurate. They also give away the location of the gun firing them. A few shots by the observer in their direction usually causes them to stop firing or stop using tracers.

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1st Lt. James E. Sain
Observer, 50th Aero Squadron

Infantry contact cannot be governed by any certain set of rules but each time changes in order to get results. The difficulties to overcome are rarely ever the same, but by knowing the experience of a few, the others become easier. For instance, if the observer knows approximately where the line is, then he can come down very low and find it even though no flares or panels are shown and if he doesn't know except that it is within five kilometers, then he must start and work up slowly firing rockets continually. The terrain must be known perfectly by the observer or many things of importance will be passed up before they can be definitely located. The kind of terrain also makes a great difference in the observer's ability to carry out a successful infantry contact, woods and mountains being the greatest drawback.

There are always several things to do almost at once, firing rockets, locating things on the maps, watching the sky for enemy planes and directing the pilot, and there should be a perfect understanding between the pilot and observer. There are several things to prevent an observer from doing a successful Infantry Contact, the main three being: Poor visibility, fire from the ground and enemy planes. The first is overcome only by low flying. If visibility is good, to escape fire from ground fly around five hundred meters and change direction constantly, and to get away from enemy planes, never allow him the advantage and you are reasonably safe. The Infantry Contact report is very important, therefore much care should be taken to get it absolutely correct.

Reconnaissance is very different from Infantry Contact and yet it is very much similar. The object is to see in both, but different methods are used to see it. In reconnaissance, everything you see should be behind the enemy's lines. Fly so as to cover as much ground as possible at one time, yet see it well, and that means no one altitude can be used. Spend the time looking where things naturally would be; in woods, valleys, along side of roads, etc. When an object is seen circle round it until sure what it is, if necessary to even distinguish uniforms. If fired at from ground at this altitude, return the fire and the enemy seeks shelter. The main difficulties in reconnaissance are anti-aircraft guns and enemy planes. The first is overcome by changing altitude and direction. Enemy planes should never be allowed the advantage of getting between you and your own lines or surprising you.

One of the greatest aids to observers is having experienced men as instructors. They have been given the wrong impression about many things before going to the front and that is especially so with Infantry Contact and reconnaissance and many important things were left out. Not enough time was spent in map reading and cross country trips to be followed by maps alone.

—58—

1st Lt. John W. S. Gilchrist
Observer, 104th Aero Squadron

1. Infantry: So far as I observed the most successful infantry missions were those in which the observer did not call for the line with rockets, but by very low flying found the advanced elements of infantry on the ground—generally in patrols and not in the oldtime line—and reported where those troops were. Occasionally the infantry answered rockets but not often. In my opinion the reason for this was that observers were sent out far too often with the order "Find the line." The infantry got tired of seeing the signals from the aeroplane. So long as the infantry is advancing it is not hard to find detachments of them, but when the infantrymen are halted and dig themselves in and their position [is] fairly well known, they do not want to expose themselves to enemy observation. At such times, no aeroplanes should worry the infantry with rockets. In my opinion the Air Service should have a few signals for use with the ground and use them sparingly.

Insignia of the 104th Aero Squadron.

2. Instruction of Infantry: A great many infantry officers who criticize the Air Service preface their remarks by, "Well, I don't know anything about the Air Service, but—." Not only junior officers, but officers of the grade of Major or higher often make criticisms that show they do not understand the nature, function, and limitations of the Air Service. Some system of lecture, as many rides in aeroplanes as is practical, and visits to Squadrons where they can see photographs and reports, and talk to the pilots and observers, would bring about a better understanding.

3. Instruction of Air Service. Air Service officers who could go to the front on visits to the infantry would probably learn a great deal that would help them in their work.

4. Artillery and Air Service: In my opinion the Artillery expected too much of the Air Service without having a very clear idea of how to work with the Air Service. An Observer who had been an Artilleryman, could by visiting batteries and being present when shoots occur, clear up many misunderstandings.

5. Morale: So far as I observed, the pilots and observers in my squadron were anxious for this Squadron to have a good name and wanted to do their work in as good a manner as possible. But they resented in being sent out on missions when weather conditions precluded a possibility of success—for instance, photographic missions that were sent out on cloudy days or late in the afternoon. They sometimes felt that they were being sent up on missions which were of no particular use and did not believe that the mere fact of "flying at the front" was worth while unless they could accomplish something. A frequent cause of complaints was the system of alerts. In only one case I can call to mind was the mission of such a character that it had to be executed instantly. The other missions assigned to pilots and observers on alert were generally those which could be performed at any time within a three or four hour limit.

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1st Lt. John W. S. Gilchrist
Observer, 104th Aero Squadron

Recommends: That a systematic plan of education in the possibilities, uses, and limitations of the Air Service should be given to all Infantry and Artillery officers to overcome the hostile attitude now felt for the A.S. by those branches. Also that Air Service officers visit the Infantry and Artillery with which they are to work in order to clear up misunderstandings concerning the duties of each branch.

—60—

1st Lt. John H. Caufield
Observer, 104th Aero Squadron

1. I think artillery reglages were very unsatisfactory during my presence at the front (Sept. 25th-Nov. 11th, 1918), but that the chief cause was the artillery's ignorance of airplane work. As much training as possible by actual firing to familiarize artillerymen with aerial methods and its limitations, is the only remedy that I see for such a condition. I think the panel and radio system now in use is a good one.

2. I believe that Infantry Liaison was fairly effective during the period mentioned, but that it would have been much better had the infantrymen been impressed with the advantage of signalling to planes by panels, flares and rockets. Both officers and men were very ignorant as to what they were supposed to do to uphold their end of the liaison. Some officers did not know even what a six-star rocket meant, and were completely in the dark regarding the finer points, such as the use of battalion or other P.C. panels, ground-signal rockets, etc.

3. One of the chief causes of other branches neglecting their end of the aerial work, I believe, was their attitude toward the air service. Artillerymen, infantrymen, doctors, and in fact every branch of the service engaged at the front, take an unfriendly attitude toward the air service, not toward men in the air service personally, but toward the service generally. They have wholesale collections of stories as to airplane inefficiency and even cite some cases of alleged cowardice. All of such stories can be traced directly to ignorance of aerial work, and to exaggerated ideas regarding the number of American planes at the front, and the work they were expected to accomplish. They base their notions on newspaper stories and want results to match. If some real facts were published, even now, regarding the number of planes that took part in the American offensive and the casualties, accomplishments, etc., of these planes, I think it would do a great deal to raise the Air Service in the opinion of other branches. When they change their attitude toward the Air Service, and become more friendly and tolerant, they would probably show more interest in their end of the work, to the benefit of all concerned.

—61—

1st Lt. Fay W. Williams
Observer, 104th Aero Squadron

Infantry Contact: The work of an infantry plane is best divided into two phases, times of attack and quiet times.

At times of attack, a plane over the line at all times is imperative, and if the regimental and battalion headquarters had displayed their panels, this plane would be of great assistance. About all we could do was to report a group of men progressing here and there as the infantry can't stop and display their panels. The failure of liaison between the infantry and the air has been due to lack of training.

In quiet times the front line should not be called for except at daybreak and late in the afternoon unless other orders are received from Division Headquarters. The front lines should not be called for until the end of the mission. Quite a good deal of time is lost due to not flying in our own sector. Each pilot and observer should have his sector limits fixed in his mind and not go outside of them. Identification rockets must be shot when the plane is in front of our own line in order to get results.

Artillery Reglage: Our main trouble has been the lack of liaison. It is absolutely necessary for a successful reglage that the pilot and observer should see personally the commander of the battery and find out his method of fire and limits of range and deflection. Quite a few times locations of targets were dropped on the nearest battery and it was usually out of the area covered by the battery and by the time Headquarters were notified and a battery designated our gas supply became exhausted. A plane sent up every afternoon just before dusk can locate enemy batteries and this is of the utmost importance. This was done but seldom and we did not accomplish what we should have in this.

Counter Attack Plane: This plane should not start over until after two or three hours of the beginning of the attack. Results obtained in the first hours were unsuccessful and I believe a counter attack plane should cover a corps sector instead of a division front as the latter is too small for successful counter attacks to . . . [form?].

General Impressions: The main reason for the failure has been due to the ignorance of the capabilities of an aeroplane by the Infantry and Artillery. So much has been promised by the newspapers that actual statements should be given in order to change the hostile attitude taken by the infantry and artillery.

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2d Lt. Fred E. D'Amour
Operations Officer, 1st Aero Squadron

I. The chief criticism which I consider can be made as regards the use of aerial observation is the crying need of ground units for training in working with the Air Service. One does not realize how totally ignorant our troops are as regards aerial work until one works as ground liaison officer with a division now at the front. This ignorance is not limited to the troops themselves, the command is equally unfamiliar with the advantage and limitations of aerial cooperation. It is important enough when our own troops shot down an American aeroplane as has happened several times in this squadron, but it is even more unfortunate when Division Commanders refuse to give us their cooperation, and the entire work of a squadron is in vain. A case in point is when the C.A.S. [?] of the 80th Division refused to arrange practice exercises [with] us, another where the Commander of the Artillery Brigade of the 35th Division hesitated to assign a battery for fugitive target work, saying "we gave him his own men for targets" and another where the same division had been in the lines for 4 days without any of the P.C.'s except the division having their panel.

These faults can only be remedied by a course of training, not only of men, but officers as well. It need not be a long course for infantry, merely to make the men familiar with the American cocarde and to teach them to display their panels when called for. This would require only four or five practice exercises.

In artillery the course should be more thorough and repeated frequently. It is [not] necessary that any actual firing be done, since, the main difficulty has been in lack of liaison between airplane and battery commanders and not any fault of the men at the guns. For this reason, only panel exercises are necessary, a shoot being actually run through, corrections sent and all the workings of an actual reglage gone through, except that no guns are fired.

I believe that the above criticisms have been repeated over and over again so often indeed that they seem to lack force. But experience has proven beyond question that no matter how efficient the personnel of a squadron may be, no matter what improvement is made in type of machines, the Air Service *must* have cooperation from the ground forces in order that the results obtained will justify its future maintenance.

II. Several times while this squadron was operating at the front

A wrecked aircraft of the 1st Aero Squadron, following an observation mission on 6 July 1918.

it was called upon to make practices with divisions in training behind the lines. This extra work was always called for at times when the resources of the squadron were strained to the utmost keeping up operations over the front and at times when it was far below its required quota of pilots, observers and planes. It is easy to see that the squadron could not carry on its regular work with the same degree of efficiency, when called upon for this practice work in addition. Had the training above mentioned been done previously, it would not have been necessary to call on an already overburdened squadron for work which should have been done in the S.O.S.

III. There is an over-organization in the Air Service which causes considerable confusion. The squadron is a complete unit in itself and I see no necessity for a group organization. The Chief of the Air Service of the corps could just as well be group commander and send his orders to squadrons direct, rather than relay them through the group causing a duplication of work all through. Every Squadron has its own operations, its own supply, its own transportation, and I fail to see any reason for the existence of the group.

IV. The Squadron Commanders should be the final authority as to whether or not weather conditions will justify a mission being sent. He should not be forced to send out a mission against his own judgment by a higher authority unfamiliar with the conditions.

V. I believe better results would be obtained, more work accomplished and the good spirits and morale raised by giving more recognition in the way of promotions and decorations to the flying personnel, especially observers. An observer is much more familiar with the work of an observation squadron than a

pilot is, yet I know of only two cases where observers are in command of squadrons. Only one observer in this squadron has been promoted while five pilots have been thus honored. In no case is the table of organization carried out, it seems unnecessary to prepare such a table unless its requirements are fulfilled.

VI. Red Tape. I leave this problem for someone wearing stars to solve.

—63—

1st Lt. Howard T. Fleeson
Observer, 12th Aero Squadron

It is only when pilot and observer have an intimate knowledge of the terrain over which the attack covers that infantry liaison can be accurately carried out. The pilot and observer must at all times keep their sense of direction. This is done by means of the sun and by the outstanding features on the ground. The observer's study should be contours, as well as the roads, woods and rivers which are the necessary points of study in every kind of aerial observation. Both pilot and observer must know the exact location of the present line, the objectives of the attack, the hour of attack and the hour that the objectives should be reached.

It is best to reach the lines at least 20 minutes before the advanced positions of the infantry are to be taken, this allows time for a study of the situation on the ground and in the air. If the air seems free of enemy aircraft, fly up and down the old lines once or twice, if you meet with hostile machine gun fire from the ground, it is obvious that the advance has been held up. Perhaps it is only local, that is, at one end of the sector you meet with machine gun fire and at the other end you do not. Fly further in the next time except at the points where you know the enemy are. If you meet with no fire from the ground still, cut in farther at certain points you will no doubt see friendly troops, if they are the most advanced units they will sometimes wave their panels before you call for them. In this way you get an idea where to expect the panels or flares as you have an approximate idea as to the location of the lines. Before shooting your six star rocket, take a survey of the sky for hostile aircraft as it is the most favorable moment of attack for the enemy, as the observer will be busy watching the ground and the pilot the course he is flying. It is here that a study of contours is so

valuable to the observer; it permits quick and accurate locations of the panels or flares displayed by the infantry.

If troops are going forward, they will not always display panels. If you meet with this situation, continue to follow the advance until it is held up. At this point, Battalion Commanders by means of battalion panels may call for a lengthening of the barrage, hand grenades or ammunition, or state that our artillery fire is falling short or that our troops are unable to advance farther. The aeroplane here becomes of great value in transmitting this information to Division Headquarters. It is sometimes possible to aid the infantry by machine gun fire from the air on the strong points of the enemy. This is greatly appreciated by our own troops and extremely discouraging to the enemy. However, the work of straffing should not be done until Division Headquarters has all the information that it is possible for you to give them.

The least number of six star rockets it is necessary to fire, to secure the result sought for, the better. Infantrymen complain that the shooting of rockets from the air gives information to the enemy artillery for their adjustment on our front line positions. The writer believes that there may be some truth in the statement. In doing Infantry liaison when our troops were on the heights west of Chateau-Thierry, I shot about four rockets, after getting the line we flew up and down, seeking to aid the infantry in any way possible. It was not long before the enemy began a violent bombardment of these advanced positions. Whether this was a prearranged barrage on our positions or incited by our shooting the rockets, I do not know.

Oftimes the infantry has not been trained in the use of panels; in such a situation, you will have to fly low enough to distinguish uniforms. When the visibility is good, this is possible from a height of 200 meters, but you will often have to go low as 50 meters to be sure of your identification. Unless panels are shown you cannot be sure that the troops seen are the most advanced; so in writing your report, it is best to say "Friendly troops seen at" and "Infantry showed panels at."

The enemy seeks to prevent aerial observation by two methods; first, antiaircraft and machine gun fire, and, secondly, aircraft of their own. The former is the least effective of the two but is dangerous for the inexperienced. Antiaircraft is avoided by constantly changing altitude and direction, machine gun fire by skidding and increased speed. Enemy aircraft will seldom if ever attack a biplace machine unless it has superior numbers. When attacked, it is best to withdraw and make a running fight toward your own lines. The attacking planes will come under your tail and in a vertical dive on you from a higher altitude. The pilot

will kick his rudder to throw off their aim and when he does this you are able to get a good shot at the one underneath. For the one above about all you can do is to pray that he is a poor shot. Don't get excited and aim on the nearest first. Shoot in short burst of five or six shots. On the approach of hostile aircraft, the observer should fire a short burst at long range so as to inform the pilot of their proximity; the pilot likewise must notify the observer of all planes which he deems hostile.

—64—

2d Lt. W. J. Rogers
Observer, 50th Aero Squadron

Rogers was the man who "found" the "Lost Battalion." During an advance by the 77th Division on 2 October 1918, six companies of the 308th Infantry and two companies of the 306th Machine Gun Battalion had penetrated the enemy line and had been surrounded by enemy forces. The 77th had tried for several days to break through and reestablish contact but without success. The battalion had displayed its panels, but the 50th Aero Squadron, which was working with the 77th Division, had been unable to spot the panels or other signs of the battalion at the place accurately reported by the battalion commander in messages sent by pigeon. Food, ammunition, and other supplies dropped by the 50th Squadron had landed just out of reach of the Americans, who were hanging on to their position in a wooded ravine. On the morning of 7 October the 77th and other American and French units made another effort to reach the battalion. Flying with 1st Lt. Robert M. Anderson (see Document 51, above), Rogers spotted a panel that morning about 200 yards east of where the airmen had been looking for the battalion. Rogers immediately reported the coordinates by message to the 77th Division. The ground attack was successful, contact with the battalion being reestablished later the same day.

In doing an Infantry Contact Patrol, I first fly along the sector over our own artillery to get an idea of the battle. Observe where the barrages are falling, friendly and enemy, and get an idea of the enemy aerial activity. I judge the approximate location of our lines. Then fly in on our side of the sector, fire a rocket and come out, say 500 meters. Then go in on the other side and

Airdrop to the "Lost Battalion" from an airplane of the 50th Aero Squadron. (Painting by Merv Corning.)

fire another rocket. By this time the line is being shown where I fired the first rocket. I get up close enough to see the panels and flares and fly across the sector, putting the line on my map as I go. Then I'm through.

I did most of this work at 500 meters altitude. When weather conditions are such as one must fly lower than this altitude, it is well nigh impossible to do the mission. In open country an observer can fly along a road, or a small wood, and locate troops on the ground orienting himself by villages, but in a forest like the Argonne, when there is a fog or mist, when you lose sight of the villages on either side, it is like being on the sea. You must fly by compass. You cannot locate what you see on your map with any accuracy. The results obtained, therefore, do not compensate for the risk incurred. A machine gun or a rifle bullet from the ground, and the resultant forced landing destroys a machine and kills pilot and observer. The records of this squadron furnish the unrebutted evidence of this fact.

The manner in which panels are laid by the infantry so as to take advantage of the sun and contours is of the utmost importance. When the writer located the famous Lost Battalion in the Argonne Forest, they had put their panels on the side of a hill, in, and facing the sun. I could not mistake them.

When panels are put in shell holes, they should be put on the side and facing the sun. If put in the bottom they look like water. Panels cannot be seen from the air very easily if the sun is shining and they are in the shade.

An infantry observer should not strafe, except under favorable conditions. He is the best trained man in the Air Service, and he accomplishes but little at this for the risk he is taking. He is too valuable for such work. However, there are times when he can take the enemy unaware and inflict many casualties.

When the Americans made their memorable breakthrough from Grand Pre to Sedan, the writer was observing the disorderly retreat of the Germans on one occasion. On a road through a small forest there was much artillery being rushed to the rear. The pilot, Lt. Anderson and I fired about 800 rounds on the road before the Germans could realize what was happening. By the time they had crawled into shell holes and other hiding places with rifles and machine guns, we were gone. It would have been suicide to have returned. The French civilians in a nearby town informed us later that we killed 60 horses and as many men. The good results were due to the excellent aerial gunnery of the pilot in the first instance and the fact that we enfiladed the road. We had a very few aerial combats in our work. I think the DH4 with the Liberty motor must have been divined by the Germans as a two-seater fighter.

They came around in Fokkers many times in superior numbers, looked us over, and went away. Sometimes they would fire a few shots.

One Fokker went around into the sun one day and came at Lt. Anderson and I three times. We left the sector three times but each time returned and finished the mission without a combat. My experience was that they wouldn't attack the Liberty without a distinct advantage.

In conclusion I might remark that aerial observation is neither a bed of roses nor the path to glory that the man on the ground sometimes imagines it to be. The wind behind a Liberty is terrific, and it taxes the strength of the strongest to fight it 3 hours. If the ship is rolled and tossed about very much, either by bumps or purposely to avoid shell and shrapnel, the occupants sometimes get sick. Very similar to sea sickness, you lose your lunch and the wind places it in a neat layer on your goggles. The wind has blown your hankerchief from your pocket. You wipe it off on your teddy[a] sleeve. You start to write your messages and of your three pencils you have one left. You break the point on it and your knife is in your pocket under your teddy bear.

You read in the air report the next day that our chasse men shot down 30 planes, and that the efforts of reconnaissance planes to drop provisions to a lost battalion were of no avail, all falling to the Germans.

But I like it. I'm sorry we had war, but since we did, I'm glad I was an aerial observer.

—65—

2d Lt. James E. McCurdy
Observer, 50th Aero Squadron

Too much importance cannot be given to close liaison between the infantry and the aeroplane. While the infantry are advancing and obstacles are being overcome, even in the best terrain, it is impossible for quick and precise information to be obtained by the ground liaison agents.

No matter how thoroughly trained the Infantry and Artillery may be, there are sure to be times when the shells from our own guns will fall upon the advancing troops and unless information on this is quickly gotten to the artillery units supporting, the attack is held up and many lives lost, at a time when every life lost and every second of delay diminishes the chances of success.

U.S. infantry troops advancing over "no-man's land."

In order to have close liaison between the infantry and the aeroplane it is absolutely necessary that the infantry rely on the aeroplane for communicating with the commanders in the rear; and it is of even greater importance that all signals from the aeroplane be properly interpreted and promptly answered. Nothing is more discouraging to an aerial observer than consistent delay on the part of the unit with which he is working in answering signals.

Through negligence on the part of the officers, infantry units have been known to go into action without having been equipped with liaison materials (panels, flares, etc.) and without instruction in the use of these materials. This is gross carelessness, and the officers guilty of this are taking unnecessary chances with lives of their men. When an aeroplane calls for the line, those men showing panels and flares should make sure they are the advanced units at that point, as showing of more than one set of panels in depth leads to confusion, and confusion in battle means disaster.

When troops are in thick woods, the showing of panels is useless as it is impossible for the aerial observer to see them, but flares show up plainly as a smudge of blue smoke. In case the Infantry units are without flares an ordinary smoke smudge would be recognized.

Now comes the question of altitude. No two observers will agree on the correct altitude to fly on infantry liaison, but it is a

fact that little can be accomplished at a greater altitude than 300 meters. For my part I have always found 100 to 200 meters to be the best altitude for good work. At this altitude the danger from enemy machines is diminished by half, for a plane is not likely to attack and if he does attack, he can only attack from above; also the anti-aircraft guns cannot be used on a machine at this altitude, while machine-gun fire from the ground is no worse at this altitude than at 300 meters.

The last point I will mention is a proper understanding between pilot and observer. An observer, in order to be successful in infantry liaison, must feel the utmost confidence in his pilot; also the pilot must feel that the observer is perfectly competent to carry out his mission and at the same time guard the machine from attack from the air.

When I say an observer must feel the greatest confidence in his pilot I mean that he must feel that his pilot is not only a very brave and willing flyer, but that he is a very skillful one. I remember on one occasion while flying on a photographic mission with two other machines, we were subjected to heavy fire from machine guns on the ground and anti-aircraft. It did not seem possible for the machines to escape without injury, but I felt no fear for the safety of my own machine for I had confidence in my pilot though at the same time I felt the liveliest fear for the safety of the other machines.

—66—

2d Lt. Adolph O. Devre
Liaison Officer, 50th Aero Squadron

The duties of a squadron liaison officer may be compared favorably with those of a walking delegate of a labor union in civil life; both act as the buffer between their respective organizations and those for whom they work, and both are constantly on duty to see that the interests of their constituents are carefully safeguarded, and to clear up any misunderstanding which may arise between them and their employees. The liaison officer is the medium by which the aero squadron and the line forces with which it is working, come to a complete understanding of the work at hand and thru him any difference may be adjusted.

The aero squadron liaison officer must be thoroughly familiar with the duties of the aerial observer, and he must be well impressed with the limitations as well as the possibilities of aerial observation. He must, therefore, have had actual experience in flying over the lines, and accordingly he is selected from the squadron roll of observers, temporarily detached from the squadron and sent to the Headquarters of the division with which his squadron has been assigned to work.

On arriving at this post, the new liaison officer at once seeks to make himself known to the officers of the divisional staff. This is done on his own initiative or under the guidance of one of the staff officers. The Chief of Staff will explain what he expects of the aero squadron, and criticize what they have done for his division in the past. From the Operations Officer and Intelligence Officer can be found the means of obtaining that latest information as to the situation on the sector. The Operations Officer will also, on request, furnish a copy of the field orders and the plan of liaison for whatever movement the division may be interested in at that time. The Chief Signal Officer has charge of all lines of communication, and the liaison officer should at once find out from him the best way to communicate with the squadron, the system used in receiving the radio and dropped messages from the airplane and the codes in use. From the Staff Officers of the Artillery Brigade the distribution of all artillery units can be determined and what units rely on aerial observation for their fire control.

The daily work of the liaison officer varies to a certain extent. He must at all times be sure that the proper divisional panel is being displayed, and in such a position that the observer can readily see it. He will make sure that the panel men understand their work and that they are in direct communication with the radio receiving set. He must keep in close touch with the operations and intelligence offices; any abrupt change in the position of the front line, or change in an artillery location must be sent to the squadron at once. All reports on aerial activity must be investigated thoroughly, especially those involving the work of his own squadron.

It is also important that the liaison officer visit the artillery battalion and infantry brigade posts of command to see that the airplane is giving good service and is receiving proper co-operation from the ground. The infantry must at all times be equipped with panels and flares, and instructed in the proper use of each. With the artillery the exact method of fire must be agreed upon, and also the number and positions of the batteries designated for fugitive target work.

The whereabouts of the liaison officer must always be known

U. S. 155-mm artillery guns at Varennes.

at division headquarters. In case a special mission is required, the operations officer will notify the liaison officer of the nature of the mission and the hour of the execution. The liaison officer will promptly transmit this request by telephone or radio to his squadron operations officer who will start the airplane on its mission.

In addition to the above routine, the liaison officer must assume the roll of missionary, for there seems to be a widespread lack of knowledge in the line forces as to what an observation squadron can do and what it cannot do. Many infantry officers think that our planes fail in their missions because they do not patrol up and down the front line continually to prevent the enemy from strafing our trenches, yet they also insist that we keep a lookout on the enemy's back areas. Daily, innumerable questions about the Air Service are asked of the liaison officer, and he can readily dispel some of the erroneous ideas which seem to prevail at the present time.

—67—

2d Lt. Walter L. Francis
Observer, 90th Aero Squadron

There are but few flying men who will not agree to the statement that infantry liaison or infantry contact, as it is probably better known in the American Service, it at once the most valuable, most dangerous, and most difficult type of airplane work. Of course it is only carried on in periods of attack when our troops are advancing and when lines of communication from the front to the P.C.'s are very often useless.

Theory says that the Infantry contact plane will fly from 800 to 1000 meters and that when called upon to do so by prearranged signals the infantry will show their panels or flares on the ground, the observer will plot the line of panels thus formed and will drop a map with the line marked out upon it. Practice, however, is widely different. First of all the infantry is very busy fighting, and at 800 to 1000 meters your signals would many times be unnoticed. Then again a battlefield is covered with debris, papers, and various things which look like panels from that altitude. So you find first of all that you must fly lower. Still for some reason you can only see a panel here and a flare there, and you see also some figures moving on the ground but you cannot make out whether they are friend or enemy. Again you decide to go down a few hundred meters. Now you are flying at a hundred meters or less, well within the trajectory of the artillery, and also within range of enemy machine guns, but you can make out your men and the enemy also. Your signal rockets also fall nearly to the ground and are seen by the men. Now the proposition comes down to locating the advanced elements of your own troops, which in the method of attack now used against enemy machine guns, will never form a continuous line, but will merely be groups of men spread out, and advancing slowly to encircle and put out of action the points of resistance which are bothering him.

One case is known where an Infantry Liaison mission was carried out with a thick layer of fog at fifty meters. The team doing the work flew to the point where the troops should be, dropped through a layer of cloud and proceeded at that very low altitude to locate their advanced units with good results.

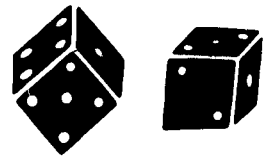
There is always the enemy scout plane to be kept in mind. The observer cannot hang over the side and search the ground as he does in training, but must continually be on the alert against monoplace attack. A French observer of three and a half

years experience once told me, "The secret of successful observation is to never be surprised. Watch the ground one second and the air nine." His idea was that if you see your opponent as soon as he sees you or sooner, you can at least choose your own position for receiving his attack. Any flier knows that the biplace attacked by a scout cannot attack and expect to survive many such combats.

Many times when rapid advance is being made the team performing the missions does not know exactly where their troops are expected to be. Some observers have quite successfully used the following plan: They flew well back into the sector, until they saw large groups of our troops in close order advancing on a road, then they turned about and following the road back until the units grew smaller and finally disappeared, they then began to look for the advanced elements, and gradually picked them up and established the line. This again means flying at low altitudes where friendly troops can be recognized by sight. Another squadron at Chateau-Thierry flew forward until they encountered enemy machine gun fire and then knew that they were over enemy troops and began to search out their lines, a little further back.

Another practice which has been found very satisfactory as well as almost necessary is to fly down the approximate front line firing as many as five or six signals calling for the line. This gives the entire line a warning to show their position, while firing only once at one end of the sector might very often be unnoticed in other parts of the line resulting of course in a failure of the troops to show any panels.

Successful infantry contact missions depend upon the observer and pilot seeing the line. If it cannot be given at the time by panels it is up to the aviator to go down and see the men themselves. Many times after several days in line continually fighting, the troops have lost their panels, and their flares are all gone, so that the infantry cannot be too harshly criticized for not always responding to the airplane call. Hence the necessity of the observer seeing from a low altitude.



Insignia of the 90th Aero Squadron.

—68—

1st Lt. Pressley B. Shuss
Observer, 90th Aero Squadron

During the four months on the quiet Toul Sector, Lt. Livingston[a] as Pilot and myself as observer accomplished a number of exercises with different infantry units in order to train the infantry in working with the planes and to get the needed experience ourselves.

On the morning of Sept. 12, 1918, we were assigned our first real Inf. Contact mission in combat. We left the flying field in sufficient time in advance of the scheduled time to test the wireless and to fly to the designated P.C.'s to locate message dropping grounds.

The first difficulty which presented itself was getting through our own barrage. This was accomplished by observing the flashes of the guns, choosing a point to enter where the least number of flashes were observed and flying through the line of rising projectiles in the direction of fire at an altitude of 300 meters. Then later choosing a point where the least number of projectiles appeared to be falling we flew through the falling barrage at an altitude of 600 meters.

Flying in elongated circles, and figure eights, over our troops we worked forward more each circle, first observing that vehicles were not visible in advance of certain points, then massed troops were not visible in advance of other points, further advanced I saw friendly troops in an open formation after descending to 200m as visibility was very poor with some rain. Advancing further I observed more troops, but as the barrage was still about one kilometer in advance we continued north to the line of bursts of the barrage and worked back searching each part of the sector for our troops. After seeing the most advanced ones visible I fired several rockets which means "where is the front line" and also where are the P.C.'s of the units.

The only answer was given by one Battalion P. C. showing its position. After firing several more of the same rockets without answer from the front line we circled over the [one?] point after the other descending until we had located the most advanced troops and the rear guard of the enemy troops, and the rear guard where they were visible.

I found that at an altitude less than 150 meters it is necessary to circle over [one] point and search it thoroughly before proceeding to another as the speed of the plane would only permit a short glance at one point while flying straight, also that

men on the ground are very difficult to see if they are in shell holes or immovable.

While observing the advance of the troops I sent by wireless code the line of the barrage and location of the front lines and while flying back to the rear I wrote out the dropping messages and marked on the drop maps the location of troops, barrage fire (in enemy territory) and any thing observed which would be of interest to the command. I dropped one copy of these at Division P.C. and one at Corps P.C.

After landing I immediately reported to the Intelligence Officer, gave him what information I had, then made a detailed report of the mission.

All subsequent missions were accomplished in the same manner, but many difficulties presented themselves which had to be overcome. The most important difficulty is the presence of enemy planes. During all missions I had to watch the air for enemy planes and have rarely failed to see some every mission.

They endeavor to surprise us which we counteract by keeping a very careful watch and by always standing up with the machine guns ready to mount.

I wish to warn all concerned of the importance of this as I was surprised by four enemy planes diving down through the clouds when I was sitting down. By the time I had risen and turned my guns on them they were out of range, having turned away which showed us that we were saved by the fact that they were more surprised to see us than we were to see them.

Had they known that we were there we should have been easy victims as they passed us within 30 meters.

At that time I was wearing a fur lined coat reaching to my knees, when I arose to get my guns in action the wind blew the skirt of the coat up between my hands and the guns which added to my delay and prevented any chance of my getting a good shot at them.

I have never worn anything but a union suit since that experience.

As a biplace plane has movable twin machine guns in the rear it is most effective in an aerial combat while appearing to be running away; therefore [it] should only fight when the enemy is aggressive.

When attacked during a mission we have always led the enemy planes over our territory and when they turned back we would return and finish the mission or repeat the tactics until they go home, as we carry more gasoline and can stay longer in the air.

The second important difficulty is bad weather conditions. Rain decreases the chances of the infantry answering the signals. To

overcome that we must fly low enough to see the man. I had to fly as low as 30 meters on the afternoon of Sept. 12, 1918, as the rain was very heavy and large drops. On that instance the pilot reduced the speed of the engine until we could just fly level to decrease the chance of the propeller being broken by the heavy drops of rain. In fact it was split anyhow but we were able to finish the mission unaware of that.

Fog or ground mist not only prevents seeing men or panels except when directly over them at low altitude but makes it exceedingly difficult to keep your location and direction and nearly impossible to locate them accurately on the map when we do see them.

To overcome this we fly low over a road or river we know near as possible to our sector then pick out one land mark ahead and keep it in sight until we see another. Inasmuch as our speed is so great that requires selecting landmarks very quickly in a fog as one may see only a few hundred yards ahead. That

Twin machine guns on a "biplace plane" of the 166th Aero Squadron. Lts. Linn D. ("Grandpa") Merrill and Edward C. ("Red") Black, Jr. (at the guns) man the aircraft.

is not possible if the pilots and observers do not know the sector very well; therefore it is very important to study all marks of the sector very thoroughly.

I have on several occasions accomplished an infantry contact mission during bad visibility that would have been impossible had I not spent hours studying large scale maps of the sector.

I refer particularly to territory in the way of enemy lines where one does not have occasion to fly over at low altitude previous to the mission assigned as the advance of our troops bring new territory in our field of work in one day.

The difficulty of locating the *front line.* The infantry does not like to show their positions (first) because they have a great fear of all planes caused by enemy planes shooting at them with machine guns, dropping bombs, and regulating artillery fire on them, (second) because they are not able to distinguish enemy planes from allied planes due to the lack of instruction, (third)

Bad weather conditions make aerial observation exceedingly difficult. The photo shows U.S. troops in action at Belleau Woods.

because of rumors to the effect that the enemy use planes with the allied identification marks for the above purpose. I do not believe that is true.

I made a visit to the troops while they were in the front line and thus was enabled to find their reason for the existing conditions above mentioned.

The troops do not realize the importance of the command knowing their exact position and location and progress in combat and how quickly the plane can get the information to the command after obtaining it.

This difficulty is overcome on our part as much as possible on the mission by repeatedly asking for the line and staying over them as long as possible and in the event that they will not show panels or flares we go down until we can see them unless they are in a green forest, in that case it is impossible.

It can be readily seen that if we see troops in an open space and a forest in advance we cannot tell the command that the troops that we saw are the first line unless they show panels indicating it, as we have no manner of knowing if there are more troops in the woods unless we receive an answer by the Bengal flares from the woods.

This also meant that we must fly forward until we see the enemy troops in order to be sure that no more of our troops are in advance of the last observed. Doing this decreases very much our chances of getting the information to the command as the enemy troops shoot at the planes with rifles and machine guns at a very effective range.

We have conducted school at the Aero Squadron which is attended by about 200 officers and non-commissioned officers of the infantry of one Division at one time for the purpose of instructing them in distinguishing planes, methods of showing the lines, sending messages to the plane, and the importance of liaison between the infantry and the contact planes.

The Squadron has sent observers to visit the Infantry Division, Brigade, Regiment, Battalion P.C.'s and into the front line to find out what the infantry thinks of our work, what we can do for them and to instruct them in what our work is, how we do it and enable them to identify allied planes. This better understanding will lessen their fear of planes and prevent our troops from firing at allied planes and machine guns which has occurred very frequently.

—69—

1st Lt. Flynn L. A. Andrew
Observer, 104th Aero Squadron

1. Too much time is lost in the execution of an Infantry Contact Mission which defect can be remedied only by the thorough training of infantrymen designated to work with the aeroplane; and immediate answer to signals from the aeroplane is imperative.

2. The method of firing rockets from the aeroplane as a request for information is not sufficient to insure a reasonable successful mission, for two reasons to wit: (1) A six star rocket requesting our line is very often fired when the ship is behind the front line which means that the infantry whose whole attention is directed to their front, fails to see the signal, the line is not shown and the time is lost. (2) An observer failing to get the line at this first signal must again signal, distracting his attention from the ground where it should be constantly in order that he may always be oriented. This defect can be cured by some continuous signal that will show the infantry at all times just what the ship is requesting. Two methods could be used. (1) If the ship was sent out to get the line, one, two or even more streamers attached to the ship, meaning a definite thing and showing the infantry at all times that this ship requested the line. (2) Mechanical devices such as small antennas which could be instantly rolled in or out, attached to each a small streamer or more compact signal, one meaning one thing, two another, etc. In this way no time would be lost, while over the lines, the infantrymen could have the signal constantly before them. The whole time of the Observer could be given to them.

—70—

2d Lt. H. L. Borden
Observer, 90th Aero Squadron

During the latter part of the Meuse-Argonne operations the First American Army was greatly handicapped by the absence of cavalry with which it could harass the retreating enemy and accurately learn the disposition of the enemy rear guard. To remedy the defect the idea was conceived that the observation squadrons at the front could to a large degree, do the work which in former wars was intrusted to the cavalry.

Observers located the disposition of enemy troops for batteries such as this Coastal Artillery at [Nixenville] (Meuse). Shown is a 340-mm railway gun in action.

So far as this writer knows this was first suggested by Major Littauer,[a] Chief of the Air Service of the Third Corps of the First American Army. About the first of November he instructed the observation squadrons in the Third Observation Group, to cooperate with the Infantry by locating our advancing front lines and then flying over the sector to a depth of from four to six kilometers carefully locating the enemies first line of rear guards and their supports. This information was to be embodied in a brief message marked "urgent—hand to the nearest officer" and dropped to the troops in our front lines. In addition to securing this information the observers and pilots were to harass the enemy by machine gun fire.

Owing to the short duration of hostilities after this plan was put into operation, it never received a thorough test; however, a few cavalry reconnaissances were carried out with great success.

In view of the short period of experimentation and the changing conditions in the terrain, the air strength of enemy air-

craft and anti-aircraft defenses (which always confront the observer during an advance) no hard and fast rules can be laid down for the successful carrying out of a cavalry reconnaissance; however, it can be definitely stated that the purpose of the cavalry reconnaissance is to first find our front lines in a certain sector, and then to scour the air so carefully that practically every meter in the enemy's lines will have been seen to a depth of from four to six kilometers, so far as possible locating the hostile first line of defense machine gun nests, etc., with their supports in the rear. Then this information should be written down and dropped to our front line troops.

Now to accomplish such a mission it is evident that certain general rules must be observed. The first thing to be considered is the way to accurately locate the enemy's forces (it is not necessary here to speak of methods of finding our front lines for every observer trained in Infantry contact work understands that). The location of the enemy is much more difficult. Generally the hostile troops have retreated to previously determined positions where they are well protected and concealed. Also, being well trained troops, when they first see a hostile plane (if they are at all exposed to view) will take all the cover available, or if there is none will be prone and motionless. Hence they are extremely difficult to see.

Therefore it is necessary that the observer on a cavalry reconnaissance should fly at such an altitude that he can pick up such difficult objects. For the individual observer the altitude will depend upon weather conditions, the keenness of his eye sight, concealment offered by the nature of the terrain to troops on the ground, etc., Under conditions of such poor visibility as prevailed during the Meuse Argonne operations the writer found that an altitude of 100 meters was the most satisfactory in his individual case.

In addition to the greater facilities for locating troops afforded by flying at a low altitude is the fact that a plane is safer from M.G. bullets at an altitude under 200 meters than one from 200 to 600. This is due to the rapidity with which the plane passes out of range and the rapidity of changing angle of sight.

When the enemy troops are seen, if the conditions are favorable, it is a good idea to strafe them with machine guns. This not only demoralizes the hostile rear guards but (if your advance guard is not too hotly engaged) they will see the direction of your tracers and this will point out the position of the enemy. Furthermore, when a plane begins to shoot all the M.G. nests in the vicinity if not already firing will open up. By thus drawing the enemy's fire the observers can locate by sound and by sight (if tracers are used) the machine gun nests which if

not discovered would take a heavy toll of our infantry.

It is not advisable to go into further details in regard to the carrying out of a Cavalry Reconnaissance. Only experienced observers should ever be sent on such a mission. A trained observer bearing in mind the purpose of the missions (as have been outlined) must work out the details as to altitude of flight, etc., himself. In regard to manner of flying, one thing only should be insisted on; as in every case when flying over hostile territory, the pilot should never fly straight ahead. He should throw off the many machine guns for whom he is sure to be animated target.

It is evident from the few experiments successfully made that the Observation Squadrons have a new and valuable field of work in the making of cavalry reconnaissances during an advance. Tho the planes cannot harass the enemy as thoroughly as the cavalry, they can cover the territory much more quickly and more carefully. The experienced pilot and observer can cover the front of a divisional sector in from one to two hours, drawing the fire from all hostile positions and locating the strong points of defense, this in most cases can be done rapidly and without loss of life. On the other hand the progress of the cavalry is slower and always costly in lives of the troops. It will remain for future opportunities to demonstrate beyond a doubt the valuable service that an Observation Squadron can accomplish thru a "cavalry reconnaissance."

—71—

2d Lt. William Nickel
Aerial Gunner, 99th Aero Squadron

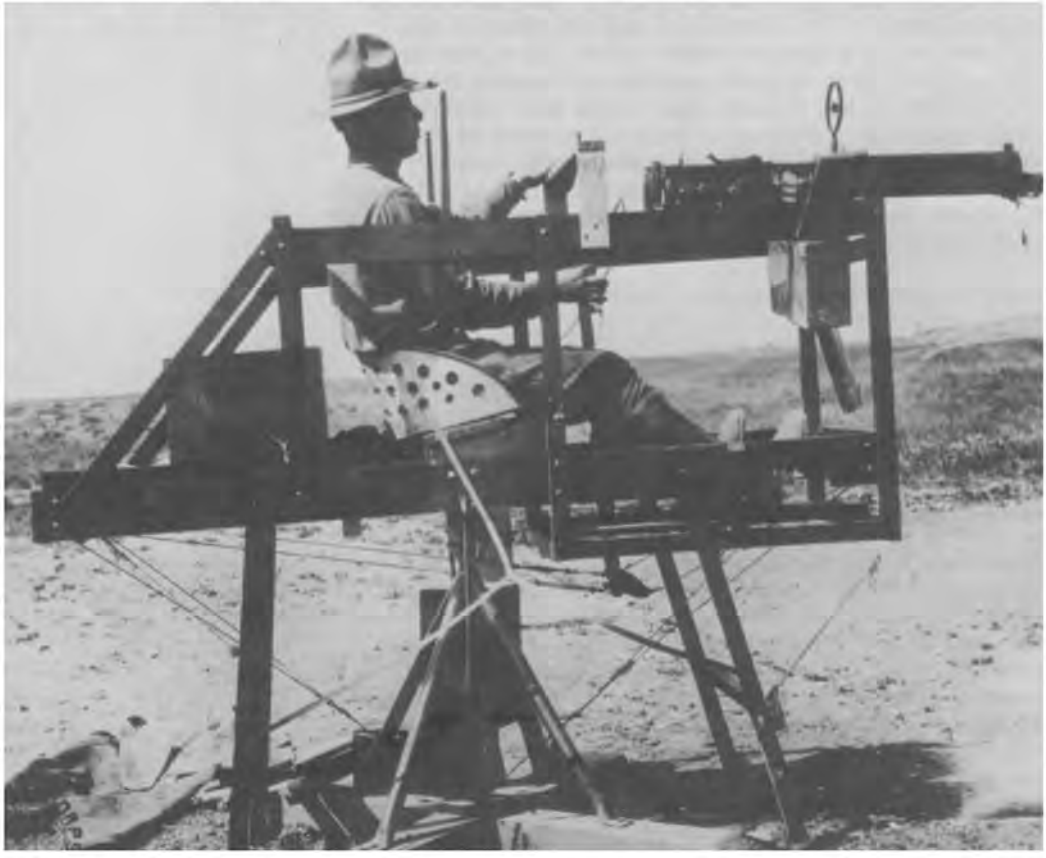
Having been from April 20th., 1918 to Sept. 15th., 1918, Chief Instructor in Armament in the School for Observer Gunnery at Casaux, and having been asked to report in brief, from this experience in connection with my experience at the front with the 99th Squadron, the following is submitted:

A waste of time is the result of the method of machine gun instruction, in an effort to systematize the assembling and dissembling of machine guns. Because of the different characters of different persons, it is impossible to achieve uniformity. Instruction for some is thereby retarded and they must begin their studies anew when they reach the front.

The French system comprises a complete course in the rudiments of gunnery, and the need of constant practice, careful

calibration of ammunition, and proper regulation in sights, and the knowledge thus attained, afterwards renders the student independent of the armament department of his squadron. The lives of both men in a plane are frequently dependent upon the proper action of the observer's guns. It, therefore, behooves the observer to know his guns initimately, precisely and to have such knowledge of stoppages, or other trouble, as to enable him to remedy such trouble in the least possible time. Academic instruction is not sufficient; the learner should have ample practice, demonstration of the manifold causes of failure of action

A rocking nacelle used as a dummy fuselage for training aerial gunners.



and the quickest means of correcting them. Brief lectures giving the fundamental theory of the actions and operations of machine guns will suffice much better than long, intensive discussions which tire the minds of the listeners and cause a loss of interest. The time thus saved, could be spent with great value, allowing the student to do by actual operation, what he must eventually do in any case, i.e., construct his own personal method for achieving results, whether it be in assembling and demounting his gun, or in the clearing of stoppages. Timely suggestions by the instructors, are, of course, of material benefit.

The machine gun instruction centers of our service, uniformly base their course on this systematic method, and on the use of a single gun, whereas in actual practice at the front, the twin gun is universally used. This discrepancy between instruction and practice should not occur, because it is manifest that with twin guns instead of single guns, new difficulties arise.

The practice of removing the magazine to clear simple stoppages, with either the single or twin guns, is unnecessary and is also cumbersome and slow. The French who are experts at clearing such stoppages, do not remove the magazine in actual work at the front, nor does their course of instruction include such an operation. In my estimation the French method is quicker and safer for both pilot and observer than is the English and so-called American method, which includes removing the magazine for all stoppages.

A combat seldom lasts over 30 seconds, and the average combat lasts about 10 seconds, the average distance being about 200 meters. Every move that the observer makes can easily be seen by his opponent. If the observer begins to demount his gun, the enemy closes in to a closer range, thus making his shooting more accurate. The observers who joined our squadron, who had taken their aerial gunnery training under our own method, invariably learned from the students of the French this easier, quicker method of clearing jams and stoppages.

I found that the French sight was the most preferable. Our Government having adopted the so-called Norman Ring,[a] an English sight; the Reille Soult was impossible to get from our Ordnance Department.[b] In many cases the observers had their mechanics to make the Reille Soult sights, some borrowed them from the French, and in some cases where they could not be procured or made, the observer used no sights at all, judging his shooting by his knowledge of deflection.

The student has never been taught any method of defense against machine gun fire from the ground. As about 75% of the casualties of our squadron were from this source (a not unusual percentage I am told), it is quite apparent that a gunnery school

instructor should be absolutely familiar with combat conditions, and where possible, experienced in such work.

At Cazaux we mounted a shot gun on a tourelle and had the students to fire at clay pigeons. This method enabled the student to attain quickness in judging deflection, ease in handling the tourelle, or "feel" as it is called; and lastly and most important of all, he learned to shoot quickly from a tourelle.

Map reading for aerial gunners has always seemed to be a minor subject, whereas it should be a most important one. Oft-times he finds it is his duty, not only to orient himself but actually steer the flight course. Forewarned is fore-armed, and the aerial gunner who is never sure of his location is rarely in a position to be fore-warned.

—72—

Col. Frank P. Lahm
Chief of Air Service, Second Army

Balloon Service. On my arrival in Paris the last of September 1917, I found no Balloon Service organization. This work was being handled in the Technical Section, Paris, with Major East,[a] Air Service in direct charge. There was no one in France at that time who had been in the Balloon Service or was technically conversant with the subject. Foresight on the part of those in charge had led to orders being placed with the French for eight complete company equipments, for 50 additional equipments of balloon baskets, cables and basket equipment. It was fortunate that these orders had been placed as the first companies to arrive from the U. S. did not have their equipment with them. At the same time orders had been placed in Italy for Fiat trucks and cars, which, though slow in arriving, made possible the operation of the first units. A cable had been sent to the U. S. asking for eight balloon companies at once. They did not arrive until late in December. In the meantime, artillery brigades had arrived from the U. S. and were in training at the various artillery training centers, unfortunately without balloons to work with them, with one very notable exception, that is, the Artillery Camp at Le Valdahon. The 84th French Balloon Company had been sent there in August and a great deal of credit is due its commanding officer and chief observer for their excellent work in teaching our artillery the use of balloon observation, in training artillery officers as balloon observers, and later in training some 24 of our own balloon officers who were sent over here to

receive their balloon training. Had the other artillery training centers had balloons at their disposal a much better understanding would have been arrived at between the Artillery and the Balloon Service. Those artillery brigades that had balloons available during their training period show the results most plainly, as did those who trained where there were no balloons. In the latter cases it required a long and difficult course of education at the front which could have been conducted much more easily before arriving there. In all future service, we must guarantee the presence of both balloons and observation planes at all artillery training centers.

On the recommendation of the French it had been decided that our balloon school should be located near the French Balloon School at Vadenay north of Chalons. I represented the Air Service at a conference there in October, with officials of the Headquarters of the French Balloon Service, the French Balloon School and the French Mission. It was agreed that our school

Germans fire at an American observation balloon.

would have six French officers and 10 French non-commissioned officers as instructors, who were to work with our own instructors. With the assistance of the Construction Department plans were drawn up in the Paris office which organized immediately after my arrival, providing for training the officers and most of the enlisted specialists of balloon companies coming from the U.S. Construction was started in November, one balloon company arrived in Chalons about December 23 and was utilized in construction work. This was completed about the end of March when the German offensive made it advisable to evacuate both the French and American Schools.

Had it not been for French balloon equipment, French assistance in our early instruction and the benefit we derived from their previous balloon experience, our own Balloon Service would have been greatly handicapped and we would not now record the success which I feel it has had in France, practically from the beginning. The time came, however, about the end of March, when it was advisable for us to separate our own activities from those of the French and rely more upon ourselves so I believe it was wisely decided that our School should be moved to Souge where it could operate under our own control, still however, assisted by the advice and cooperation furnished by the French through their representatives at the School.

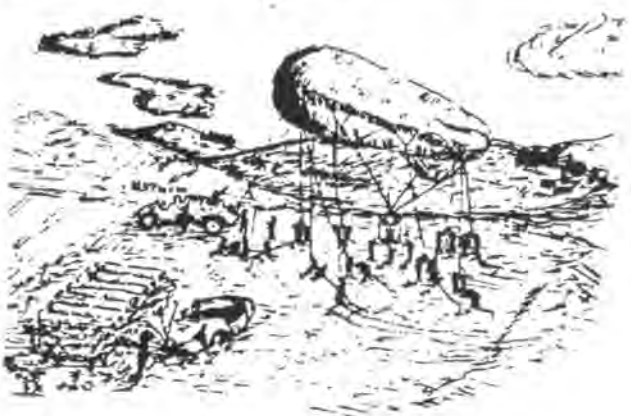
The French offered to train 100 Balloon Officers and a cable to that effect was sent to Washington about October 1917. Fifty-four extra officers with no balloon training were sent to France and put into French balloon companies at the front, afterward receiving artillery instruction at Le Valdahon, additional balloon instruction in the 84th French Company at Le Valdahon and some of them finally graduating from our Balloon School at Souge. This was a war expedient that I trust we will not have to repeat, and will serve us a lesson to prove that our own facilities must be sufficient to meet our needs without calling on a foreign nation to train our officers in bulk. They were given valuable training by the French, were fortunate to receive instruction in companies operating on the front, but the training varies in different companies, was unnecessarily long in others. A very few of these officers were not of the desired standard as raw material and wasted their own time as well as that of the French. The latter should not be called upon to sift out our new officers, eliminating the unfit and reclassifying the others. That is our own duty. I believe the records show that not over 30 per cent of these 54 extra officers proved to be good observers.

On being relieved in Paris by Colonel Chandler about November 20th, I went to Headquarters Air Service at

Chaumont, organized the Balloon Section in that office, remaining until the removal of the Air Service Headquarters to Tours, after which I was in charge of the Advance Section of the Balloon Service including the supervision of training of the extra officers in French Companies at the front and of our own balloon companies at the Artillery firing centers at Le Valdahon and Haussimont.

The history of the American Balloon Service in France may be considered as the most successful part of our Air Service activities. The first Air Service Unit to go to the front was the Second Balloon Company which relieved a French Balloon Company near Royaumeix, the end of February 1918. The companies that came from the United States were as a rule made up of excellent material, well trained and well disciplined, and their services were uniformly efficient when put to the test in action against the enemy. The Balloon Service's great difficulty was in persuading the General Staff that their services were required in France and at the front, and in securing priority of shipment of both personnel and material.

With none of the Heavier than Air's offensive opportunities, our observers have shown the greatest fortitude, energy, efficiency and devotion to duty. Full advantage has never been taken of the Balloon Service, that necessary liaison between the Heavier and Lighter than Air Services has never been properly established and we still have much to learn before the Army will reap the full benefit to be derived from this very valuable auxiliary.



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Col. Charles DeF. Chandler
Chief, Balloon Section
Air Service, AEF

Commissioned in the Signal Corps in 1898, Chandler had become interested in balloons and had been placed in command when the Aeronautical Division was established in 1907. He had qualified as a balloon pilot in 1907, dirigible pilot in 1909, airplane pilot in 1911, and military aviator in 1912. He had been in charge of the Signal Corps' aviation schools at College Park and Augusta, had commanded the 1st Aero Squadron at Texas City in 1913, and, among other things, had established the Army's balloon plant and later the balloon school at Fort Omaha. He had been placed in charge of lighter-than-air experiments and engineering in Washington in April 1917 and had gone to Europe with Foulois in November, replacing Lahm as head of the Balloon Section, AEF.

The following paragraphs summarize the lessons learned during the present war which pertain to the Balloon Section:

As a result of our experience the present complement of one balloon company per Division should be considered only as an allowance and all companies serving with Army Corps should be classed as Corps Air Service. When a Division joins the Corps one balloon company should be assigned to it, normally remaining under the tactical control of the Division commander during the entire period that the Division pertains to the same Corps. There is no objection to the transfer of a Divisional balloon from one Corps to another with its Division, whenever prospective military operations make the transfer expedient.

The control of a balloon Group commander over Divisional balloon companies in his Corps should be considered technical and not tactical; the supervision relating principally to personnel replacements, supply of maintenance equipment; provision for hydrogen and the consolidation of information reports required by Corps Headquarters.

Army Artillery should in all cases arrange with the nearest Corps balloon to adjust fire instead of having special balloons attached to Army Headquarters exclusively for Army Artillery. An army reserve of 10 to 15 balloons should be available in each army for special assignments, particularly the relief of companies in Corps Groups after long periods of arduous service: The

Burning balloon.

Army Reserve companies should never be considered as available only for Army Artillery.

Balloon Wing Headquarters of an Army should be utilized to exercise the technical supervision over all balloons in one Army.

Instead of the small administrative units now provided by Organization Tables for each Balloon Group Headquarters and Balloon Wing Headquarters, there should be allowed one Balloon Park for each Army; this Park to have the same personnel allowance as balloon companies and utilized to provide detachments not only for each Group and Wing Headquarters but for tube dumps, balloon mobile parks and all other balloon detached service of an Army.

. . . . . .

The change from balloon squadron organization to separate companies, each serially numbered and combined in Groups according to their assignment to Army Corps proved to be entirely satisfactory and should be continued.

The procurement of balloon observers by assignment only from Artillery which was effective from January to August 1918 was not satisfactory. It resulted in much waste of time and effort in cases where Artillery officers were detailed as balloon observers against their inclinations for air service.

It was found that the course of instruction at the Balloon School covering a period of three weeks and including only the most essential subjects could not be pursued satisfactorily by officers having no previous balloon experience. In time of peace, to cover the entire subject thoroly, a course of one year should be provided to insure complete instruction for officers having no previous ballooning experience.

. . . . . .

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Maj. John H. Jouett[a]
Wing Commander, Army Balloons
Second Army

A graduate of the U.S. Military Academy, Jouett had been commissioned in the Coast Artillery in 1914 and detailed to the Aviation Section of the Signal Corps in 1917. Going overseas with Foulois's party in November 1917, Jouett had served as Chandler's assistant in the Balloon Section and had been commander of balloons in IV Corps before becoming Balloon Officer of the Second Army in October 1918.

Maj. Jouett.

There are two well defined periods of balloon activity, which are: in a stationary sector and in an offensive.

The balloons of the American Expeditionary Forces in stationary sectors performed very creditably in their work with artillery, in their work of general surveillance, and to a certain extent, in their work with infantry. There lacked, however, to a great degree an understanding and perfect liaison with the aeroplane service. In the Group which the undersigned commanded in the Toul sector about the only liaison that was made with aeroplane units was a series of conferences between pursuit pilots and balloon observers for the purpose of discussing the best way to attack balloons, the best ways for balloons to evade attack, and the efficacy of various types of protective fire from the ground. No other liaison was ever attempted, and, to the best knowledge of the undersigned, in no group was there any liaison with the aeroplane service worthy of notice.

This is all wrong. It is a well understood fact that balloons should undertake to regulate for artillery on all targets which can be seen from the balloon. In other words, the aeroplane should not touch those targets but should be used for other things. On the other hand there are many targets which the balloon cannot use, due to defilade and other causes, and which should be regulated upon by aeroplane. In quiet sectors there should be nightly meetings and discussions between the Corps Air Service Commanders and Corps Balloon Group Commanders for the purpose of assigning various duties and functions to both aeroplanes and balloons. By these meetings, and these meetings only, can the maximum amount of work be done and each portion of the work done by the unit which should do it. This is by far the greatest lesson which was learned from the functioning of balloons in a stationary sector.

During an offensive. In offensives, balloon groups were composed of companies which had received training only to work as separate units and there had been practically no effort made to have the balloons of a group work together. This was, of course, unavoidable because there had been no offensive on any great scale on the Allied side and there was no precedent from which to work and it is, therefore, evident that these lessons had to be learned. The French, from time to time, had courses at their balloon school for their group commanders, and in the opinion of the undersigned, this course should in future be given to American Group Commanders. There are many, many points which came up which had to be settled immediately, without ever having received previous thought, points which should have already been worked out.

During days of preparation for an offensive, the Group Commanders should have nightly conferences with the Company Commanders in order that the work of the Company Commanders may be checked, that all necessary work is being done, and that no unnecessary work is being done, and to better insure the proper understanding of present and future conduct of operations within the group. During this same period the Group Commander should form a balloon telephone central with direct lines running to each of his companies in order to have uninterrupted communication.

10th Balloon Co. truck convoy with winches, moving from one position to another.

When an offensive has commenced and any gains have been realized, balloon companies immediately drop out of control of the Group Commander in so far as communication is concerned. If the advance is but a short one of 5 to 10 kilometers, liaison can be kept up, but when the advance is greater than this, or, when there is an advance every day—although it may be a small one—communication with the rear cannot be kept up by balloon companies, if they desire to keep up the more important work of remaining in touch with combat units with which they are working. After various attempts to keep in touch with balloon companies during an advance, both by telephone and by wireless, the undersigned was forced to adopt a plan which worked very satisfactorily and which could be followed at any time in the future with good results. An Army Corps Staff always maintains a forward observation point to which a trunk line is run. Along this trunk line there are usually test boxes. The Group Commander should form an advance P.C. at a test box which is as near as possible to the center of his balloon companies. Permission should be received from the Corps Signal Officer to cut in at this test box. The Group Commander should take station at that point when his duties permit and he should have an officer there when he is absent. Balloon companies should not be forced to run lines to this point, but should be required to have half-hourly courier service between the companies and the forward P.C. It was found by the undersigned that at no time was any company more distant than 3½ to 4 kilometers from his forward P.C., so that there was no great hardship in having a set of runners carry pencil memoranda of operations completed during the preceding half-hour.

Group Commanders should so conduct the administration of their groups that they are at all times free to go from company to company. They should not be tied down anywhere to any one point. The Group Commander's place during a battle is with his companies, and he should proceed from company to company giving advice and helping out in every way within his power. By the selection of a good adjutant for his Balloon Group Headquarters this can very readily be done. It has often been found, due to congested traffic, that Group Commanders have not been in their offices for stretches of from 24 to 36 hours. There should be no necessity for their being there.

As the Tables of Organization now stand, since the addition of a certain number of cargo trailers, a balloon company has just enough transportation to be entirely mobile. A balloon company must be entirely mobile or it looses one of its greatest assets in an advance, that is, to be a good forward observation post in a minimum of time.

Transporting a balloon to a new position.

—75—

Capt. Alvin C. Reis
C.O., Balloon Group, V Corps

The assignment of balloons to Army Artillery as such should be abolished. It is recommended that all balloons under the jurisdiction of the Army be assigned directly to corps.

The necessity for providing a channel through which reports can be transmitted promptly requires that the reports come through an office which is in more intimate touch, than Army Headquarters can be, with balloons on the line. Information obtained must be acted upon at once. Delay of an hour, in the effort to secure connection through main controls, renders the information worthless. All balloons should be connected by direct line to the balloon central of the sector, so that the value of the balloon's observations may be immediately utilized.

The mission of all balloons in a sector is, fundamentally, the same. The mission is two-fold: surveillance of the sector and adjustment of fire.

There is no distinction in method and aptitude between an observer's watching matters of interest to Army Artillery and an observer's watching matters of interest to G-2 of the corps. Ludicrous it is to assume that a balloon can look only for things of importance to the Army, shutting its eyes to things of importance to the corps. The balloon must see everything and should report everything to one central balloon group office. That office should be held responsible to determine whether the information is of value to Army Artillery or to Artillery Corps, to G-2 of the Army or G-2 of the Corps.

There is no distinction in process and function, between adjusting fire for the 155's of Corps Artillery and adjusting fire for the 270's of Army Artillery. There is no distinction between objectives for Corps Artillery and spotting objectives for Army Artillery. The work is identical.

The present designation of Army balloons, as such, creates this double paradox of permitting the Army balloon to be idle when the Army Artillery does not fire and, on the other hand, of compelling the Army balloon to reach over into the sector of other balloons where Army Artillery batteries may be situated, attempting to regulate fire on an exaggerated Balloon-Target-Battery-Target angle.

The balloons in a corps area should be distributed territorially, not tactically. The balloons should be identified with a sector, not with a command. The balloon should see everything and do

everything in its sector. The balloon should regulate every piece of artillery, of whatever caliber, in the sector. The balloon should observe everything in the sector, whether it be the relief of enemy troops (a matter of interest to G-2 of the Corps) or whether it be a 42-centimeter gun in action (a matter of interest to the Army Artillery).

The function of every balloon in an operation should follow this defined rule: It should see everything directly in front of it, and no more. It should regulate for everything directly behind it, and no more. Thus will efficiency and harmony be augmented.

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Capt. O. B. Anderson
C.O., 43d Balloon Company

Equipment: Recommend that companies operating against an enemy be issued light transportation called for in the tables of organization.

Conditions in this Company required liaisons and reconnaissance to be made on foot. Demands made on this Company were in the light of full equipment—therefore, unreasonable orders were received, about sending reports, couriers, etc.

A winch detail for a captive balloon.

Command: Recommend that a Balloon Company, when once assigned to a Division, be left with it throughout the operation of the Division.

The practice of assigning a balloon to a new Division just before an attack does not permit the greatest efficiency through liaison.

The practice of taking away a balloon from a Division just at the time it can be used effectively is not considered to the best advantage.

The practice of assigning balloons geographically should be discouraged. A balloon operating with a tactical unit cannot operate geographically. Its movements should be governed completely by the tactical movements of the unit to which it should be permanently assigned.

Upon taking the field, a balloon company should be detached from control of the Air Service for tactical employment and turned over to the combat unit.

Balloon inflation.

Determining the conditions for the operation of the balloon should be left to the company commander, who should be held responsible for the technical part in the employment of a balloon, in all other respects the balloon should be under the orders and be supplied by the combat unit.

It should be as much a part of a division of infantry as is the artillery brigade headquarters.

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Capt. O. B. Anderson
C.O., 43d Balloon Company

Recommendations on Equipment: That a special study be made concerning transportation issued to balloon companies.

Heavy trucks with low axles are not suitable for mud and bad roads.

A company should be equipped with a light tractor with caterpillar tread. This is to replace tender which is useless. Compartment in tractor for tools would replace tender in every respect and would really facilitate mobility in mud, open fields, or any kind of roads.

Experience proves that a light tractor has enough speed when a balloon forms a part of a large unit which moves slowly.

Motorcycles for liaison work, alone, are not enough. Two saddle horses are indispensable.

There is 10 times the necessity for a horse in a balloon company than in a battery of artillery, for artillery reasons alone.

A chart room truck should be issued.

Trailers are dead weight.

The transportation of a balloon company should not be built for speed, but to insure steady progress in any weather or on any road.

Command: The organization known as "Balloon Group" is believed to be useless, during field operations.

The work of the balloon is so varied and it is concerned with so many different features that to do justice to the units in line, the balloon should be assigned to them and left to work out its own mission.

To accomplish the best results, it is believed that this can be done by placing the balloon under the orders of the combat unit or artillery brigade.

—78—

Lt. Col. Warwick Greene
Chief, Executive Section
Air Service, AEF

Greene, a graduate of the Harvard Law School, had been Director of the Bureau of Public Works in the Philippine Islands and later Director of the War Relief Commission of the Rockefeller Foundation before being commissioned in the U.S. Army in 1917. After serving on the Air Service staff in Paris, he had become Chiefof the Progress Division when the Coordination Section (later Coordination Staff) was established in June 1918. Greene had succeeded Lt. Col. H. A. Toulmin, Jr., as section chief when the Coordination Staff was reorganized as the Executive Section at the beginning of November 1918.

The creation of the Coordination Section by General Patrick was an effort to tie together and relate the diverse and scattered activities of the Air Service, AEF. Supply and technical matters were being handled by an office, headed by an Assistant Chief of Air Service, in Paris. Personnel administration, training, information, balloons, photography, and some other things were supervised from Headquarters, Services of Supply, at Tours. In the Zone of Advance an Assistant Chief of Air Service was in charge of developing airdromes, depots, and parks. All of these activities had to be coordinated, not only within the Air Service, AEF, but also with plans and programs of General Headquarters, AEF, at Chaumont, and with the requirements of aero squadrons and balloon companies in service at the front. Finding that coordination previously had been weak and faulty, Patrick tried to correct this situation by creating a special coordinating unit soon after he became Chief of Air Service, AEF. Greene, as the result of his experience on the Coordination Staff, thought there was a better solution to the problem.

1. In accordance with your instructions to prepare a statement giving my personal opinions and recommendations based upon my experience with the Coordination Staff and its successor the Executive Section, the following is submitted:

Coordination Staff

1. The principal duty of the Coordination Staff was as its name implies to coordinate the activities of the Air Service, A.E.F. To this end it was empowered:

a. To inquire into all activities of the Air Service.
b. To prepare plans, programs, etc. for the Air Service.
c. To make the necessary estimates for carrying approved plans and programs into execution.
d. To follow up the progress of the Air Service in executing its approved plans and programs.

2. In addition the Coordination Staff had property accountability and the mobilization of squadrons.

3. While the Coordination Staff, under its energetic Chief, Lt. Col. H. A. Toulmin, Jr., did notable work in assisting to reorganize the Air Service and to bring it to a much higher level of efficiency, yet in my opinion the same duties would have been better performed by a regular staff organization, under a chief of staff reporting directly to the Chief of Air Service. This staff would have been divided into the customary G-1, G-2, etc., and all of the duties of the Coordination Staff except mobilization and property accountability merged in a more comprehensive organization.

4. Besides being a clean cut, compact and efficient military organization, this would have had the inestimable advantage of making the organization of the Air Service uniform with the rest of the Army. As this staff system had already been worked out

Bedding down a balloon.

and was in operation on a large scale in the A.E.F. (and similar staff organization in the other Allied armies) the Air Service would have wasted no time in drawing up plans, preparing schemes of organization, working out the details of duties, etc. On the contrary, it could have availed itself of a ready-made plan of organization, in actual operation, a practical success, and so well known that a mere reference to a section number carried full information to other army staff officers of the exact jurisdiction embraced by the section. All of the duties actually performed by the Coordination Staff could have been performed under such a staff organization—and in my opinion performed with less effort and greater effectiveness.

5. To sum up, the important duties of the Coordination Staff could have been carried out to better advantage by the regular staff organization in use by the American and Allied Armies.

Executive Section

1. On or about November 1, 1918, the Executive Section succeeded to the functions and duties of the Coordination Staff, except inspection. I do not know why the name Executive Section was selected.

2. This Section had hardly gotten under way when the Armistice fundamentally changed all conditions in the A.E.F. This historical and statistical work of the Section was, at the suggestion of the undersigned, transferred out of the Section. This work was then placed in a Historical Section under the charge of an Assistant Chief of Air Service.

3. Mobilization work being finished, the force which had been engaged in this work was, upon the recommendation of the undersigned, transferred out of the Section in order to work elsewhere on demobilization.

4. The preparation of plans, estimates, programs, and the follow-up work on the progress of the Air Service automatically ceased.

5. There remained in the Executive Section property accountability and the valuation of the assets of the Air Service, a duty which had been added to the Executive Section after its formation.

6. With reference to inspection: the undersigned while a member of the Coordination Staff recommended that an Inspection Department be organized for the entire Air Service, to be divided into three branches, namely,

Military—Discipline; morale; administration; smartness; flying, gunnery and combat efficiency; condition of stations, parks, messes, sanitation, etc.

Captive balloons sometimes were caught in trees.

Mechanical—Condition of engines, motor vehicles, machinery, etc.; shop efficiency, etc.

Property and Equipment—Care and condition of equipment; efficiency of supply methods; condition of depots; keeping of property records, etc.

7. This matter was taken under advisement by higher authority. In the meantime, all property inspection which had been carried on by the Accountability Division . . . came to an end. About five weeks later (some time early in December) it was finally determined, in view of the Armistice and of the rapid demobilization of the Air Service, not to have military and mechanical inspection as an organized branch or department of the Air Service. The Executive Section however was directed to resume property inspection through the Accountability Division.

8. Since that time the Accountability Division has carried on as systematic a property inspection of the Air Service as conditions have permitted. This inspection has revealed a wide range of efficiency. At a few stations conditions were excellent, in many fair, in some indifferent, or poor, and in a few deplorable. Generally speaking, motor transport is particularly badly cared for and this branch of the Air Service lacks discipline, good morale, and pride in the condition of the vehicles. Unfortunately this condition has been prevalent through the motor transport of the A.E.F. which for many reasons has not reached the standards of the British and other armies. At the same time the undersigned has seen some motor transport with the 3rd Army and with certain divisions of the A.E.F. in

better condition than the best in the Air Service.

9. Thus military and aviation mechanical matters have been none of our concern, yet in the course of these inspections we could not help noting that where equipment was well cared for and property records were in good shape, military discipline and mechanical efficiency were also high. Conversely, poor property conditions were usually accompanied by slack discipline and low mechanical efficiency.

10. I believe that an Inspection Department of the Air Service, given the necessary authority and efficiently organized, would have greatly increased the effectiveness of the Air Service. Had such a department been organized in the early days of the Air Service, the history of the latter would have been different. A comprehensive system of inspection would have welded the Air Service together, prevented duplication of effort, checked slackness, permitted full use of our limited materiel by preventing waste and misuse, save[d] large sums of public money, and raised standards of efficiency throughout all branches of the Air Service. Indeed, it is difficult to see how the Air Service functioned without such a department. Unquestionably it would have been a better organization, both from a military and a business point of view, if the Chief of Air Service had been served by a competent Chief Inspector, with a live, trained and aggressive force of inspectors under him. Inspection should have been organized on constructive as well as on critical lines.

Lt. Prentiss M. Terry.

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1st Lt. Alfred T. Bellinger
G-2, A-7, GHQ, AEF

The Intelligence Section of the General Staff (G-2), GHQ, AEF, was organized into divisions which carried letter designations. The Military Information Division, G-2-A, headed by Col. Arthur L. Conger, had several subsections, with A-7 being responsible for Air Intelligence. A-7 had been organized by Lt. Prentiss M. Terry, who had been succeeded by Maj. (later Lt. Col.) Charles F. Thompson. One of the members of Thompson's staff was a young Yale graduate, 1st Lt. Alfred T. Bellinger,[a] who wrote the following report on air intelligence organization and activities.

This war has been responsible for the development to a hitherto unknown degree of the science of military intelligence. Whereas previous Generals have been content to learn of large enemy movements with questionable accuracy from their spies, and of a number of minor unrelated details from the occasional capture of prisoners or documents, it has become possible through the careful exploitation of all sources of information for Commanders in the present war to reconstruct the major part of the enemy's organization and intentions with dependable completeness. This work is the special care of the Second Section of the General Staff (G-2) in the American forces, which directs and coordinates all the agencies of intelligence. None of these is more important than air intelligence, though its possibilities have been fully appreciated only within the last two years. However, before the United States entered the war, the experience of the French and British had proved that the results of air reconnaissance and the data to be gathered from air photographs were of such importance that it was well worth while to assign specially trained men to this work exclusively. In recognition of this, but with a most imperfect understanding of it, early tables of organization of Air Service made provision for an Information Officer with each squadron in the field. The idea in mind was that these Officers should take care of military intelligence proper and also collect and disseminate information on enemy and allied aviation of interest to the Air Service only. In October 1917, however, the problem having received more specific consideration, an agreement was made between the C.A.S. and the A.C. of S. G-2 providing for the detailing of Officers as representatives of the General Staff to serve with Squadrons in the field. From this time it was recognized that the matter was primarily a Staff affair and all the Intelligence Officers so assigned, from whatever branch of the service they were drawn, were, in point of fact, selected and trained by the staff, under whose orders they acted. In spite of this original arrangement, nevertheless, the idea that the work of air intelligence belonged properly to the Air Service persisted in some quarters, to the detriment of cooperation and mutual understanding. The thesis of the supporters of this theory was that it was necessary for an Intelligence Officer to have technical knowledge of aviation for the proper performance of his duties and that it was impossible to get good results from a system which gave so prominent a place to an Officer attached to Air Service units yet not responsible to the Air Service. This view was based on a consideration of the French system in which the corresponding Officers, while in the closest contact with the 2me Bureau, are in effect members of the French Air Service. To put

an end to the possibilities of contention on the subject in March 1918 Major D. M. Henry was sent by the Air Service and Major C. F. Thompson by the General Staff to study the methods of the British whose air intelligence was conceded to be the best in theory and organization. After a study of considerable detail, covering a large number of units and headquarters, these Officers presented reports without consultation in which, however, they were in perfect agreement on the point that, under existing conditions the work could be satisfactorily handled only by the General Staff at G.H.Q. Accordingly a subsection on Air Intelligence (G-2, A-7) was formed which was to select all the Branch Intelligence Officers. The reports made it evident also that convenient as it might be for these Officers to have theoretical and practical knowledge of aviation, such knowledge was by no means essential, whereas it was of the first importance for them to have an acquaintance with Intelligence in general such as could only be gained by an intimate association with the Staff. It was then decided finally that all bombing and reconnaissance units should be supplied with Branch Intelligence Officers, responsible to the G-2 of the Army or Army Corps under which their unit operated, through whom orders for reconnaissance were to be transmitted to the C.O. and information gathered from reconnaissance disseminated to all concerned. The most important feature of this arrangement was that it made the work almost wholly a matter of the personal relations of the Branch Intelligence Officer. It was very soon shown that his efficacy was in no way affected by the arm of the service to which he belonged. If he was not able by force of personality to make good his standing in the Squadron to which he was attached, no possible official position could repair the damage. And if he was able to give the person most concerned (G-2 in ninety nine cases out of a hundred) prompt and accurate information about the enemy, it mattered not at all who was technically his commander. That the system was capable of excellent results is abundantly proven by such an example as that of the 91st Squadron (later the 1st Army Observation Group) where a C.O. and a B.I.O. both possessed of ability, energy, and a fine sense of values produced an organization which may be fairly considered as good as any Army can show. That the relations of the Air Service with G-2 were in general, only moderately successful is due to a number of causes. In the first place G-2 A-7, always an amorphous office, suffered badly from the prevailing G.H.Q. disease of atrophy of the sense of proportion. In the second place, through force of circumstances it was often impossible to secure officers for assignment to Squadrons who had the requisite breadth and balance. It was

only one of the numberless ways in which the A.E.F. suffered from the lack of experienced officers. In more cases than one the value of a reconnaissance Squadron was very materially reduced because the B.I.O. was ignorant or tactless—shortcomings of exactly equal seriousness to his position. In the third place the latent jealousy of various Air Service Headquarters to the whole system frequently hampered its efficacy. It was one of the unfortunate bi-products of the plan to make the Air Service a complete and self sufficient arm of the fighting force that some who had had no experience of the war from any other point of view were inclined to resent any infringment of the sovereignty of the Air Service without due consideration of the matter from the standpoint of the force as a whole. In this case it was the failure to grasp the essential fact that intelligence of any kind is concerned wholly and solely with "killing Boches and preventing casualties" and that all questions of credit and precedence are extraneous and impertinent. There was further difficulty due to the reluctance of certain Air Service Headquarters to look at reconnaissance as an ordinary part of the day's work and not a matter of particular moment. Evidence of such an unfortunate attitude is to be had, for example, in one of the bulletins of the Air Service of the 2nd Army on aerial observation the obvious tendency of which was to show, not how important it was but how difficult it was[b]—a publication as useful as though the Chief of Artillery should issue a memorandum on the unlikelyhood of hitting what you aim at. In this case the lack of mutual understanding was due, it would appear, less to the inability of the Staff to appreciate the special work of the Air Service to grasp the general work of the Staff. Nevertheless these drawbacks are all such as time would have remedied and, while the consideration of them is useful to show the dangers to which the system is liable, it does not alter the conviction, supported by the success of the British, that the system itself is sound and, based as it is on individual ability, is capable of indefinite expansion and adaptation.

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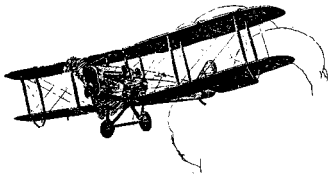

1st. Lt. Robert B. Rhoads
Operations Section
Second Army Air Service

The writer's experience during the past 8 months has been, to a large extent, a very limited one in scope, so far as the practical details of organization and supply are concerned. Having been in the Operations Section continuously since the first functioning of the Air Service with the First Army Corps on May 1st, my experience has been almost entirely along tactical lines.

To most of us who have been interested in the utmost efficiency of the functioning of the Air Service, the relations of G-2, General Staff, to the Air Service have been a question of considerable discussion and criticism. The present arrangement whereby missions for both photographic and visual reconnaissance are ordered by G-2 direct to each Group Commander, through the respective Branch Intelligence Officers, is subject in my opinion to criticism in several ways. In the first place, the missions which are given are often prepared by officers totally unqualified to judge of the possibilities and limitations of the Air Service, and often orders for wholly impossible missions go to the Group Commanders without the knowledge of the Army Air Service Commander, who might have been quite able, having seen the assignments, to so alter and rearrange them that they could have come within the scope of possibility.

I know of instances where Groups were given missions of such magnitude that weeks would have been involved in their execution. With the danger of inexperienced Group Commanders, often their missions were *attempted* only to be abandoned without result after the greatest amount of lost effort. Then, too, the system whereby G-2 assigns missions direct, robs the Army Air Service Commander of the benefit and value to the service, of his experience, whereas by a wise selection, missions could undoubtedly be accomplished much more efficiently in every respect.

From an Army Operations Section point of view, it is my opinion that entirely too much effort is expended in the issuance of the daily operations report. The report is never more than history of past events, and all effort spent in it is just so much

effort lost in the greater game of studying the enemy's intentions and in devoting the best efforts of the Operations Section to constructive work. This question involves not only the lost effort of Army Air Service headquarters, but that of every squadron and group in the Army.

On account of the undue emphasis put on this question during the St. Mihiel and Argonne offensives, great hardship was put on the personnel of all squadrons, groups and headquarters, and the mechanical equipment and loss of time to all concerned, through apparently needless demands made upon all units in regard to daily operations reports, certainly made its mark on the morale of all concerned during the trying days of those two offensives.

In this same connection, the undue emphasis given to operations reports, which resulted eventually in a great amount of unhealthy and unproductive competition between groups in order to make *paper* results, was responsible, as I personally know, in several group commanders dispatching many missions, which they knew beforehand would be unsuccessful, and which were always costly in every respect, simply to increase the flying hours and total number of missions as shown on the daily operations report.

The whole question of reports—engineering, statistical, operations—was one without any correlation whatsoever, resulting in an enormous amount of useless duplication of paperwork for all squadrons and groups. A thorough review of this subject with a painstaking compilation of statistics has been made by the Assistant Chief of Air Service, Z. of A., which report, in my opinion, will bear the fullest examination and will reveal some startling wastages in our report systems.

One of the greatest difficulties experienced throughout the whole history of the Air Service, was in my opinion, the lack of liaison between the Air Service and the other arms. While totally unfamiliar with the methods in vogue in training in the states, it would seem that during the long period of training which our divisions underwent both here and in the states, liaison could have been established so that infantrymen and artillerymen could at least have known what an American cocarde looked like when they arrived at the front the first time.

The questions of organization, assignment of squadrons to divisions, etc., have been so often discussed that further mention of those points seems totally out of place. However, so far as the Army Air Service Operations Section is concerned, in my opinion, the Observation Wing is an extra cog in the machine which delayed rather than expedited the fulfillment of orders. The Wing Commander had no tactical prerogatives and at best could be no more than a technical adviser. The additional

paperwork demanded by Observation Wing Commanders brought an undue hardship on all Observation units under them, and often duplicated work done for the Army Air Service Commander by all units.

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Capt. Heber Blankenhorn
Chief, Propaganda Section, G-2, GHQ, AEF

Heber Blankenhorn, who had been assistant editor of the New York *Sun* before the war, was given the task in February 1918 of forming a psychological warfare unit in the Military Intelligence Division of the War Department General Staff. Having developed a plan that had received the approval of Chief of Staff Peyton March and Secretary of War Newton D. Baker, Blankenhorn was sent to France to report to Col. Dennis E. Nolan, Assistant Chief of Staff G-2, GHQ, AEF. He took with him Capt. Walter Lippmann, Lt. Charles Merz, and some other newsmen who had been commissioned at his request. An investigation of Allied methods was started but cut short in August by orders to begin propaganda operations at once. Operating from a room on the floor above Pershing's office in Damremont Caserne at Chaumont, Blankenhorn organized and directed the preparation and delivery of propaganda leaflets over German lines by airplanes and balloons. Copy for the leaflets was prepared in Blankenhorn's section and sent to Paris or Langres for printing. The leaflets then were sent by truck to field units at Bar-le-Duc and Toul for distribution to the aero squadrons and balloon companies responsible for delivering them over the lines. Blankenhorn described the leaflet operations in the following report.[a]

No Air Service, No Propaganda

. . . . . .

. . . if there had been no Air Service, or if the Air Service had balked, there would have been no propaganda against the enemy worth mentioning. . . . in any future war against a civilized nation propaganda should be used extensively in the field and preparation should be made early by the Air Service for such use. . . .

Allied balloons carried propaganda leaflets behind German lines.

Function of the Air Service

Propaganda against the enemy, consisting in the main of leaflets, was under the direction of A.C. of S., G-2, G.H.Q., A.E.F. The function of the Air Service was distribution of the leaflets, principally by airplane, a few by paper balloon. The Propaganda Section prepared and printed 5,164,750 copies of 18 leaflets of which over 3,000,000 copies were dropped over the enemy lines and concentration areas by the Air Service, A.E.F. The campaign, modeled in method both of organization and of distribution on the practice of the British and French General Staffs, was inaugurated suddenly in the end of August and reached its greatest intensity in the month immediately preceding the armistice. Its purpose was to contribute to the general demoralization of enemy morale and in specific sectors to break the fighting spirit of particular units and to bring about desertions from particular units at critical times. The main arguments . . . used in the leaflets were American military participation, rendering Germany's military defeat inevitable, and America's peace program, offering Germany the best way out of the war. In other words the propaganda leaflets spread the moral effect of the shells, bombs and bayonets of the Americans and at the same time drove home to the Germans that the one way of mitigating their disaster was by seizing early the opportunity to

get peace on Wilson lines. More specifically, certain of the A.E.F. leaflets spread in the German Army the knowledge that Americans did take prisoners and treated them especially well, particularly well as regards rations, and that German soldiers who knew that the war was lost and who did not care to get killed in the last battles of the war were being received in the American lines.

American Aviators distributed these leaflets with tireless devotion. It was a strange business for them. They could see on a photograph the effects of their air bombs, they could bring back mapped reports of their observations of enemy activity and in regulating artillery fire they had visible and immediate proof of the worth of their endeavors and risks. But in dropping leaflets out of the skies the fliers saw no visible results and had no first-hand knowledge of the effects of the whole campaign. These effects accrued to the profit of the infantry and were studied and recorded by the G-2 Staffs of Corps and Armies. Some of the airmen must have thought it a thankless task. Some without doubt thought it time wasted. It is therefore especially fitting and necessary that these fliers should have some knowledge of the estimate placed by the General Staff, A.E.F., on the fruits of their labors.

Proof of the Pudding

Considerable proof already exists of the effectiveness of these leaflets. No competent authority connected with the General Staff would on the basis of the present evidence attempt to make sweeping claims concerning the destructiveness of the leaflets but neither will any competent authority deny that when the full evidence is in, it is possible that the judgment of historians will declare that the results were rather sweeping. In other words the evidence in hand, necessarily very incomplete, indicates undoubted results and implies effects which may have been much greater than can now be positively ascertained.

The evidence now in existence is of several kinds:

1. Testimony of Boche prisoners, who were extensively and intensively questioned for propaganda purposes throughout September and October.
2. Enemy orders concerning propaganda, captured by the A.E.F. and by the British and French.
3. Enemy proclamations against Allied propaganda, published in their press.
4. Letters from Germans and interviews with German ex-officers obtained since the armistice.

Complete evidence of course cannot be obtained until the German General Staff publish their memoirs and German Army

Records are available to the historian. It is probable that conclusive evidence can never be obtained because the effects of propaganda were in the invisible minds of men and because Boche who caved in as a result of propaganda more frequently denied it than admitted it. Soldiers naturally prefer to assign as their reason for surrender the overwhelming barrage, deprivation of supplies or being outnumbered. A good soldier prefers to say that it was a very large shell which lowered his morale rather than a little piece of paper. And yet it may have been the little piece of paper which actually broke the camel's back and made the German and his squad stay in their dugouts and give up when the Americans came in sight.

Hastily summarizing the evidence in hand, the following statements are borne out in the records:

1. Prisoners came over in increasing numbers with the American leaflets concealed on their person, in some cases held in their hands as passports; prisoner privates generally indicated their belief in the statements of the leaflets and asserted that the leaflets were no help in making them fight; prisoner officers generally denied that the leaflets had any effect but about 25 percent declared that the effects were bad and some insisted that the leaflets were disastrous; prisoners frequently asserted that the first news they got of important developments, such as the armistice notes and Austria's withdrawal from the war, was obtained from our leaflets and caused widespread depression; prisoners more and more demanded as they marched back from the lines those famous American rations advertised in the leaflets; prisoners in October were, 90 percent, convinced that the war was lost because of American participation, and were in doubt only as to whether America and the Allies could win the decisive victory which Germany certainly could not.

2. Captured enemy orders, which were corroborated by prisoners' statements, showed that the German Command tried to counteract the leaflets by paying the soldiers for turning them in; showed also that men were to be punished for reading the leaflets or having them in their possession; that measures were taken to stop the men's practice of mailing them home; that officers gave lectures to counteract the leaflets; that extensive and exceptional steps were taken to bolster up morale in the German Army and that the rain of American and Allied leaflets was a main cause of worry to the German High Command.

3. Proclamations and exhortations against the leaflets were published in increasing numbers in the enemy press in September and October, including especially the famous proclamation of Hindenburg himself directed solely against the leaflets, denouncing them and warning against them and praising

the German soldiers for obeying orders and turning them in. The figures which Hindenburg gave, 504,000 leaflets turned in in May, June and July, were useful to the Propaganda Section because it enabled us to calculate the percentage. The leaflets turned in were just 4 percent of the total. Meanwhile the German press decried soldiers' and civilians' belief in the leaflets, together with the practice of passing these leaflets around in home circles and in cafes.

4. Since the armistice letters from German officers have blamed the leaflets as principal cause of the lowering of German morale; letters from revolutionary leaders in Berlin have asserted that the common soldiers of the army were relied on because of the large number of revolutionary letters recently received from the front; German military critics have publicly blamed a considerable part of Germany's downfall on the leaflets. One officer interviewed by Americans after the armistice, for example, declared, "I can only talk as a soldier on the front, but there the effects of propaganda were disastrous and especially so in the last six months. Even the little *Flugblaetter*, after you read them you imagined you read the truth, that our government was lying to us. I remember one; after I read it, I felt like blowing my brains out. I never let one of our men read them but it was difficult, they were everywhere." This officer referred mainly to British air propaganda but his testimony applies as well to American leaflets which had this in common with the British, they both were confined to statements of bald fact.

In general the present judgment of the Propaganda Section, G.H.Q., is based on such recent testimony as the above together with previous prisoner questioning reports, especially by its own questioners. The reports of Corps and Army questioning contained many such statements as the following from the report of the 3rd Corps, October 12-13, obtained from officers of the 40th Infantry of the 28th Division; "The propaganda which your aviators have dropped over our lines has given us no end of trouble. . . . A very large number insisted on secreting them on their persons and when home on leave make it a practice of reading and distributing them to relatives and friends. . . . In fact civilians would write to men at the front begging them on the score of this propaganda to seize the first opportunity to desert." Even on the present evidence the judgment of the Propaganda Section is that the leaflets' effects, while uneven, were largely as was intended and that they contributed in considerable measure to creating that unescapable atmosphere of defeat with which the German Army was shot through at the time of the armistice.

Credit to the Aviator

If the above judgment is correct, and should be borne out and even enlarged by the judgment of the historian, it should be emphatically reported now that the principal credit for the achievement should go to the individual fliers of the Air Service, A.E.F., who undertook the risky bother of searching out the German in his lair and virtually handing him the destructive arguments. The 1st Army Higher Command of the Air Service did not make any noticeable great effort in the matter but individual fliers, and a great many Flight and Squadron Commanders, gave the business their unremitting thought and determination and action. The history of the success of propaganda is virtually the history of aviators and squadron captains, who were button-holed on Air Fields all over the zone of the American Armies by persistent propaganda officers and who, rising to the occasion in the typical American rough and ready fashion, loaded their buses up with the leaflets and while observing or bombing or regulating artillery showered the leaflets into the German airs. Especially these aviators cooperated with the Branch Intelligence Officers attached to Air Squadrons.

Fliers' Daring

The Propaganda Officers in the course of their investigations at the London War Office and at British G.H.Q. learned that the British Air Service had forbidden their fliers to carry propaganda on the ground that it was an unwarranted risk. Two British fliers[b] had been sentenced by the Germans to hard labor for carrying propaganda and the German High Command had proclaimed that they would shoot or hang any aviator caught carrying propaganda. Therefore every British bus carried a little card attesting that printed matter could not be carried in the plane.

In the beginning of October the Austrian Command issued a new order threatening hanging for captured pilots who carried propaganda. When this threat was brought to the attention of one American Squadron (The Third Corps Observers at Souilly) the Squadron Commander was asked what effect it had had.[c] He replied that as a result he had issued orders that the fliers carrying propaganda should not fly lower than a couple hundred meters. He added that American Aviators had flown as low as 50 meters over Montfaucon with the leaflets.

In short the American aviators, despite enemy threats and Allied caution, seemed never to have hesitated and rather to have risen to greater activity because of the greater risk. The record of the American flier in this respect was communicated in

the middle of October to the British Propaganda Direction with the result that the British Air Service was moved to revise its orders just before the Armistice.

The Individual Flier

The attitude of the Chief Command in the Air Service, First Army,[d] in the end of September was natural and easily explained. Handicapped by inadequate equipment, overtaxed by the magnitude of effort expected of it, suffering heavy losses and threatened with continual shortages, it was very natural that the attitude should be taken and the statement frequently made, "Propaganda has no place during operations. Come back in the winter and we will do anything for you that you want." It is to the credit of those holding this view that when argument was made exposing their fallacy, the attitude changed quickly to one of cooperation. The principal argument, however, was the willingness and eagerness of certain Corps Squadrons to carry propaganda as already displayed in action. It was the venturesomeness and inquisitive daring of the individual aviators which saved the day. They studied the leaflets, argued over them, planned out automatic releases for them and cluttered up their buses with them on every sort of more strictly military flight. One flier was busy inventing a propaganda air bomb to be dropped from great heights in order to reach limited areas accurately. In the British Army the rumor was current that fliers had been prone to burn up the leaflets in the Hangars rather than carry them. In the French Army fliers were paid special little bonuses for every little pack of the leaflets thrown overboard. In the American Army it seems to be true that the individual flier was sufficiently intrigued by the fun of the thing to do the job and do it well. Riding the unseen and perilous areas over the German lines the individual flier could slack on the job without any possible check-up. He could have thrown the leaflets over in bundles instead of loose, he could have dumped them just anywhere, but it seems that he preferred to risk his life to get those papers into the areas where they would do the most good.

Technical Points

It was a new business to the flier. He had to work out the technical points of how to stow the leaflets in his ship, how to get them overboard loose and yet not tangled in the tail of his machine, how to take advantage of air currents and avoid adverse winds so as to snow under specially designated areas. The Propaganda Section, using British data, had worked out the

A meteorological balloon to be released for observation in determining speed and direction of wind.

wind driftage rates of paper and distributed the tables to the air fields. The very first fliers, lacking these tables, made a slight mistake, with the result that half the leaflets they distributed fell a good three or four miles back of the American lines. The average leaflet takes five minutes to fall 1,000 feet, a bunch therefore dropped at 6,000 feet in a twenty mile wind will drift ten miles. On later flights the aviators seemed to have been generally successful in covering specially designated German Divisions.

The Balloon Wing of the Air Service, which it was planned was to have carried out the sending of propaganda by free balloons during the winter, encountered greater technical difficulties which also were worked out by the Propaganda Section in conjunction with experiments carried out by the Meteorological Service of the Signal Corps. . . .

Very few free balloons carrying propaganda were sent off before the armistice, and these entirely by the Independent Truck Sending Stations of the Propaganda Section. A first set of eight free balloons was sent off by Observation Balloon Number 6, as an experiment, on September 17, 1918, at Dommartin la Montagne in the St. Mihiel Salient, under the direction of the Chief, Propaganda Section. The experiment was entirely successful.

Organization

Based on experiments and experience the following scheme of organization was worked out for the cooperation of the Air Service with the Propaganda Section, G-2-D, G.H.Q.:

(a) By airplane. The Chiefs of the Air Service, First and Second Armies, were made responsible for the distribution of leaflets by airplane, over areas and at times designated by the Propaganda Section; leaflets to be distributed, wherever practicable, on all of the flights for other purposes and where necessary, on special flights for propaganda purposes primarily. Reports of distribution were to be made through the B.I.O., through the G-2s, to the Propaganda Section, G.H.Q. Indications of areas and priority of distribution were to be made through Propaganda Liaison Officers with the G-2s of each Army.

(b) By balloon. The Chiefs, Balloon Wings, First and Second Armies were to be responsible for the distribution of leaflets by free balloons, operated by the Observation Balloon Companies. Free balloons and made-up balloon "releases" were to be furnished the Propaganda Section, together with indications as to time and areas of use.

(c) The Balloon Wing was also to supply hydrogen gas to the Independent Mobile Sending Stations of the Propaganda Section for free balloons.

The above organization was put into effect as regards (a) about three weeks before the Armistice; as regards (b) it was never in effect and as regards (c) it was in effect just before the Armistice.

The Balloon Wing of the First Army, properly enough, took the stand that gas could be furnished for free balloons only after the needs of Observation Balloons were met, and more, were safeguarded by reserves sufficient to cover all emergencies. Emergencies consisted of Boche planes which came over and burned up our big observation balloons. Every time a big balloon was burned two hundred tubes of hydrogen gas vanished which might otherwise have been used for propaganda. So many balloons were burned that the balloon sending program never really got under way. Only in the Second Army, where the

shortage was not so great and where the Chiefs of the Air Service and of the Balloon Wing were convinced believers in the efficacy of propaganda, were steps taken to inaugurate the program on a big scale but this effort like many others was "ruined" by the Armistice.

The free balloons used were the standard British propaganda balloons, made of chemically treated paper with an oiled silk neck, to which was attached a "release", consisting of a fuse and hangers to which bunches of leaflets were attached. As the fuse burned down the leaflets fell free and scattered at regular intervals. The balloon was about nine feet long and required half a tube of gas. Four pounds of leaflets (about 600 sheets) were easily carried on the "release." . . .

It was especially planned to make extensive use of free balloons during the winter lull in order to reach the civilian population of Germany, especially of the Rhineland. Experiments carried on in the United States at the instance of the Propaganda Section, G.H.Q., and of the Psychological Section, M.I.D., Washington, had partly succeeded in evolving a large balloon capable of carrying 10,000 leaflets to distances of from 300 to 500 miles. Meanwhile the Air Service, S.O.S., A.E.F., had enlarged its hydrogen gas producing program so as to provide gas for a really extensive winter campaign.

The balloons actually sent off, aside from those mentioned, were dispatched from the neighborhood of Verdun by the Mobile Sending Stations of the Propaganda Section. It is noted that the French Army made extensive use of balloons and the entire huge distribution of the British Army throughout the summer and autumn was accomplished by free balloons. There is no doubt whatever that next to the airplane the free balloon is the best medium of distribution.

Conclusions

The airplane was the great weapon of propaganda in the A.E.F., nine to twelve Aviation Fields handling the leaflets, averaging in distribution 5,000 to 10,000 leaflets a day and some as high as 30,000 a day. The most effective effort was made by the 3rd Corps Observers at Souilly, the 4th Corps Observers at Toul, the day bombers at Amanty (later at Maulan), the Army Observers at Vavincourt and the various Corps Observers at Rarecourt, Foucaucourt, Remicourt, Beauzee, and Rumont, later St. Mihiel (the last two, French).

The miserable weather prevailing in October was the great deterrent to greater distribution. It rained persistently and when it did not rain, cloud levels were so low as to make flying impossible. The Armistice caught the Air Fields with great

quantities of leaflets on hand which would have been distributed but for the weather and the extreme changes of the line in the last fortnight of the war.

It was never possible to tell the exact amount distributed by each squadron because, in the haste of making war, squadrons failed to make formal written report of all their efforts. The main credit goes to the unnamed aviator, the lone enthusiast in the skies, who unperturbedly and intelligently rained the leaflets on Fritz's haunts.

The use of the Air Service for propaganda purposes in any future war against a nation whose soldiers are capable of reading should undoubtedly be a part of the recommendations of the War Plans Division of the General Staff.[e]

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1st Lt. Evan T. Mathis
Armament Officer, I Corps Observation Group

1. In this organization the office of Group Armament Officer was not created until August 29, 1918.[a] At this date three squadrons, namely the 1st, 12th and 50th, comprised the Group. The planes of the first two squadrons mentioned were Salmsons and were equipped with one synchronized gun, the Vickers with the mechanical synchronizer, while the planes of the 50th Squadron were D.H. 4's and were equipped with two Marlins with the C.C. synchronizing gear. The planes of all three squadrons carried two Lewis guns on the tourelle.[b]

2. The duties of the Group Armament Officer were chiefly that of Supply to the three squadrons. The Squadron Armament Officer would submit a list of material needed to the Group Armament Officer and same would be obtained by the latter with Group transportation, when possible to obtain said transportation, and delivered directly to the squadron armory; no stock of supplies was kept by the group. The lack of sufficient transportation has hindered the supply to a certain extent, but never did this lack affect operations as each squadron carried an emergency supply.

3. As mentioned above, the work of the Group Armament Officer in the case of this group was mainly that of Supply. This is due in a large measure to the fact that two of the squadrons had been operating on the front for several months and the personnel has been well trained in its duties. At very few times

A wagon train bringing up supplies and ammunition.

was the Group Armament Officer called upon to endeavor to solve some technical question in regard to the armament. However, the armament officers of the post would collaborate in the solution of any trouble which arose and in the means of improvement of equipment.

4. Sights—The question of sights for guns is a personal proposition with each pilot and observer. Unless otherwise desired by the pilot, the sight for the Vickers on the Salmsons was set for 200 yards. Some pilots wish their sights set for 300 yards but none over that distance. In case of the sights for the Marlins on the D.H. 4's the guns were set so as to have either converged fire at 200 to 300 yards or parallel fire, the pilot's wishes being consulted in each case. The Salmsons use the five inch ring and bead and the D.H. 4's use the two inch ring and bead in addition to the Aldis telescopic sight.

1st Lt. Edward M. Urband mans a Lewis Gun mounted on a DH-4 of the 135th Aero Squadron.

5. The Norman Wind Vane Sight with the ring back was furnished as the Lewis sight. It was usually mounted on the right gun of the set. Some observers preferred the Reille-Soult sight and same was obtained by the observer of the squadron whenever possible. Some preferred the simple rifle sight, and some cases the Norman sight was put on the right gun and the rifle sight on the left. Such a combination is in my opinion an excellent one. Tracers were used every third round and it will be remembered that these in themselves serve as an excellent sight after the first few rounds fired at the enemy.

6. Synchronizers—The mechanical synchronizer was used on the Salmson planes for the Vickers. The ease of oiling this cam box is an excellent feature. In two cases the cam gave considerable trouble; in one case this was due to uneven wear on the cam and in the other to improper grinding of the cam surface. The latter mentioned case should never have passed the inspector—the facts were that the gun fired and a firing angle of 35 degrees could be obtained but there was practically no over-travel of the trigger motor plunger due to the fact that the cam had insufficient throw. The two cases were remedied with new cam boxes which were obtained in less than three hours:

7. The C.C. synchronizer which is an oil gear was used to fire the Marlins on the D.H. 4's. Some trouble was experienced with it due to the difficulty of keeping the pipe line free from air. Also the soldered joints at the generator would break to motor vibration. It was practically impossible to obtain spare parts for these gears and often it was necessary to obtain a new one in order to get some part needed.

8. The first Salmsons which were supplied to the 1st and 12th Squadrons were equipped with a Lewis gun on the upper plane. This was abandoned due to the lack of need of it and to the tremendous amount of resistance offered to flight.

9. Prior to the change to Salmsons in June the 1st and 12th squadrons (the 50th Squadron at that time was outfitted) were equipped with a French type Lewis gun, cal. .303. These proved highly satisfactory but spare parts were difficult to obtain and the interchangeability of parts was satisfactory. However very few breakages occurred. This was Darne Revise Lewis and it is indeed an exceedingly fine piece of work with a strictly high class finish.

10. The Salmsons came equipped with the modified ground type Lewis made by the Savage Arm Co. This gun was modified in France and as could easily be seen in many cases was very much abused at this stage. These guns were sent out on the planes without being tested after having been modified. Orders were received by the squadrons to turn in all .303 guns and at the same time a change of stations was effected requiring a move of 150 miles from the point where these guns were turned in. This was the latter part of June. The first few days of July saw some hard air fighting on the Chateau-Thierry front and untold trouble was experienced with these modified Lewis guns. This trouble was the most serious that could be brought about and it was necessary to abandon the use of this gun and go back to the use of the .303 French Lewis.

11. Then the American Air Type Lewis made also by the Savage Arm Co., was supplied on all planes. After drilling the gas port in the barrel to 4.5 mm and the port in the gas regulator cup to 6 mm. this gun proved fast and satisfactory. The drilling was done in the squadrons after the guns were sent to the squadrons with the approval of the Inspection Department for work over the lines.

12. The performance of the Vickers gun was at all times satisfactory. Some trouble was experienced with the first American made copperized link. The performance of the Marlin was also satisfactory; it proved to be a very fast shooting gun; at the beginning of its use some trouble was experienced with double feeds. This was entirely and positively eliminated by the use of a small attachment which could be made in any machine shop.

13. The Very pistols supplied gave very poor results on ejection. It was practically always necessary to use another round or a stick for this purpose. Several of the main springs required refiling and retempering. The Very pistol ammunition was absolutely unsatisfactory due to old age and improper storage

before reaching the squadrons; all this ammunition was obtained from the French government.

14. Some trouble was also experienced with the Frankford Arsenal ammunition, F.A. 18, which was made specially for aerial machine guns. One lot F.A. 18 Ball, lot number 433, was put into the ammunition boxes of the planes and considerable [?] experienced. A 1000 round test was run on this lot and two rounds were found to have no powder in them and several misfires were obtained. This necessitated the discard of all the ammunition in the planes and the reloading of some 12000 rounds per squadron for the synchronized guns alone.

15. Finally will state that the main trouble found with equipment could have been detected by more thorough and rigid inspection both at the manufacturing points and at the stations where the armament is installed on the planes.

16. Would recommend that when a field is picked to be used for aviation purposes that the proper butts be constructed into which the guns may be fired from the planes for testing.

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2d Lt. R. H. Wessman
Armament Officer, 50th Aero Squadron

On August 1st, 1918, the work of the armament section of this squadron takes its beginning.[a] Before this time the men had been doing all kinds of fatigue work, and on calling them all together it was determined that only three of the thirteen men assigned to armament work had training fitting them for this work, while several could act as helpers. So the first step was to call them together, find out their previous occupation and experience and then to instruct them on the work they were to do. At this time we had no ships and plenty of time was available for this work.

By the time the planes had begun to arrive the men had begun to gain a little experience. A tent had been set up, a butt was erected, and things moved along with occasional hitches due mostly to inexperience. The following program was carried out for getting armament on planes in condition.

As the planes all arrived in a group, the best results were obtained by handling each article of armament equipment at one time, setting this out of the way and then taking another article. For instance, the Marlin guns were dismounted from the planes. One group of men disassembled the guns, cleaned off the

cosmoline and the rust, of which there was a great deal at first and put the guns in first-class shape. The guns were then fired through and thoroughly tested by me, every gun being shot several hundred times and perfect performance being required before remounting on the planes. Having passed this test okay, another group again dismounted and cleaned thoroughly. After this they were put back on the planes.

It must be said that the Marlin guns performed excellently, showing that at some point they had been run in very well, for they performed better than they did in the states where I have had some experience at a run in plant. Their condition, due to exposure from weather conditions, at first was bad but these improved.

Then the question of the Lewis guns came up. At first it seemed that not a gun would shoot. In every case it was the same story; the piston would not come back, showing either too much friction or not enough gas. The latter was finally decided on as being the cause, and the problem cleared up when we bored straight through the gas chamber nipple through the barrel with a 4.5 mm drill. After this no trouble was experienced.

By the time the guns were fixed, a good line was obtained upon the capabilities of the men, and they were each assigned to a certain number of ships, and they were made responsible for all the armament on those ships. They were brought into the Armory as occasion required.

The C.C. gears presented another problem, for very few systems were in working order. Many pipe lines were broken, all of them bent poorly, and leaked everywhere. A sergeant was dispatched to the First Air Depot, and in the Armory there picked up all the information he could on the gears and Marlin guns. On his coming back he ripped out most of the systems, straightened the pipes, packed the trigger motors, and gradually got the guns in shape. The work on the gears being completed, the guns were then shot through the props at the butt and the sights were harmonized.

By the time the squadron was completely organized, the armament was in condition for service. Much was learned in the first operation of the St. Mihiel drive, and from this experience the present state of organization originated, which may be of interest.

In the first place, the most important thing developed was the absolute need to place responsibility and also to arouse the man's interest in his work so that he would take pride in having the armament on his plane in the best of condition. Those two factors, the pride in his own plane and his responsibility for

them, to a large extent governed the success attained. These factors were brought about through the following organization.

There were 18 planes in the squadron besides a few extras. Each three planes were assigned to one armorer. He was responsible for the armament fixed on the planes, such as Marlin guns and ammunition, sights, tourelle, etc. He was responsible for keeping the gears filled with oil and taking the air out of the system. Also for going to the Armory for the Lewis guns and ammunition and putting them on the plane and taking them back to the Armory. There his responsibility increased in regards to the Lewis guns. One sergeant was in entire charge of all these men, and all armament in the hangars, so to speak.

One man was put in entire charge of the gears, to inspect them regularly and make any repairs which the ships's armorers could not. The latter would take out the floor boards, etc., and prepare things for the C.C. gear man, who would in this way lose no time in getting around the ships.

Now we come to the Armory. A sergeant was in charge of everything therein. Under him there were six men, two corporals and four privates. One corporal specialized in Lewis guns, making any necessary repairs and preparing the guns, and shooting them before putting them on the planes. The other corporal specialized in Marlin guns. Under them are three helpers who clean Lewis guns and do the other necessary work round the Armory. One man tends entirely to the ammunition keeping individual pilot's and observer's ammunition straight, taking care and filling magazines, calibrating and getting together sets of Very pistol ammunition. There is one other man in the Armory who keeps records straight, keeps up supplies, takes down and posts the number of rounds fired, makes out reports, etc. So much for the organization. Let us now take, for example, a day in the Armory to show how the organization works.

The list of missions for the following day is obtained the night before, and is posted on a bulletin board so that the armorers may ascertain what work is in store for them. The armorers in the Armory then prepare the Lewis guns for early morning flight.

In the early morning every bit of armament is thoroughly inspected by those concerned. Marlin guns are cleaned, gears filled, air taken out, etc. In the Armory all the Lewis guns are cleaned superficially.

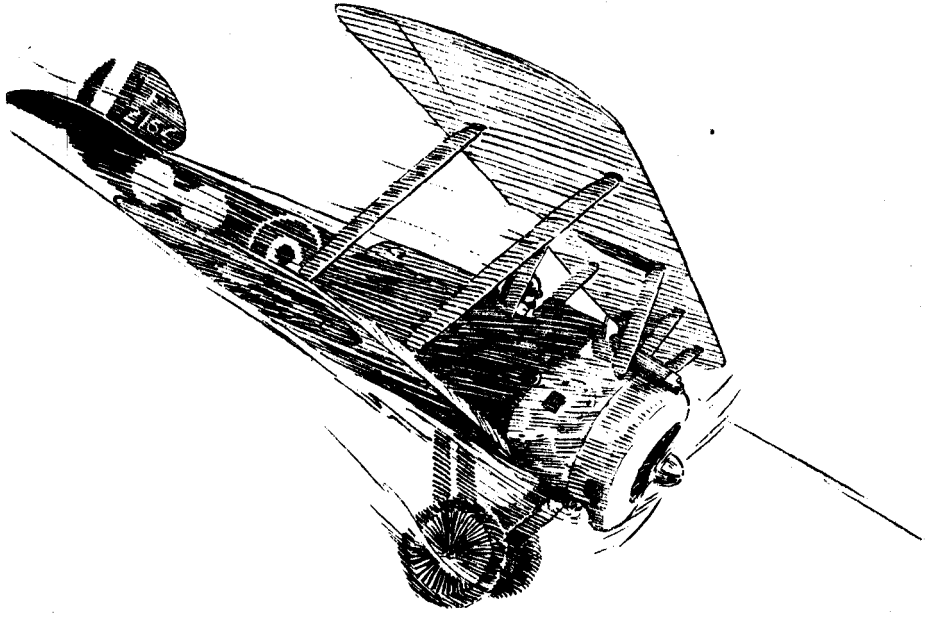
It is time for a mission. Three-quarters of an hour before hand, the Lewis guns are shot through and placed on a table, the ammunition and flares beside them. The armorer from the ship which is to go, comes in, gets the guns and ammunition and places them on the ship. He then tests the gears, wipes out

the barrels of the Marlin guns, loads them, leaving them on safety.

When the ships come back, he gets the report of the number of rounds fired and troubles, if there were any, carries back the guns and ammunition, reports number of rounds fired to clerk and ammunition man. He goes back to his ship, cleans the guns and puts the armament in shape again. In the Armory the Lewis guns are cleaned and the magazines refilled.

Now, as to suggestion for improvements which experience has shown. In the first place, as a rule guns and gears, when they arrive on the ship, due to the weathering they receive or some such cause, are usually in very bad condition. And are badly rusted, often the barrels. For this reason it is our opinion that guns and gears ought to be drawn by the squadron as needed, rather than be received on the ship.

This argument for drawing armament instead of receiving it is not the only argument. The guns from a new plane must be



taken off the plane, thoroughly cleaned and tested by shooting anyway, so it would save this dismantling the guns if they were drawn from a supply depot. Again, for example, you have several crashed planes on your field, as we have had occasionally. Orders are to leave the guns on the planes. A pilot has used and liked these guns. These guns could be mounted on the new ship coming in, without dismounting the pair from the new ship, and thus having extras which have to be returned. In other words you could cut down on the total number of guns necessary.

Every plane coming to us had six magazines and many fiber belts, and we had to return at least 175 of those Lewis magazines. This would never have had to be done if we drew only what was needed.

Now to another problem entirely, that of Signal Pistol Ammunition. This squadron had very little success with the signal pistol ammunition which was available, and though such precautions as were possible were used, several missions failed because of the failure of the ammunition to fire correctly at the proper time. As this squadron did a maximum of Contact Patrol, in which Signal Pistols are of great importance, the poor quality of the ammunition was especially noticeable.

It appears that a more stable type should be developed with an improved type of pistol. The pistols used would never eject. The ejector was worthless. Besides every cartridge had to be calibrated through the pistol it was to be used in, for the cartridge and pistols were very irregular.

Also an improvement in the cartridge carrier should be made. After two experiences in the squadron, a carrier was developed which gave great satisfaction. It was fastened to the outside of the fuselage so that if struck and exploded by a bullet (which actually happened in this squadron), it will burn outside and not inside the ship.

A piece of aluminum sheeting [was] fastened to the outside of the fuselage and to this again was fastened another piece of aluminum, shaped to fit half way around the cartridge, and catching the rim so it could not fall. Across these were stretched a piece of elastic rubber which held the cartridge and also served to streamline the holder. An old inner tube served admirably.

Another thing contended with throughout was the poor quality of aircraft ammunition. True, some lots were okay but many of them had to be discarded after testing. Worst of all though were the lots which were only found bad after they were mixed up in the ammunition boxes. Those gave all sorts of trouble. The deep

set primers found in the aircraft ammunition was especially noticeable.

It is the opinion of this squadron that C.C. gears are not very practical. There was practically no trouble due to shooting prop, but the constant care required and undependability of the gear makes [it] rather impractical. For instance, a gear will test out on the ground alright, but taking the air it will not function. A secondary pipe breaks in the air. The soldering breaks loose from a vibration. The principle and action of the gear is good, but it is the unexpected trouble that cannot be found, which makes it bad. A gear, depending for successful operation on a tightness, where there is so much vibration is impractical.

—84—

[2d Lt. Robert A. Kohless]
Ordnance Officer, 1st Aero Squadron

1. In moving from camp to camp, guns and magazines were damaged by lack of proper transportation facilities. This trouble was overcome by the use of a four-wheel trailer with improvised racks and fixtures.

2. The installing of machine guns (Lewis) in the tail of the fuselage to shoot underneath the tail of the aeroplane was found to be unsuccessful owing to lack of room for maneuvering and for the use of sights, and was discontinued.

3. Very pistols were found to be faulty in construction; main springs were as a rule too weak and ejectors often failed to eject exploded cartridges.

4. Some trouble was experienced with Signal flares. Many flares when received were found to be mouldy and damp.

5. Defects in ammunition were noted as follows: low primers, split cases, and insufficient powder charges.

6. Cams operating the synchronizer for Vickers guns on new planes received by the Squadron were in many cases faulty. This necessitated obtaining and installing new cams.

7. Considerable trouble was experienced with American-made black enameled and coppered Vickers links. These links were evidently badly made and held the cartridges too tightly.

—85—

1st Lt. Melville C. Hall
Ordnance Officer, 12th Aero Squadron

Based on the experience of the past 5 months operations, the armament work in connection with the Salmson Observation plane may be divided into two parts: (1) pilots' machine guns and (2) observers' machine guns.

Calibrating and supplying of ammunition for all machine guns used on the plane should be made the duty of the Armament Officer, the pilots and observers to inspect and recalibrate if they think necessary. Much confusion resulted under the arrangement of requiring each officer to calibrate the ammunition he used.

Operations: Frequently when the squadron moved to a new field, operations would be started before the armory could be set up. A special heavy truck should be assigned to move extra guns and the other ordnance supplies to the new field without delay.

Personnel: Trained armorers (from 10 to 15) should be under the direct charge of the armament officer, he to be empowered to make such promotions as are desirable, subject to approval of the Squadron Commander. The practice of loaning untrained men from the squadron was the cause of much poor work and inefficiency.

Material: Guns and ordnance supplies should be brought to the squadron ready for use, after the usual cleaning and testing. Overhauling and marking in of the guns was often done in the early months on the front. Experimental work was carried on when the guns were unfit to be sent into the air, but this extra work could not be handled well along with the routine work during the active operations. The First Air Depot gave us excellent service in filling requisitions, but it could not be expected that the armament received here in poor condition could be put into firstclass working order.

—86—

Maj. Ira B. Joralemon
Designs and Projects Division
Supply Section, Air Service, AEF

Gen. Mitchell (left) with Maj. Joralemon.

Joralemon, a mining engineer, had earned Mitchell's praise for the "wonderful work" he had done in preparing airdromes and getting supplies for the Battle of St. Mihiel.[a]

1. The following are the general results of the experience in preparing airdromes in the army areas.

2. For summer campaigns, it is most necessary that the Air Service have its own supply of tents and tent hangars for rapid moves. Since the advance, in case there is an advance, will nearly always be through devastated country, there is no chance to billet squadrons. Therefore, enough tents of the 5 x 8 meter, wall type, or some similar good type, should be supplied to house the officers and enlisted men and to furnish necessary offices and shops. Some type of tent hangar should be devised intermediate between the present individual tent hangar and the Bessonneau.[b] It should be stronger than the present tent hangar which often collapses in severe wind storms. Probably a tent hangar built to accommodate two or three planes of ordinary size would be most satisfactory.

3. For more nearly permanent installations, the Air Service should have its own supply of light demountable barracks, and all hangars of a more permanent type. These hangars might be of the Bessonneau type although probably they would be more effective if they were about half the size of a Bessonneau, or they might be made in the German style of a light wooden framework with board covering possibly. Some adaptation of the Adrian Barrack[c] principle might be satisfactory.

4. Since during great activity, when construction material is greatly needed, it is practically impossible to get railway transportation, the supplies of barracks and hangars should be stored at some depot within trucking distance of the airdromes. The construction squadrons should have sufficient motor trucks to carry the hangar and barrack equipment for an airdrome in a reasonable number of loads. Experience has shown that approximately 12 heavy trucks and four light trucks are needed during the times of great activity. Part of this equipment need not be assigned directly to construction squadrons, since it is not often that all the armies are active at the same time. The transportation could be placed under the equipment officers of

the group of armies and by that office temporarily assigned where necessary.

5. It is absolutely vital that all this construction material as well as construction personnel be directly under the Air Service. If the material and personnel are controlled by the engineers, at the time when they are most needed, the engineers are overworked by other branches of the Army and cannot give the proper attention to the Air Service.

6. During the preparations for the St. Mihiel and Argonne offensives, the army engineers showed every disposition to cooperate with the Air Service. In spite of this, the barracks which they furnished for use during the St. Mihiel offensive, arrived just in time for the Argonne-Meuse offensive, while the barracks which were promised for the Argonne-Meuse offensive, came just before the armistice was declared.

7. For use at times of activity when the airdromes are always more or less temporary, all buildings should be of very simple demountable types and of as few types as possible. This will make it possible for the construction squadrons to carry only a very few simple tools. On such airdromes there is no time to install a water system and tank trailers must be used exclusively. The only electric lights are those which can be

Airplane hauled for repairs to the machine repair shop at the 1st Air Depot.

supplied by the lighting trucks of the squadrons.

8. When an advanced airdrome is first constructed, nothing should be erected save barely the necessary tents or light demountable barracks, to shelter the men and officers. Later on, if it seems likely that the airdrome will be occupied for a month or two officers mess halls should be erected, floored and finished as well as possible. Next, mess halls should be erected for the enlisted personnel. Finally, the officers barracks should be partitioned and floored as is desired by the squadrons.

9. During the first few weeks on an airdrome, squadrons can operate with machine shop trucks entirely and can use parts of the hangars for storage space. Later on, if the airdrome continues to be occupied, a workshop should be erected for every squadron and a storehouse for the air park attached to the group. This will generally require an equivalent of nearly one Bessonneau hangar for the park of a group.

10. All construction material in the area of an army should be considered expendable material and should be absolutely under the control of the Air Service commander of that Army and of the group of Armies through the equipment officers. This will make it possible to teardown buildings from one airdrome and move them to another without the delay which is caused by getting authority from anyone further back.

Fuselage repair.

—87—

Capt. Charles W. Babcock
Chief Aeronautical Engineer
Third Aviation Instruction Center

1. The most important lesson that has come to my attention during the present war is the improper distribution of mechanics. Some of the best mechanics in our Air Service were used on all kinds of work except on work that they were best fitted for. A close survey of the mechanical personnel would show expert toolmakers or other expert mechanics doing kitchen police, military police and work of a similar nature. In many cases mechanics were doing stenography or clerical work while stenographers and clerks were striving in the shops with all their might to become mechanics. Mechanics are not made in one day nor one week: it takes years of practice in order to become an expert mechanic.

2. Guard Duty was another drawback to the mechanical personnel. This important work always had to be taken care of by expert mechanics. Take, for example, a shop using personnel from several companies or squadrons; each company or squadron furnishes a detail for the Guard. Take six men out of every outfit that is employed in your shop and note the confusion caused in all of your departments. This changing around goes on day after day and keeps your departments very well disorganized.

3. My statement boiled down is simply this; use mechanics for mechanical work; use laborers for kitchen police; use non-technical men for military police; and use soldiers, and non-mechanics for Guard Duty.

—88—

2d Lt. Lee M. Rogers
Engineering Officer, 1st Aero Squadron

(a) The quota of 18 planes assigned to a squadron having 18 pilots is inadequate during an offensive operation.

(b) When squadron is on the move great difficulty is encountered in obtaining replacement machines and supplies due to the number of channels from the squadron to the air park.

(c) Difficulty is encountered due to substitution of parts from Supply Depot, and lack of inspection, especially propellers.

(a) Recommend that the squadron have an extra flight of six (6) planes, making a total of twenty four (24) planes and four (4) flights. Each pilot is to use his own plane. If washed out or on repair to draw from 4th or repair flight, allowing more careful inspection of plane before leaving on mission.

(b) A direct method of obtaining supplies and machines for squadron from Air Park through Squadron Supply Officer.

(c) Particular attention to be paid to requisition of parts as called for and only those parts to be supplied. A more distinct line be made of parts for different types of machines supplied from the same Air Park.

—89—

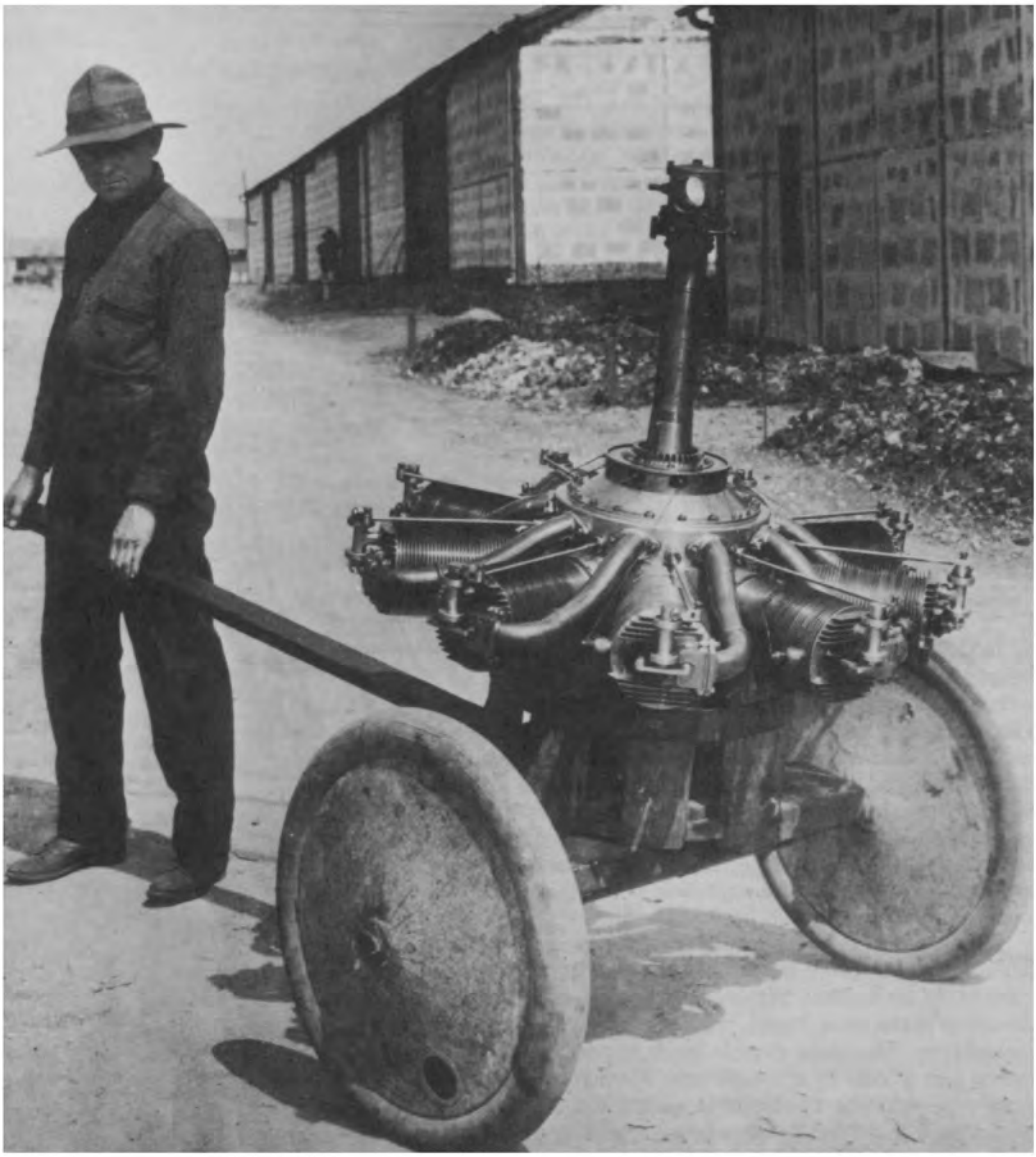
Engineering Officer
12th Aero Squadron

Three distinct obstacles hampered this department in its work:

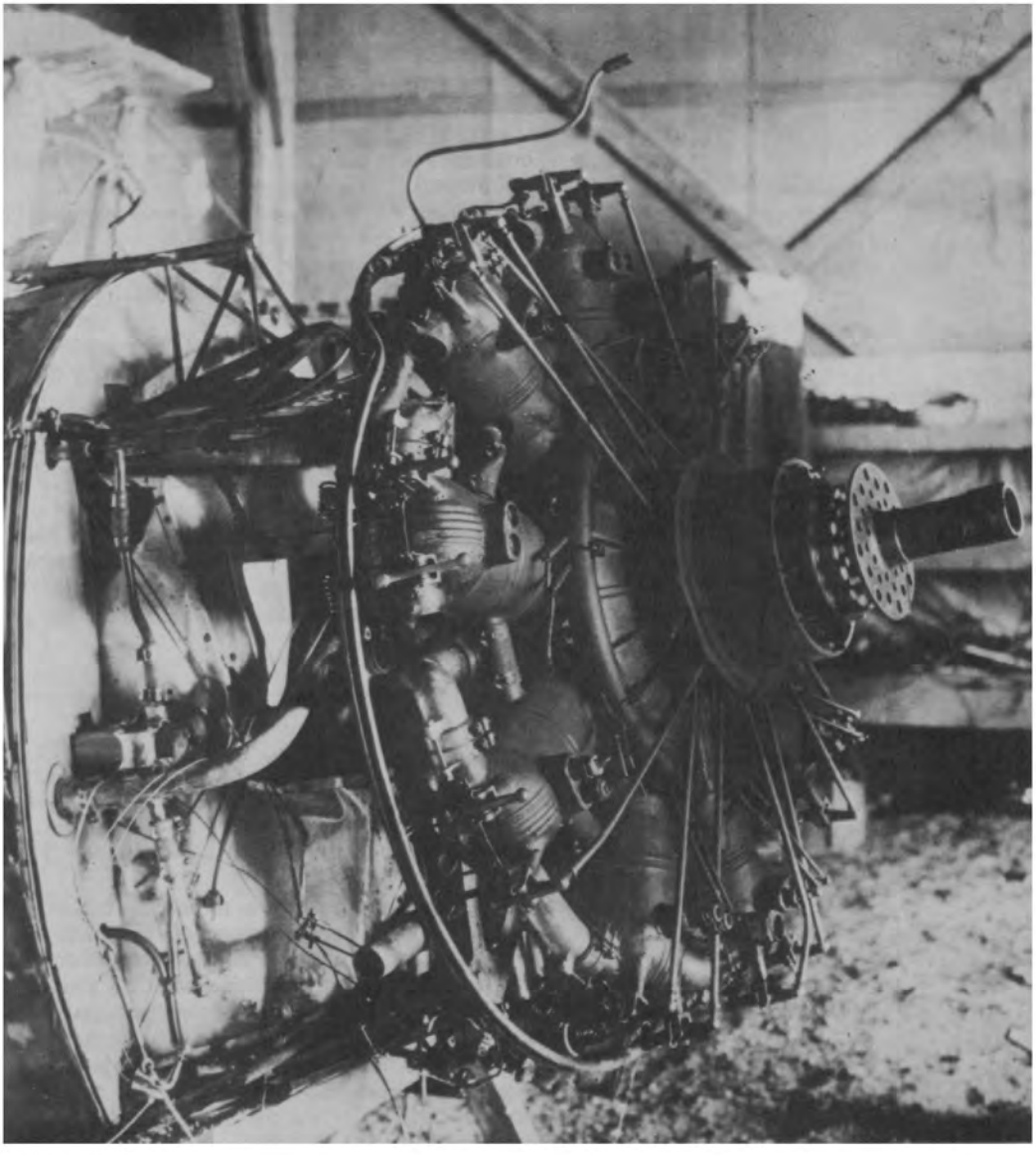
1. Lack of Personnel. The shortage of personnel was caused by faulty material furnished. By material we will cite motors and magnetos as examples. Motors furnished to us and installed without a thorough overhauling were unsatisfactory and unsafe. This made a complete overhauling of every motor received for installation, and a motor repair shop had to be maintained. This drew three men from those available for hangar duty. Every magneto had to be rebuilt to insure efficient operation. This drew two more men from the hangar detail. A complete and thorough inspection of all material furnished to a squadron should do away with the necessity for the squadron doing this work and would leave more men available for hangar duty.

2. Poor Material. Material furnished to our squadron was faulty in almost every instance. Each motor received was completely torn down, repaired, and reassembled. Not many damaged parts were found, the main trouble being faulty assemblage. The same trouble being encountered whether the motor was a new or a rebuilt one. Magnetos were another source of constant trouble until we started to rebuild them. It would be a great aid to squadrons operating in the field if they could use material without first overhauling and rebuilding it.

3. Supply. At all times during the period of the two operations, the greatest difficulty was encountered in securing



Transporting a rotary motor at 3d AIC, Issoudun.



Engine repair.

supply of parts, motors, propellers, etc. This will be dealt with in another part of the report. The Engineering Department has all it can possibly do when operating in the field without being hampered with lack of material.

In summing up, will say that personnel as provided for in present table of organization is sufficient to do all work provided proper material is furnished.

A closer relation between Air Parks and squadrons operating in the field is suggested. The Air Park working with our squadron during this period was located so far from the squadron that practically no cooperation was secured.

One of the most important facts connected with the successful operation of the hangars and Engineering Department of this squadron is the placing of responsibility for the work being done directly on the man doing the work. This was carried out very successfully because in every instance of faulty or careless work the responsibility was directly placed on the man doing the work who was summarily dealt with by the squadron commander. It is suggested that the Engineering Officer be allowed full control of the man doing work on airplanes. Let him pick and choose his men from the personnel as he sees fit. It is deemed unadvisable for the Engineering Officer to take charge of any work other than maintenance, repair, and the responsibility for successful operation of airplanes.

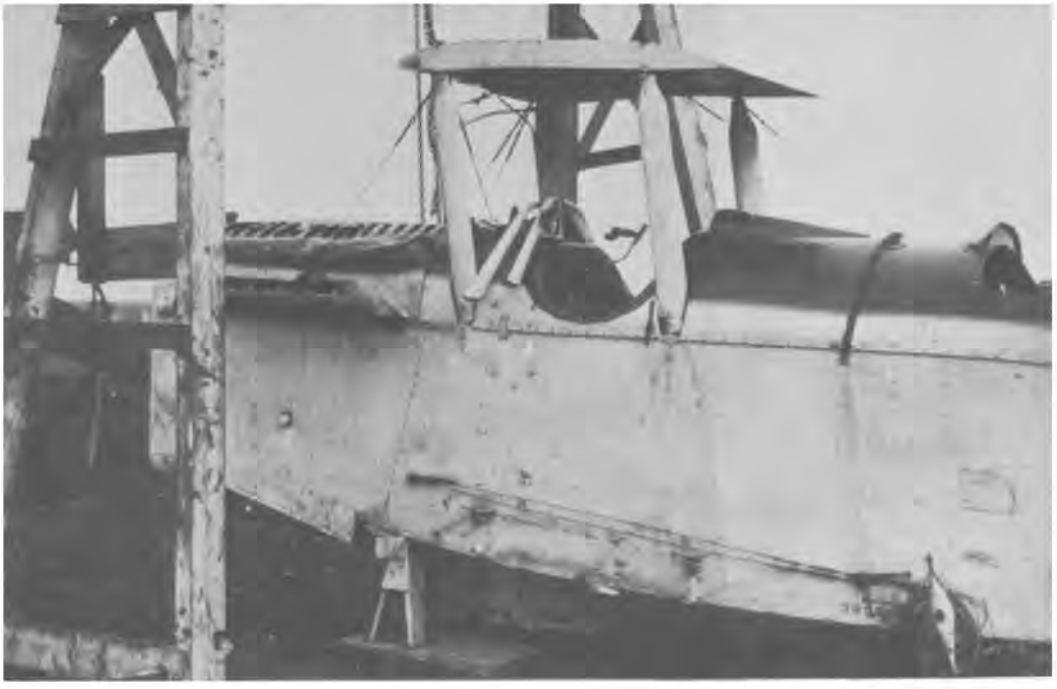
—90—

1st Lt. E. E. Esslinger
Engineering Officer, 50th Aero Squadron

I found during my first experience, in the month of August, that the Liberty planes were not ready for service. In fact at the First Air Depot, the planes often required considerable amount of work, which was done by our squadron mechanics, before they could be delivered to our flying field. A great amount of this work and repairs was necessary, however, owing to the ferry pilots not being familiar with the flying fields. Often planes were damaged due to rough and unserviceable fields.

Have made recommendations for the following changes, some of which have been made:

1. The Shock Absorbers originally designed for the DH 4 were absolutely worthless. Perhaps, under the most favorable



Aircraft overhaul at the 1st Air Depot.

conditions, perfect landing and ideal flying fields, these shock absorbers would give limited service. We overcame this trouble by using the Brequet shock absorber.

2. The Liberty wheel was entirely too light for the service required. The rims often buckled and the spokes would become dangerously loose. The Brequet or Salmson wheels with the Liberty tires were found to be entirely satisfactory.

3. The Tail Skids on the first planes were not tipped with a steel shoe. Tail Skids would often be worn so badly that after two flights new ones would be required. This trouble was corrected by building up the end of the skid and covering same with 1 × ⅛ [inch] cold roll steel.

4. The radiator cap was poorly constructed and made from light material. The overflow tube was changed from the top of the radiator cap to one side of the cap opening. This tubing was then placed under the radiator cowling entirely out of line of

Wing repair.

guns and also improving the streamline. By using heavy radiator caps and cap openings the spraying of water was eliminated.

5. By far our greatest troubles were with spark plugs.[a] We were furnished with the following kind of plugs during our operations: Splitdorf, A.C. Titan, A.C. New, Joly, Oleo 37, Oleo 82, M.Y., M.Y.[?],[b] and at least six other French made plugs. The Splitdorf plug gave absolute satisfactory service. One set of these plugs gave satisfactory service for about forty hours of actual flying time. Often the mechanics would find from five to eight defective plugs of the other makes on the completion of two or three hours of flying. A great number of the porcelain plugs would have broken off defective porcelains. Many French Mica plugs would foul up and short across the plugs. By actual experience and test the Splitdorf Mica plug proved to be satisfactory.

6. The DH 4 should be equipped with a collapsible rear

cockpit seat. The Liberty steel seat interferes with the free and unobstructed movement of the observer when he is standing. Since he naturally stands in the center, it is very evident that a side seat similar to the Salmson would be a great improvement.

7. I would also recommend that the wings, both upper and lower be constructed with double ribs particularly between the first set of struts. The continual vibration and propeller blast breaks the fabric stitching.

8. Owing to the limited vision for the pilot, particularly to the front and above, I would recommend that the gravity gas tank on or in [?] the upper wings[c] and to "glass in" the center section.

Squadrons should be supplied with some convenient means to heat water and oil. The large amount of water and oil required each motor makes it almost impossible to start motor other than with some method to rapidly heat the above, especially during cold weather.

In conclusion I desire to state, that with the above mentioned improvements, some which have been made, I firmly believe that the Liberty Motor has proved to be the best in the Field of Aviation.

—91—

Capt. Harlowe Hardinge
Radio Division
Office of the Chief Signal Officer
Services of Supply, AEF

A. *General*

. . . . Information obtained from the allied armies and from experience gained before operations became a war of movement show that the organization of liaison, during a battle, between headquarters and the different arms especially the infantry, had been one of the most difficult problems. In fact, under intense bombardments, the best organized means of liaison did not function after a few hours of combat. Telephone lines were cut and visual signalling was not only insufficient but not always dependable and liaison by means of couriers was found to be uncertain and slow. At the beginning of the war (1915) the

difficulties encountered due to the inability to have perfect liaison during combat resulted in the following:

1. The infantry was completely isolated during battle and could no longer report in due time to headquarters relative to its exact location and the turn of events. It could no longer point out its needs in the way of reinforcements, ammunition, etc.

2. It compelled the artillery to fire in conformity to plans of the artillery without taking into account unforeseen events or the conditions under which fighting was being developed.

3. It left headquarters in almost complete ignorance of the operations of the infantry during battle, of the events which could bar its advance or force its retreat. It therefore prevented the proper and timely use of reserves. Maneuvering could not even be considered. Without going into details concerning the development of the airplane liaison with special reference to radio communication, it will simply be said that due to the airplane equipped with radio, it has been possible to obtain definite liaison with the most isolated units at all times during atack. The method by which this liaison was obtained will be outlined.

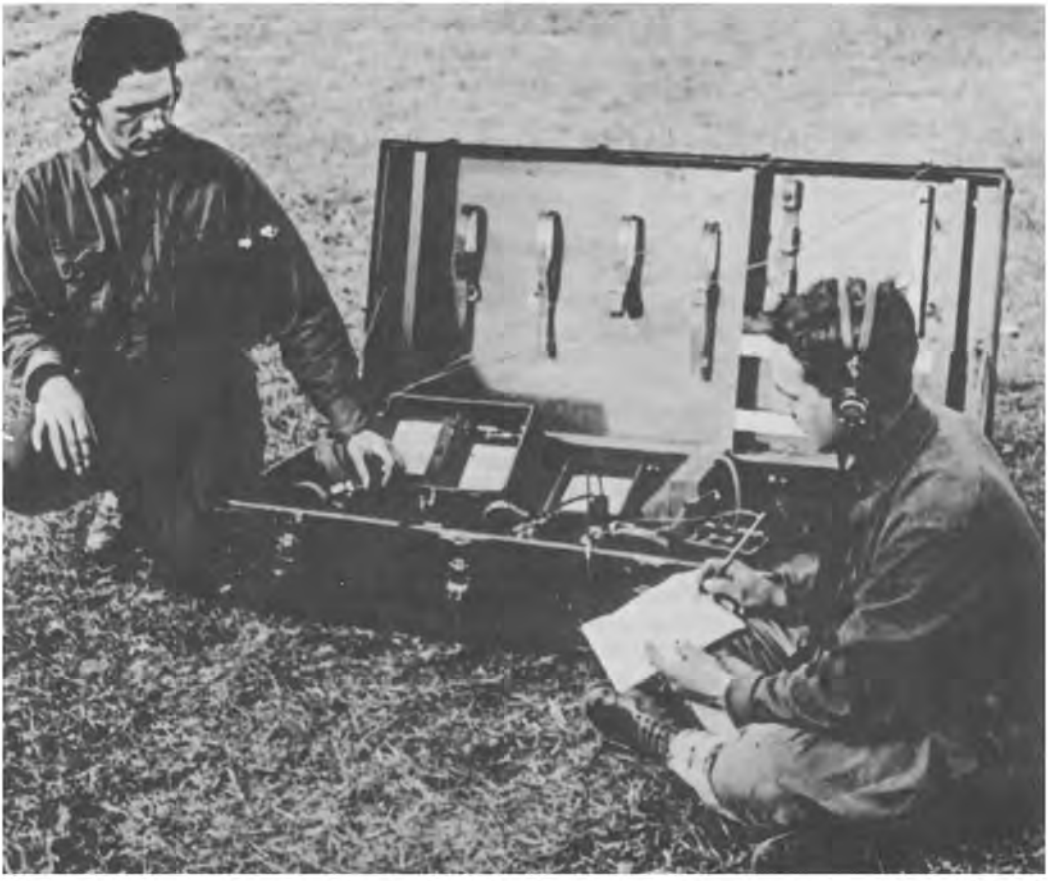
B. *Methods Employed*

1. Air Radio:

(a) Artillery Reglage: Radio communication between the airplane and the artillery receiving station was extensively used for directing the fire of both heavy and light artillery. During the long period of trench warfare this method of liaison was used very extensively, much more so than during the short period of open warfare. Up to the signing of the armistice, no two-way communication between airplanes and ground stations was used by the American units, owing to the fact that equipment was not available until a short time before, and the facilities did not permit the observers being instructed in this method of communication. Satisfactory communication however was had with the long range artillery, using the ordinary one-way set (Type "Y"-French) on airplane, the airplane flying back over the lines far enough to see the panels between each correction.

(b) Infantry Liaison: Very satisfactory cooperation between the infantry and airplanes was had by the allied armies, and while not as efficiently operated by the American Army, owing to the limited amount of instruction, the liaison effected between the airplanes and infantry proved of great value in many cases. Locations of the lines were sent down by radio and also by written messages dropped from airplanes in message containers. Often during the recent operations, practically the only effective method of liaison was by use of airplanes.

(c) Reconnaissance: By means of radio on airplanes sent on



Receiving messages from an airplane by radio

reconnaissance missions, very valuable information was often sent down, which would have proven useless had it not been made known before the plane could fly back to its hangar. The apparatus used for this work was also the standard French Type "Y" Set, the only airplane radio equipment used at the front, with the exception of a few Type "U" Sets, which were later replaced by the "Y" Sets.[a]

2. Ground Radio:
   (a) Trench Sets: . . . .
   (b) Tank Radio: . . . .
   (c) Intelligence Service: By means of Direction Finding, it

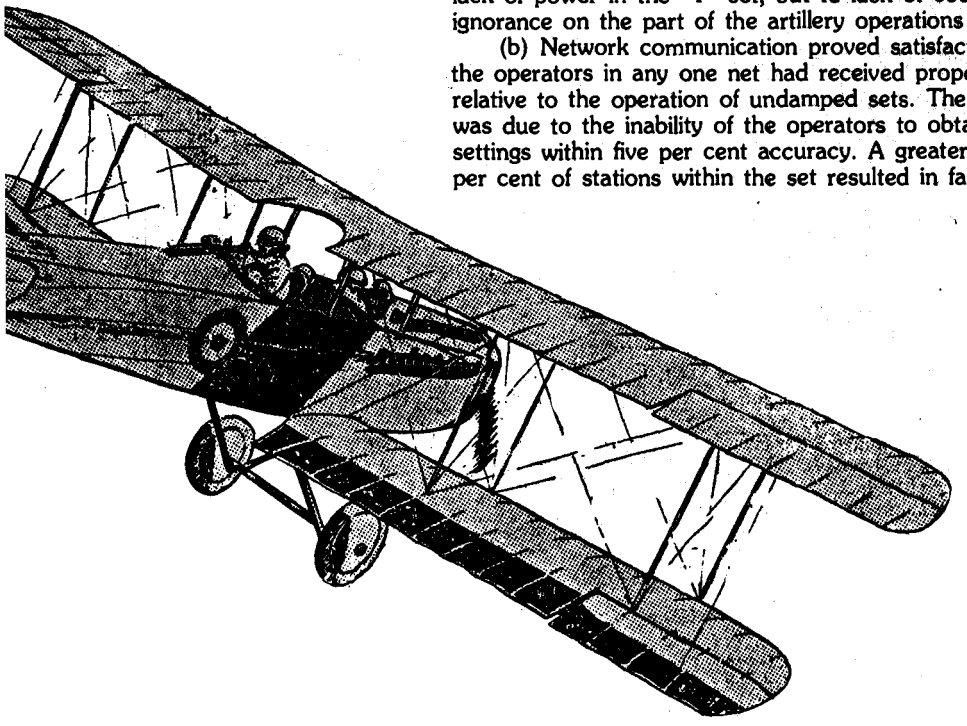
was possible to locate hostile airplanes operating radio. The Intelligence Service was, however, used primarily for recording messages sent by the enemy and in locating enemy ground stations.

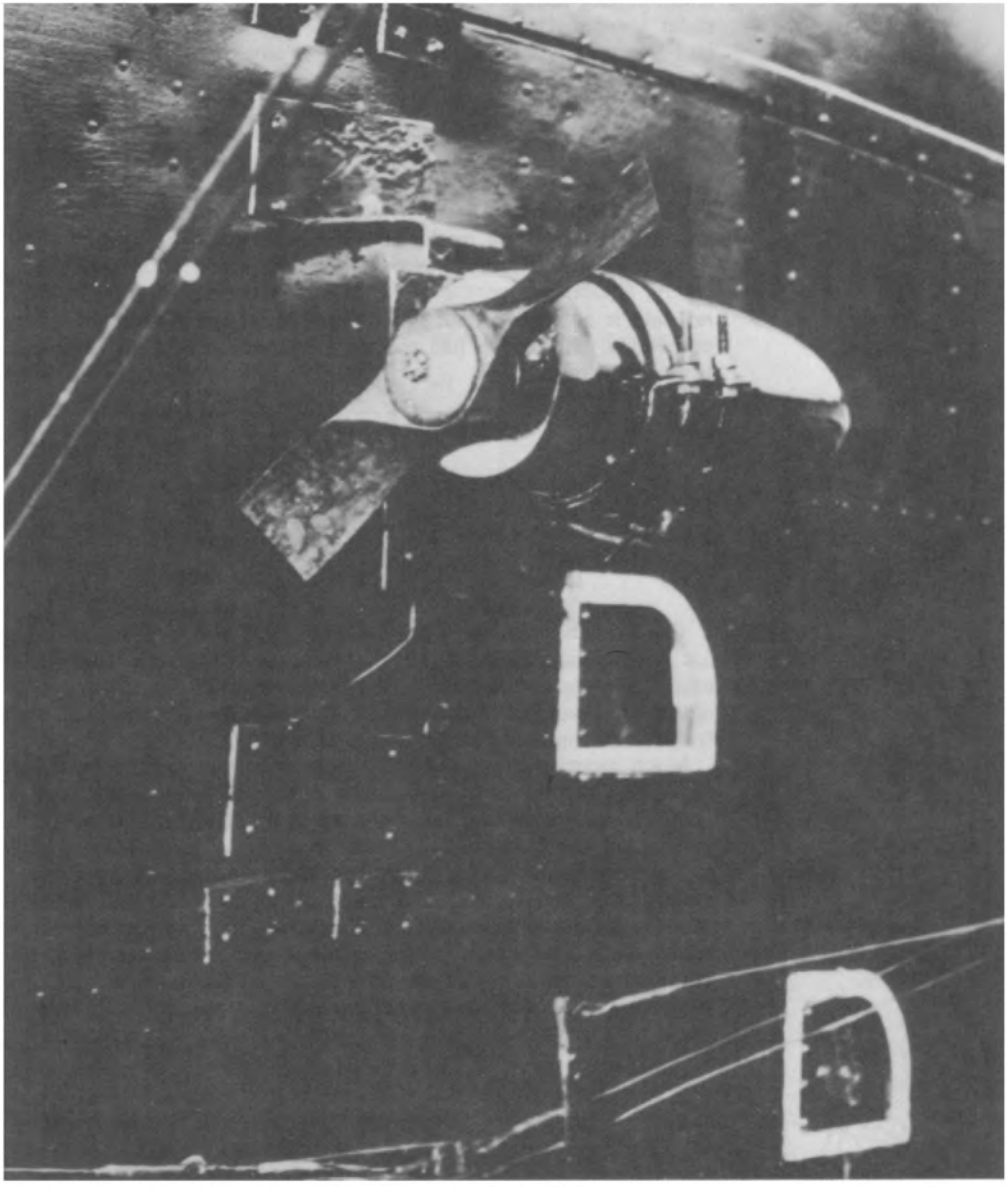
(d) Network Communication: All main divisions and isolated units, such as squadrons, were kept in communication by means of radio . . . .

3. Discussion:

(a) As has already been stated the Type "Y" French Set was the only one used on airplanes up to the signing of the armistice. This set seems to have proven satisfactory for the purpose for which it was intended. There has been considerable discussion relative to this set at the front, due to the fact that artillery operations when unable to receive messages sent with this set attributed the cause to the limited range of the Type "Y" set. It should be said, however, that after careful consideration by those who have been concerned in the operation of this set, conclusion has been reached that these failures were not due to lack of power in the "Y" set, but to lack of cooperation and ignorance on the part of the artillery operations. . . .

(b) Network communication proved satisfactory as long as the operators in any one net had received proper instruction relative to the operation of undamped sets. The main trouble was due to the inability of the operators to obtain wave length settings within five per cent accuracy. A greater error than five per cent of stations within the set resulted in failures, due to the





Generator for Type "Y" set mounted on the fuselage of a DH-4.

sharp tuning required by the undamped sets. The majority of air radio personnel at the front up to the signing of the armistice had little or no training outside of that given them in the squadrons.

(c) Radio Telephone: No radio telephone sets were used at the front up to the time the armistice was signed, as instruction had only just begun. A sufficient quantity of sets had arrived only a short time before the armistice was signed and all fixtures, such as brackets, generator collars, etc., for their installation had to be made, as none came with the sets.

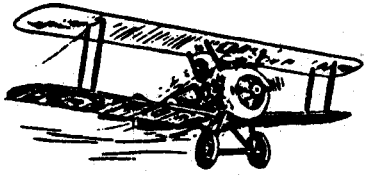
(d) Direction finding: No airplanes equipped with direction finding equipment were ever flown over the lines, consequently no data is available relative to its usefulness under actual battle conditions, although it has proven a success at test stations and training centers.

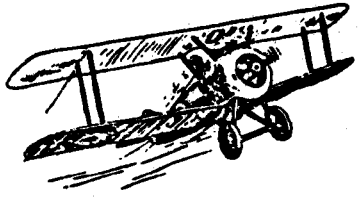
—92—

[2d Lt. Knox W. Nicholson]
[Radio Officer, 1st Aero Squadron]

The French radio set Type-Y Direct, was and is used by the 1st Aero Squadron during its participation in the war. The essential parts of this set are the high frequency fan driven alternator mounted in the drift of the propeller, and the transformer mounted within the fuselage.

Much inconvenience and annoyance has been caused by this set during recent activities because of the difficulty of testing it properly *on the ground* and because of its semi-permanent installation in the airplane, it would have been much more satisfactory to have used a highly compact transmitting set not installed but merely placed in the airplane, and then only when that machine was going out on a mission involving the use of radio. Such a set could be put in place and the necessary plug connections made in far less time than it takes to place a camera. This would save the strain which is put on radio sets





while in the air on missions not necessitating their use (i.e., photo or protection).

Another inconvenient feature of the French Type-Y set is that, due to its semi-permanent installation, all minor repairs and tests (the latter are very numerous) are made out on the field or in dark hangars. If compact portable sets were used they could be taken to the radio trailer shop where all facilities for repairing and testing are available.

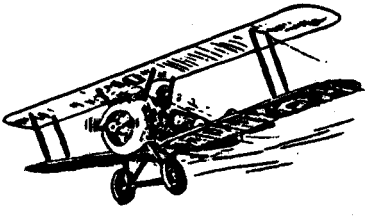
Antennae and weights[a] were lost at such a rate that the following was resorted to: The weights were placed on an improvised swivel and attached to the end of the antenna thru a spring. The dimensions of the latter were 1×12 cm. This arrangement reduced the number of lost antennae and weights materially.

The radio apparatus available, gave satisfactory service at all times, but better service could have been had, it seems, with less effort and less chance for errors or failures, by using a compact portable set as referred to above.

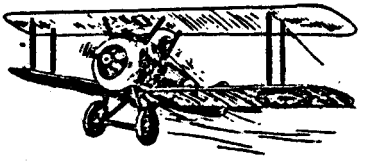
—93—

2d Lt. Oliver N. Beymer
Radio Officer, 12th Aero Squadron

In the case of planes used for radio, it is much more satisfactory to have the plane equipped at the factory. Because of the great amount of vibration with the generator mounted on a bracket on the fuselage, leads to the generator field and brushes become broken. This vibration might be cut down by mounting the generator on the lower wing. A more satisfactory interchangeable reel might be developed. The leads on the generator type "Y" to the field and brushes might be made of a braided soft wire such as used on high speed exciters, as those would withstand greater vibration than the present stranded wire leads.



A short wave indirect set similar to the S.C.R. 72 would be of greatest advantage because of the sharp wave. Less jamming



would occur at artillery receiving stations. The wave lengths of the type "Y" indirect and also of the S.C.R. 72 were too high to be used according to the wave length . . . [schedules?].

The workshop could be mounted in a medium-size truck with charging outfit installed. With this arrangement, the radio truck could be moved from field to field without depending on the squadron transportation, since the radio department often has to do work on the planes while the squadron is moving.

The system of supplies is not the best as the newly developed and approved apparatus does not reach the squadron as soon as it might. Often the supplies that are most needed cannot be had but are found in plenty anywhere but the front.

With the light truck as above mentioned, the radio department could be more independent of squadron transportation.

The radio enlisted personnel might be put on a par with the remainder of the squadron enlisted personnel in regards to non-commissioned officers.

As a whole, the equipment and personnel have been good but improvements might be made especially in a short wave indirect set for planes.

—94—

2d Lt. Harry W. Pribnow
Radio Officer, 50th Aero Squadron

During my period of duty with the 50th Aero Squadron beginning September 28, 1918, the radio section has had the opportunity of using its equipment under the greatest difficulties and with great success. Before being assigned to this squadron, I was with the 1st Aero Squadron which used the same sort of radio apparatus, although on a different type of plane. I found that the radio sets mounted on the Salmson planes were easier to take care of than the sets on the DH 4 planes owing to the construction of the machines. The Liberty planes have much more vibration to contend with than the Salmson. For this reason more care and attention must be given the radio apparatus on the DH 4 than on the Salmson.

In spite of all the difficulties the radio section had to overcome, we had but one complete radio failure since September 28, 1918, and this was unavoidable. The lead into the field broke on the winding and could not be prevented. This is the second instance of such an occurrence since the American Army started to work with its own Air Service.

Class in operating the wireless at LeValdahon.

The greatest trouble experienced was broken leads to the brushes, caused by great vibration. We remedied this difficulty by reinforcing the leads with small wire and resoldering the connections.

Another great trouble was with propellers for the alternators. We experienced great difficulty in securing 150 Km propellors Until just recently the DH 4 replacement planes for the squadron came equipped with 140 Km propellers. This was quite important because this sized propeller attained to a great speed and consequently caused the mounting to get loose and in several instances to break off. During the wet weather, mud flying off the wheels when taking off caused many broken propellers.

We had a little trouble with the mountings for the alternators because they were not strong enough. As soon as the new plane came to the squadron we reinforced the mounting, both on the inside and outside with strips of sheet metal. The last two planes we received were equipped with a much better mounting, although it should have been made to allow the use of a constant speed propeller.

The S.C.R. 57 Interphone Sets were quite satisfactory; some of the pilots and observers liked them very much, while others would not use them because the numerous wires interfered with

An elementary buzzer class in code instruction—radio training at the 2d AIC.

A corner of the American radio set room at the 2d AIC.

their work. If the helmets could have been made to fit each man they would be more satisfactory and more used.[a]

After having used the radio apparatus under all conditions, we have from time to time found room for a few improvements; for instance, when the new plane came to us it had a plug in connection to the antenna. We changed this so it would have a direct connection to the antenna at the fairlead, thus saving the observer time, trouble and preventing many failures. The keys were moved to suit the operation also.

During our operations with the 42nd Division we worked on a long wave length when on Infantry Contact Patrol work. This necessitated a very long antenna on account of the direct "Y" set. Invariably the planes returned with either the antenna clipped off or weights lost. When a plane is on this sort of a mission it must fly low over the tree tops and shrubs and the long antenna is bound to drag. If the Divisions used shorter wave lengths, and this is possible, especially for the Infantry Contact Patrol work, more of the missions would be successful.

The enlisted personnel of the radio section should be given more training with the French undamped sets. All men should be operators so that the squadron can have a man on duty all the time. It has been quite often the case that the men do not understand the working of the E-3 Bis and E-3 Ter radio sets.

After having been both in the Radio Schools in the Service of Supply and on actual service at the front, I believe that the instructors in the schools should be radio officers who have had some experience with the apparatus at the front. This would bring the actual work into and thus be better for the service.

The constant speed propeller should be highly recommended for use on DH 4 planes, but before this is possible the mounting will have to be extended, as it is too close to the fuselage at present.

The table of organization allowing eight men in the radio section is quite successful. When a squadron is together with another squadron in its group, fewer men are needed, but when at an airdrome alone and away from the group, all men are kept busy all day.

—95—

2d Lt. Joy Hopkins
Radio Officer, 104th Aero Squadron

1. It has been proven by experience that it is not necessary to

assign one radio officer to each squadron operating in the field. One officer assigned to the Group and vested with proper authority can efficiently control all radio operations of the group.[a] This officer should have transportation constantly at his disposal so that he can make liaison at all times with radio officers of corps and division, liaison to bring about a perfect understanding of methods of battery adjustment by aeroplane and to fix responsibility for all radio failures. The Group officer should be consulted relative to the feasibility of using wave lengths to squadrons in his group.

2. As a rule, the training of enlisted personnel is too general. If possible men should be trained as operators, storage battery men, or generator repair men, each course to include some of the theory of radio telegraphy. Squadrons could then requisition personnel according to their training, thus avoiding the necessity of training men in the field.

3. Radio operations of a squadron can be efficiently conducted by a well trained enlisted personnel commanded by a Sergeant or a Sergeant First Class. Only in the case of a squadron operating independently should there be a commissioned officer in charge. Squadron operations for the most part embody merely the repair of small generators, charging of storage batteries, and

The radio department at the radio tower, 2d AIC, Tours.

the requisitioning of supplies, which with the instruction now available in our radio schools, can readily be handled by [a] non-commissioned officer. The group radio officer should be consulted relative to any changes.

—96—

2d Lt. J. G. Belcher
Radio Officer, I Corps Observation Group

Commissioned Personnel: It is suggested that one officer in charge of Radio in a Group is all the commissioned personnel necessary. An M.S.E. or sergeant first class would suffice in the Squadron where the Radio work is limited entirely to the care and installation of equipment on the planes. This non-commissioned officer with the proper enlisted personnel could handle the work with ease and could be made directly responsible to the Group Radio Officer who in turn would be responsible to the Group Commander. There is no necessity for both Group and Squadron Radio Officers.

Enlisted Personnel: At least six first class operators should be attached to each group. These are necessary to allow the functioning of the "net" or long wave station, and to operate the checking-out station, and includes one extra man for emergencies. Besides these a battery man with an assistant are necessary.

Equipment: Each group should be equipped with one long wave transmitting set, preferably undamped or sustained wave. This Group has had one for each squadron, which has not been necessary. The longest distance worked by this Group has been about forty-five miles but it would be preferable to have a set with greater range. On several occasions, notably at Chateau-Thierry and in the Argonne, liaison between the group and the divisions which it was working with has depended almost entirely upon Radio and though communication has never failed it has at times been rendered extremely difficult on account of distance.

This set should be mounted in as light a camion as possible and should be accompanied by another with a charging outfit and all facilities for battery work.

Supplies: Supplies have been a problem in Radio work on the front for one reason. The Supply Parks attached to the Corps have not carried a large enough or varied enough stock for us to obtain what we needed promptly.

—97—

Maj. F. N. Shumaker
O.I.C., Air Service Section
Radio Division, OCSO, AEF

General Patrick's "Final Report" on the Air Service, AEF, gave some space to the organization of the radio service and the problem of dividing the various functions between the Air Service and the Signal Corps. As the report pointed out, the situation was further complicated by a three-way division (Air Service-Signal Corps-Artillery) of responsibility in matters pertaining to radio communications for artillery adjustment by aerial observers.[a] In the report which follows, Maj. Shumaker advocated giving the Air Service control of both ends of the radio communications system for regulating artillery fire. In support of his proposal, he cited the success the British had had with such an arrangement. He might also have noted that this was the system which had been advocated by the Technical Section of the Air Service, AEF, late in the summer of 1917 but which had been rejected.

Shumaker had been engaged in radio work with the British before his appointment as Chief of the Radio Section, Air Service, AEF, when the section was created in April 1918. Subsequently, in September 1918, he had become Chief of the Air Service Section when the Radio Section was taken over by the Signal Corps. His immediate superior, Lt. Col. L. R. Krumm, Chief of the Radio Division, agreed that whoever controlled Air Service radio should also control the receiving stations for artillery adjustment, but whether control should be given to the Air Service or to the Signal Corps was a matter for discussion.[b] At a conference presided over by Krumm on 11 January 1918, and attended by a dozen Signal Corps and Radio Officers, including Shumaker, it was agreed unanimously that ground stations for army artillery should be manned by Air Service personnel. This was not extended to include divisional artillery because in the latter case radio was more concerned with cooperation with the Infantry than with the Air Service.[c] No such distinction was made, however, in the recommendation that General Foulois made three days later to the Director of Military Aeronautics in Washington (Doc. 98).

1. I have prepared the following outline as a suggested basis for reorganization of radio cooperation between airplanes and

artillery as a permanent branch of military science along those fundamental principles that must be followed in any military operation involving the extensive cooperation between two separate arms of the service if efficiency, under the trying conditions of active service in the field, is to be maintained.

2. Effective cooperation between airplanes and artillery can only be maintained by an efficient radio system and in this regard it must be borne in mind that by far the greater skill in radio operation alone must be possessed by the receiving personnel on the ground, and that not only is this the case in the strictly technical operation of the radio apparatus but that the receiving operator must be familiarized by careful training with every detail of the airplane observer's duties and difficulties so that he may feel that his duty is one of *Loyalty to the Observer in the Air* in rendering every possible assistance to the latter in his arduous task, as well as of *Loyalty to the Air Service* in promoting the efficiency of that service in every way that lies within his power so that there will be no chance of dissension, and the mutual confidence so vital to successful cooperation between the two services will be upheld.

3. He must be made to realize that for the time being, he is the most vital link in the chain of communication and that a break or failure, which by his own personal sacrifice could possibly be avoided, means much more than the failure of a simple registration, though this in itself is serious enough, especially during the preparation for an attack when there is never sufficient good visibility flying time available to provide for the amount of counterbattery work that should be done to properly safeguard our infantry troops when zero hour arrives. It means that for the time the loss of an airplane and two flying officers is being needlessly risked and their services are being worse than wasted, for during the minutes when he is for any reason not properly receiving its signals the airplane is probably sending countless calls intended for him but which are only causing interference with the signals of other airplanes trying to work with other batteries near by. What is far more serious is that when such a failure occurs due to the operator's negligence or incompetency of training (and countless such failure have occurred during actual operations in the A.E.F), it is only human nature that, provided he is an artilleryman and responsible only to the Artillery for the efficiency of his work, he will report the failure to his immediate superior as the fault of the airplane, and each service will say that the other is at fault. Therefore, if the sender of the message, i.e., the airplane observer, is to be responsible to the Air Service, and the receiver of the message

to the Artillery, it must work out (and has in fact constantly occurred in recent practice) that dissension and loss of mutual confidence without really discovering instantly where the trouble lies and correcting it with the necessary disciplinary action has been and will continue to be the result, as long as the present system of radio cooperation employed between the Air Service and the Artillery in the American Expeditionary Forces is followed. The loss of flying time and tactical opportunities through failed missions, slow shoots and lack of confidence in airplane observation due entirely to faulty operation of radio at artillery reception stations because of operators being poorly trained, and incompetently supervised whilst in action is an appalling indictment of the plan which has been in effect in the

A Signal Corps radio set for use in aviation.

A.E.F. whereby the operators for reception of radio from airplanes at artillery stations are trained by and responsible to the artillery itself, and should be a sufficient object lesson to prelude the possibility of this plan being considered as a basis of permanent organization.

4. I have endeavored in the foregoing to emphasize that in considering any basis of reorganization of the radio functions of this service insofar as cooperation with the artillery is concerned, it is necessary to assume that firstly the principle will be finally and firmly established by the War Plans Division or other competent authority that because the sender of the radio message from the airplane must belong to the Air Service, the chain of responsibility for the radio function can only be logically

A radio set being installed in a DH-4.

completed by making the receiving end responsible to the master, who will be charged both with training of the operators for this duty, and with supervision with authority over these stations in actual operations. This latter function therefore properly devolves upon the Squadron Commander of the Observation Squadron which cooperates with the particular artillery units affected, as there can be no argument but that he is the officer held directly responsible by higher authority for the percentage of success which has squadron attains in the missions of artillery observation with which his squadron is charged.

5. For this purpose he is provided with a radio officer commissioned in and trained by the Air Service. There is also an Air Service radio officer of the staff of the Air Service Group Commander who might readily be charged with general supervision over the outside stations pertaining to all the squadrons of his group, to standardize erection and general technical and operating details of these stations. Under the present system, these officers have only the responsibility for maintenance of radio apparatus on airplanes within their squadrons, a duty which might readily be left to a large degree in the hands of the radio Master Electrician of the squadron, leaving themselves free to maintain daily supervision of reception stations in the field and to make immediate investigation and report of any failure of airplane cooperation with these stations when radio operation is involved. In an active program, there would be at least 20 such stations in operation pertaining to each squadron and the best efforts of the Squadron Radio Officer would be fully and usefully employed in their proper supervision.

6. A sufficient commentary on the value of the work which may be accomplished by the employment of this simplified system wherein the supervision and control of all the stations for receiving messages from airplanes rests with the flying service is given by the following quotation of a typical day's work by a British Wing, the 15th R.F.C., comprising three Artillery Observation Squadrons, on June 2nd, 1917:

Successful registrations by airplane radio cooperation	159
Direct hits on enemy battery positions	101
Enemy gun pits destroyed	29
Enemy gun pits damaged	30
Explosions caused	21
Total number of rounds corrected in counter-battery shoots by radio cooperation with 6", 8", 9.2", and 12" howitzers	5230
Radio failures, either at artillery reception stations or in airplane apparatus	None

As against records of this nature, we are only able to show by the reports of Observation Group and Squadron Commanders, Operations Officers, and the Artillery itself that our system has been a source of contention and that but a small percentage of the airplane cooperation by radio, which might have been expected in fair comparison with the above typical record, has been accomplished.

. . . . . .

Relationship with Signal Corps

1. The relationship with the general communication service of the army in this regard is entirely analogous with the telephone service between the artillery battery and its forward observation posts, a service in which, it will be noted, that the telephony branch of the Signal Corps takes no part beyond the supply of material on mass requisitions which are submitted by the Artillery. This is due to the fact that this service is entirely unique within the Artillery itself and in no way affects the general communication system of an Army, and it does not appear that the introduction of Signal Corps personnel, either in maintenance or operation of these lines, would contribute to efficiency. Exactly the same is true in the subject of airplane radio communication to the Artillery except that, for reasons as already stated, this work must remain as a responsibility of the Air Service.

2. The plan by which the Signal Corps is charged, as at present, with the development and production of radio apparatus for all branches of the Army is good and should remain in force, the Air Service merely requisitioning on the Signal Corps for all requirements to maintain its service of cooperation with the Artillery, both for equipment of its airplanes and receiving stations.

3. Chief Signal Officer of the Army should also, for purposes of general radio control, designate the range of wave lengths, power output, and wave form which must be followed by the Air Service in carrying out its cooperation with the Artillery, assuming supervision of this service only insofar as these technical details are concerned. The Signal service should, however, not attempt to assume responsibility for operation of this service, either in training or actual field work, as it is obviously a branch of communication entirely lying between the Artillery and its observation and in no sense affects the general communication system of the Army.

4. The above mentioned technical details may easily be supervised by the Chief Radio Officer of an army in cooperation

with the senior radio officers at Air Service Commands.

5. Installation of radio apparatus on aircraft is, of course, as much a function of the Air Service as would be the installation of any other part of airplane equipment and is provided for by a sufficient radio personnel now included in authorized tables of Air Service Squadron organization.

—98—

Brig. Gen. Benjamin D. Foulois
Assistant Chief of Air Service, AEF

1. The following suggestions bearing on the future organization of Air Service radio work are submitted for your consideration as the result of combined recommendations gathered from experiences in active operations:

(a) For a permanent organization there should be a Radio Section within the Air Service charged with administration and training of radio personnel, experimental research and development, and supply of air radio equipment. This recommendation is largely influenced by the high degree of specialization necessary in the development of communication between airplanes by radio telephony and the navigation of night-flying machines by radio direction, the vital importance of which may now be readily foreseen in the light of developments already accomplished. Considering only the subject of Artillery cooperation and taking as a possible permanent organization of 20 active observation squadrons as a basis it will be seen that the total requirement of enlisted radio personnel for this service alone is 760 men, although naturally this strength would be largely controlled by the proposed permanent artillery program. This figure however, would provide for the manning of 20 squadrons with the authorized complement of 8 enlisted radio mechanics and operators each and would make possible the immediate manning of 250 battery stations for receiving radio signals from airplanes, with an emergency pool of 100 operators for replacement. It would be unwise to restrict the radio operator strength of the Air Service to a number exactly commensurate with the supply of two operators per Battery of Corps or Army artillery on a peace-time basis for the reason that it takes much longer to train an operator to competently handle this work than it does to train and put together the personnel of the Battery

itself. An over-percentage of trained radio men should therefore be held ready for assignment to Batteries under emergency notice. An additional reason for this plan is that a most important phase of the Battery's training is that of its cooperation with airplanes, and it would be inimical to the success of such training and unfair to both Artillery and Air Service if it were necessary to send untrained operators to carry out this important work with new batteries just being formed.

(b) Successful cooperation with the Artillery can only be obtained by means of special receiving stations having no other function whatever aside from that of receiving signals from airplanes, by reason of the highly specialized nature of the service and the precise limitations of possible flying time due to varying weather conditions. It is obviously impossible to gauge the load of communication on these stations. Two hours of good visibility weather during an otherwise bad day will make it highly advantageous to put up as many as 25 or 30 artillery reglage and registration machines over a short area of frontage and if the radio stations detailed to receive signals under these difficult conditions are involved in the operation of a regular ground radio communication network both systems will break down at the moment when perfect radio cooperation is most vitally important. It is therefore recommended that all radio personnel for operation of such stations be enlisted in, trained, and supervised in action by the Air Service.

(c) All commissioned personnel should be first selected from experienced radio men and young electrical engineers, likewise enlisted personnel should have had practical work with electrical apparatus and Morse code.

. . . . . .

(e) Endeavors toward the perfection of airplane radio telephone apparatus and radio navigation of night-flying machines should be vigorously supported and the maintenance by the Air Service of a separate radio development flying field and laboratory similar to that maintained by the British Royal Air Force at Biggin Hill, reports on which have already been forwarded to your office, is considered as vitally necessary to the maintenance of supremacy in this branch, which will continue to grow rapidly in military importance.

(f) Special effort should be made to instruct and give practical examples to officers of the Artillery, Infantry, and Cavalry, in the use of radio in airplanes and the methods of giving ground signals airplanes.

(g) In a similar way the ground or deck signals now usually

employed by the Army and Navy to communicate to airplanes should be coordinated so that Coast Defense work by airplanes of either the Army or Navy will permit the prompt and intelligent communication between Navy airplanes and Army stations and between Army airplanes and Naval stations or ships.

(h) It should be borne in mind that all details of organization and training that Air Service radio officers will be charged not only with radio instruction, installation, and maintenance, but also with the electrical work incidental to lighting and heating of airplanes, and with the supply and supervision of all stations established within the Army for the purpose of maintaining regular communication with airplanes.

—99—

1st Lt. Andrew Anderson
Supply Officer, I Corps Observation Group

1. Following report on supplies, transportation and rations during existence of Observation Group, 1st Army Corps.

2. Since June 28, 1918 this Group has changed stations nine times, and excepting at one field, Toul, no previous provision had been made or arranged for to accommodate personnel with shelter, in many cases enlisted men had to sleep in trucks, under airplanes, in hangars and other inconvenient places in order to keep dry during rainy weather; at no place was there sufficient hangars to shelter planes. I would recommend that prior to an

Trucks and water tanks used at the A.S. Production Center #2, Romorantin.

organization being ordered to a new field, said field should be provided with enough hangars to accommodate 18 planes per squadron, and buildings enough for sheltering officers and men.

3. There should be gasoline and oil delivered on a new field in sufficient quantities for at least two days operations as it is impossible for a Group to carry any amount of such with transportation previously allowed.

4. The only real difficulty experienced with airplane supplies is that our base of supply has at no time been near enough, in most cases have had to haul supplies, including gasoline and oil a distance of from 50 to 80 kilometers, and only for a short time have we had a Park Squadron assigned to Group, hence have had to rely on our own transportation for our existence. I would suggest that Sub-Depots be established nearer than heretofore; not over 25 kilometers from any Group and have at least one Park Squadron assigned to each Sub-Depot to haul and deliver gasoline, oil and supplies to Groups within the area.

5. Lack of transportation and spares for such is and has been our worst difficulty. Two of the squadrons composing this Group have at times been unable to supply their kitchens with water, wood and rations. We have requisitioned for transportation from time to time; for spare parts nearly every week, but all to no avail despite continually requisitioning for spare parts to repair what little transportation we had on hand. We have received less than 5 percent of what was needed; result is that we have had to leave trucks and cars behind when leaving. Prior to the time the MTS people took over transportation and spare parts,[a] or

Water tanks used to supply airplanes.

when Air Service had their transportation under its control we did not have this difficulty in obtaining supplies pertaining to transportation as has been experienced for the past four months.

6. I would suggest that transportation pertaining to Air Service be handled by officers of that service and not by the M.T.S., for in the case of this particular Group which has operated on the active fronts since last March, the Motor Transport Service has done nothing whatsoever to help or relieve the serious state of our needs.

7. We have experienced no trouble with rations or clothing and no improvement could be made as to that.

—100—

1st Lt. A. M. Wright
Supply Officer, 12th Aero Squadron

1. To improve the supply department, we must have the cooperation of all departments especially the Air Depots.

2. Supply departments must be allowed to draw supplies on squadron requisition and not [be] hampered by a Group supply, as in the past.

3. We must have adequate transportation at the disposal of the supply department at all times so that we may be able to transport immediately gasoline, spare motors, wings, etc. As we never know what the demand may be very far in advance, also the above items cannot be carried in stock in any quantities.

—101—

O. D. Burwell
Supply Officer, 50th Aero Squadron

A resume of the activities of the 50th Aero Squadron from the standpoint of supplies and transportation (which are closely interlinked) has presented a rather complex and serious problem during the recent operations.

In the first place the difficulties in obtaining spare parts for the Liberty DH 4 planes considerably handicapped this squadron

during its entire operations. Planes kept out of active service in innumerable instances through failure of both the Advanced Air Depot at Behonne and the First Air Depot at Colombey-les-Belles to have in stock sufficient spare parts to take care of emergency requisitions. Whether or not this situation could have been improved, I do not know; in any event it remained uniformly unsatisfactory to the end—in addition to being (on account of the constantly growing distance to the base of supplies) the primary cause of the breaking down of the very limited amount of transportation that we had available.

Aviation Gas. This squadron received at certain times during its operations, quantities of bad gasoline, or gas that did not test high enough to successfully operate a Liberty engine. Some of the gas received by the 50th Squadron on actual test fell as low as 60, while the test should be at least 70 to insure the successful performance of a Liberty airplane mission. It is believed that sufficient care was not taken in grading this gas, as it has come to the writer's knowledge in at least one instance that motor gas was delivered in drums stenciled "Aviation or Fighting Gas."

Initial Equipment. The initial equipment received by this squadron when it commenced operations, in the face of the actual needs of a Liberty squadron after operating over a period of months, does not seem adequate. . . .

Suggestions on initial equipment for planes.

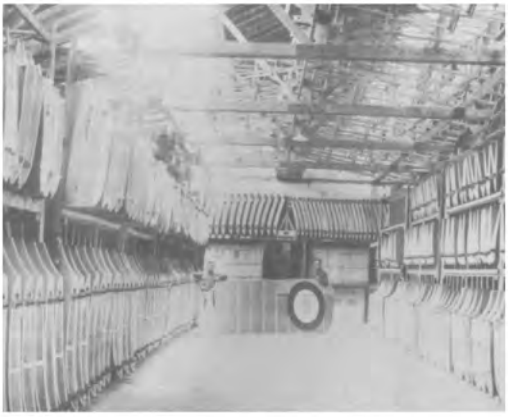
(a) A seat patterned after the Salmson type seat, to replace the present unsatisfactory type seat in the observer's pit.

(b) Planes to be equipped with rear cockpit fittings such as compass and clock.

(c) Pyrene extinguishers to be placed in both front and rear cockpit.

Gas and oil refueling station, Issoudun.

Repair depot for rotary motors, AIC, Issoudun.



Wing room of the Aero Supply Depot, AIC, Issoudun.

Airplane salvage at the Air Service Production Center #2, Romorantin.

(d) A safe place to be devised for carrying the Very pistol.

Compilation of index parts. Suggested that all parts for planes be cataloged and that all spares be numbered, in order that requisition for same can be made both by description and number. This, it is believed, would reduce to a minimum the errors that are made in supply depots by clerks who are not familiar with parts and have little time to familiarize themselves in a time of emergency.

Motor Transportation. The condition of our motor transportation has been deplorable from the beginning, gradually going from bad to worse. This squadron has never been a mobile squadron due to the fact that it has never had any more than about one-fifth of the transportation that is needed for the purpose of moving, which together with the difficulty encountered in getting spare parts and tires has been a source of great inconvenience.

1st Lt. Selmer J. Tilleson
Supply Officer
Third Aviation Instruction Center

1. In my opinion, the most important lesson learned by the Air Service in this war, has been the need for standardizing the types of machines which have proven in the service to be most practical. The need for a vast number of these chosen types of planes and sufficient quantities of accessories and spare parts for same is most vital. Each type of plane should be uniform with interchangeable parts, to do away with the great amount of work which has been necessary in the Air Service to convert spare parts into suitable and useable parts for repairing planes.

2. Sufficient stocks of spare parts must be kept on hand [or] be procurable with the least possible delay, which would go a

Salvage pile at the 1st Air Depot.

long way toward improving the efficiency of our Air Service. One of the bad features of procuring supplies in this war has been the necessity for relying on the French and English Governments for suitable types of aeroplanes and spare parts. These governments have felt it necessary to take care of their own Air Service and the U.S. Air Service thereby received only the surplus, which has been far insufficient for our needs. A permanent and sufficient source of supply must be established.

3. The necessity for the best liaison possible between the Air Service in the U.S. and the Air Service in France has been most necessary in order to procure sufficient quantities of the essential and urgently needed equipment. The need of a highly efficient salvage service is necessary to recover vast amounts of good material from wrecks and condemned planes.

4. Lastly, the need for qualified experts in each branch of the Air Service, to be in charge of each department with sufficient experienced personnel, is vitally important.

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Col. Thomas R. Boggs
Medical Consultant
Air Service, AEF

Dr. Boggs was associate professor of clinical medicine at John Hopkins University and chief physician of Baltimore City Hospital when he was commissioned a major in the Medical Reserve Corps in 1917. He served as chief medical officer of Base Hospital No. 18 (John Hopkins Unit), which was sent overseas in June 1917. Later, after making a study of the work of the medical department of the Royal Air Force for the Chief Surgeon, AEF, he had been directed in July 1918 to make a study of existing medical work in the Air Service, AEF, and make recommendations for improving the medical care and supervision of flying personnel. Following submission of his report to the Chief Surgeon he had been designated Medical Consultant to the Air Service on 8 September 1918. In a report to the Chief of Air Service on 28 December 1918, he included the following recommendations:

1. In order to arrive at any just appreciation of the needs of the Air Service from the medical standpoint it is essential to keep in mind that this branch of the service is fundamentally

different from any other. The character of the duty demands a very specially selected personnel, which is peculiar not only in physical but in mental makeup. To this is added the factors arising from the small size of the basal unit, the squadron, and the isolation demanded so frequently in order to obtain landing fields and concealment of hangers. Lastly, even the enlisted personnel differs from the other services in the combatant troops in containing a large percentage of highly trained technicians, not readily replaceable. It is obvious, therefore, that the medical organization planned for the Army in general may fail in some particulars to meet the very specialized needs of this service.

2. The difficulties met in the general medical service are principally two. The first is in commissioned personnel, there being a dearth of specially trained and adapted men for this duty; and, furthermore, the transfer of medical officers from one arm of the service to another which is unobjectionable in general is quite impractical in relation to men once trained for a very special service. Again the dependence of the medical service with the aviation units upon the Division, Corps, Army, or Section Surgeons, leads to difficulties from the lack of interest, understanding and sympathy with its special needs and demands. It is only natural that many men in responsible officers [?] with the Army as a whole, object to the special demands made and are annoyed by the privileges granted to this branch. Thus, purely personal reactions of individuals in high executive position may lead to serious handicaps. The sudden injection of a radically new member into a well crystallized formation may well be expected to produce such results.

The remedy for these difficulties would seem to lie in the separation of the personnel and property and channels of communication into a distinct division of the general medical service, or the placing on the staff of each Army, Corps, or Section Surgeon of a specially qualified officer who should handle directly for this surgeon the business of the aviation section, with of course a corresponding chief, as representative in the offices of the Chief Surgeon and the Surgeon General. Should Air Service as a whole be separated from the Army and Navy the solution would be simplified.

3. Medical Responsibility for Flying Fitness. The recognition achieved in the Expeditionary Forces, of the essentially medical nature of the decision, as to the fitness of the flying officers, and the disposition of the unfit, must be perpetuated in the Air Service if efficiency is to be increased and maintained. The medical boards and laboratories and the flight surgeons should be recognized as permanent parts of the Air Service organization.

The system of record devised and made available in the last of the active period has many points of great practical value, and should be incorporated into the record system of the Air Service. It is based upon the scheme evolved for the Royal Air Force, which has proved most successful. The essential features are compactness, completeness and constant availability, as the flyer has the carbon copies of all examinations from the entrance into training to date, which follow him in all his assignments, whether to duty, recreation, or hospital.

4. General Hygiene of Flying Personnel. Flying fitness is so intimately dependent on personal conduct and standards that no amount of legislation or regulation alone will produce the results desired; it is only through the active cooperation of the officers themselves that we may hope to reach the maximum of efficiency.

It seems evident that the most promising approach to this problem must be by endeavoring to cultivate the spirit of the athletic teams of the colleges and amateur associations. The flyers should be imbued with the idea that their team's success depends upon the fitness of each component member, and that any infringement of the recognized rules of good training jeopardize the prospects of success for the team. In this way there is a strong sentiment developed which helps in resisting the tendencies to break the training rules. As agencies making for the same result there should be provided material for active exercise, especially in competitive games, as basket ball, medicine ball, tennis, fencing, boxing etc. and inter-squadron and group contests should be actively promoted. In order to carry out these plans it would be desirable or necessary to have specially qualified athletic directors detailed to this duty.

5. Training Tables. Diet has such an important bearing on fitness for any athletic activities that it may not be neglected in the plans for the flying man. Observation at the schools and permanent camps makes it evident that, in general, the flyers eat too much for the real demands of a sound body and are apt to concentrate on the sugars and other carbohydrates. While no accurate nutritional studies have as yet become available for this class of men, it seems clear in general that they should have hot tea, soups, bouillon, etc. at any time on departure for, or return from, flights if they desire it. The regular meals should be liberal and of the best quality and well served, but promiscuous eating between meals as now practiced should be discouraged. The effects of overfeeding will be much reduced by active physical exertion.

6. Alcohol. There is no genuine evidence to support the

contention of a few well meaning but inaccurate proponents of the view that the flying man may be benefitted by moderate or even excessive doses of this drug. The contrary position, viz: that the flying man should be a total abstainer, has the support of scientific demonstration and practical experience, and by rule and example every effort should be made to banish the use of alcohol.

7. Tobacco. The laboratory tests show conclusively that visual acuity is promptly affected by the inhalation of a moderate amount of tobacco smoke; the flyer is undoubtedly better without any tobacco, though moderate smoking in hours off duty will be well borne by most.

8. Rest and Recreation. The necessity for frequent rest and change of scene with normal diversion has been pointed out in other places in this report. This [was] thoroughly demonstrated in the experience of the aviation services of the French and British Armies as well as for a short time in our own before the cessation of hostilities. We should and can improve on the methods in use by the Allies by controlling the places of recreation in such a way that the aviator may have a thoroughly agreeable change, with amusements and sports away from centers of population. In this way the temptations to license in alcohol and venery may be minimized. The assistance of the Red Cross and other auxiliary agencies would be invaluable in these arrangements.

9. Venereal Disease. Prophylactic stations for officers should be maintained in all organizations. The advisability of venereal inspection remains debatable. Certainly it should not be enforced in the Air Service alone.

It should be a matter of regulation that:

a. Officers acquiring syphilis should be reclassified and leave the Air Service.

b. No officer under treatment for acute gonorrhoea or syphilis or any complication of these should be allowed to fly, except after examination by and recommendation of a properly qualified medical board.

10. It is most important that portable shower baths be provided with each squadron; and that portable delousing and clothing sterilizing plants be available for the air units with each Army.

11. Hospitalization. In any permanent plans for the care of aviators some provision should be made for special hospitalization. The peculiar psychologic and physiologic factors involved in any adequate medical attention to flyers will require a staff of doctors able by experience and training to meet these

Some change in pace from ordinary duties was afforded by theatrical groups performing in France. Lt. Arthur J. Coyle, Maj. Ralph Royce, and Maj. Lewis H. Brereton were on hand to greet the Huron sisters.

special needs. Again we must recognize in the hospital, as in other army formations, that it is difficult to administer smoothly any organization where one group gets a different treatment from another, without reasons patent to the uninstructed. There is every evidence from the experience of the Royal Air Force that special hospitalization has paid in efficiency.

It is suggested that, in each Army, there should be at least one evacuation hospital to which sick and injured flyers are sent, there to be attended by specially trained medical officers attached for this purpose. And, furthermore, that there should be one base hospital for the exclusive care of flying officers, sick or wounded. This base hospital would suffice for a group of Armies if placed in a proper location. Provision should also be made for the hospitalization of the slightly sick enlisted personnel of the air units with armies and schools in the organization or in nearby hospitals. These slightly sick should be returned when well directly to their units, and not evacuated from the area.

12. Laboratories. The Nation should maintain at all times a fully equipped research laboratory for the investigation of physiologic, psychologic, hygienic and general medical problems relating to aviation, and for the special training of flight surgeons for field and hospital work with the Air Service. This laboratory would also collaborate with the military in aiding in the devising of new and improved methods of attack and defense, the adaptation of special apparatus to flying needs, etc.

Separate from the research laboratory there should be laboratories for the routine examinations of candidates for the Air Service, students, and accepted qualified pilots and observers. These laboratories should be so placed in schools, depots and armies as to make a thorough examination quickly available to any flyer, ordered for this purpose by the squadron medical officers or commanders. A medical board would be constituted from the members of the laboratory staff, which would pass upon the condition and fitness of each aviator examined and recommend appropriate disposition. The base hospital designated for the care of aviators should be equipped with such a laboratory in addition to the ordinary medical laboratory equipment.

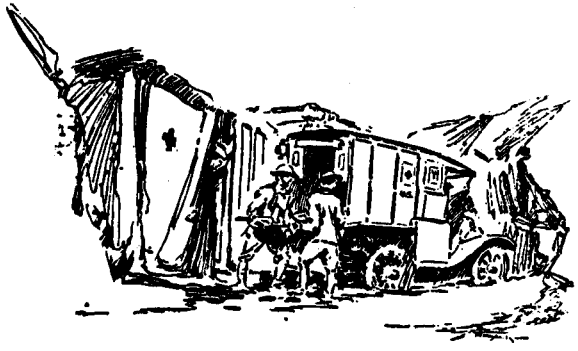
13. Dental Organization. In the schools and depots and pilot's pools the percentage of dental officers and assistants should be increased to meet the extra demands arising from the rapid shifting of the enlisted and officer personnel in these places.

In the tactical formations there should be provided dental ambulances, at the rate of one for each three squadrons, or more if these should prove insufficient. This would go far to

curtail the loss of time and valuable services resulting from a shortage of dental service.

14. Medical Officers. So long as the squadron remains the indivisible unit of the Air Service it will be necessary to provide one medical officer with each. These officers should have had a special course of training to fit them for work with air units. With each group of squadrons there should be a senior surgeon of higher grade and wider experience to direct the work of the squadron surgeons.

In each army there should be an Army Surgeon, Air Service, with appropriate rank either as an independent officer or attached to the office of the Army Surgeon to control all the medical work of the Army for the Air Forces. To this officer the Group Surgeons would report and be responsible. Army Surgeons in turn would be responsible to the Chief Surgeon, Air Service, or the Air Service representative on the Staff of the Chief Surgeon of the Forces. The medical personnel of the Air Service units, commissioned and enlisted should be considered, as an inseparable part of these units and not subject to detachment for duty with other than Air Service organizations, as has frequently been the case. The fact that when squadrons are grouped there is an apparent excess of medical officers and personnel, does not justify this removal of the personnel belonging to one or more squadrons. Squadrons are freely moved and isolated or concentrated and must be prepared for efficient work on an independent basis at all times. So long as the squadron remains the basal unit of the Air Services, this excess of medical personnel must be met and accepted as a part of the waste ineradicable from military preparation and activities. The above remarks apply with equal force to the personnel, commissioned and enlisted, of the laboratories; these are specially trained men and it is destructive of efficiency to remove them into other duties to which their training does not apply, and at the same time make it necessary to train substitutes for them.



15. Transportation for Medical Officers and Patients. The ambulance provision as laid down in the tables of organization, viz: one ambulance for each squadron, is sufficient so long as the ambulance is in working order, but arrangement should be made for reserve ambulances to supply the shortage caused by the frequent laying off of machines for repairs. This medical property should not be subject to detachment on the order of the Army Surgeon or his subordinates.

The size and nature of the flying fields, often separated by a considerable distance from the quarters of the personnel, and the infirmary, make it imperative that there be some means of rapid transit at the disposal of the squadron surgeon at all times, so that he may reach the different points of duty without delay. Ford automobiles or motorcycle side cars would meet this need.

Air Service Surgeons of Corps and Armies should be provided also with transportation by automobile, as otherwise they will be unable to perform their duties. This may be covered either by individual assignment of cars or of these officers to transportation should be a matter of record in the tables of organization and not left to chance and the good will of superior officers.

Medical Research Board
Air Service, AEF

The Medical Research Board had been appointed in October 1917 to investigate conditions affecting the efficiency of pilots, to carry out experiments and tests to determine the ability of pilots to fly at high altitude and to provide them with suitable oxygen apparatus, and to consider all matters relating to the physical fitness of pilots. A laboratory, built at Mineola, Long Island, was ready for use by January 1918. The following August the board and its staff, a total of nearly 50 officers and enlisted men, embarked for service with the AEF. The equipment taken overseas included a low-pressure chamber which the board had been using to study the effects of high altitude on breathing. In the chamber, which was large enough to accommodate five or six men, a reduced pressure corresponding to an altitude of 38,000 feet could be attained. Part of the group remained in England to study British methods, while the rest continued to France. The board, made up of four officers, established itself at the Third Aviation Instruction Center at Issoudun on 2 September 1918. A laboratory was set up im-

Opthalmological room, Medical Research Laboratory, 3d AIC.

mediately at Issoudun, and another was established early in November at the Second Aviation Instruction Center at Tours for work in connection with observers. Following is an extract from a report made by the board at the end of the war.

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The tremendous importance of the aeroplane in the war and its obvious possibilities indicate, beyond the question of a doubt, that it is here to stay and that its importance will be a constantly growing one. The meagre knowledge of the medical profession, concerning the problems of the flier and the need of post-bellum, careful, painstaking and time-consuming research in relation to them, is equally obvious. In order that the flier keep pace in development with aviation itself, it is necessary that medical science apply itself to the study, development and protection of the flier.

With these things in mind, the Medical Research Board is grasping the opportunity now presented to lay the foundation for the creation, in America, for a permanent school of aviation medicine. This school has its prototype in the Army and Navy

Opthalmological room, Medical Research Laboratory, 3d AIC.

Medical School in Washington, of which it should, henceforth, constitute an integral part.

To this end the Board is now engaged in collecting everything utilized by the Allies, in relation to training of pilots and observers, bombers and aerial gunners in relation to work of these groups at the front, in relation to admission of fliers to the service, and in relation to admission of fliers to the service, and in relation to maintaining their medical care while in the service. This includes the following:

1. Paper work.

(a) From aviation schools—training schedules, admission sheets, students reports, etc.

(b) From the front—forms covering admissions, maps, reports (individual, consolidated, weekly, etc.), from pilots, observers, and bombers.

(c) From headquarters—papers covering assignment and detail to various types of work.

(d) From Allied Countries—Papers as listed above, and, in addition, papers relating to aviation medicine, such as admission blanks, reexamination, accidents, proceedings of elimination boards, etc.

2. Medical methods and apparatus. The Medical Research Laboratory is abundantly supplied with apparatus for its work. It is attempting, at the present time, to collect and to try out methods in use by the British and French in their work with the aviators. The apparatus necessary for this is being collected.

3. Photographs, lantern-slides and moving pictures dealing with the work of the aviator are being made or collected. In this connection an attempt is being made to cover as many phases as possible of the work and the conditions at the front.

4. Statistics. These are being collected, covering all matters relating to health and efficiency, accidents, morbidity and

mortality of man occupied in the various types of air work, both in the schools and at the front.

5. A faculty and a board of consultants. The war has furnished America with its early opportunity for the training of medical men in aviation medicine. Similarly, the war has furnished America with a group of medical men, specially trained for the problems of the flier. Recognizing this, the Board has attempted to familiarize itself with all phases of the work in all the various branches of the air service by sending members of its staff to the different training schools to undergo intensive training in the different types of work. One member of the staff has been trained as a pilot, another as an observer, while still others have worked in relation to bombing, aerial gunnery, and Marine aviation, etc.

The idea of a permanent school has intensified the interest, broadened the viewpoint, and enhanced the work of the Board.

The Medical Research Board has looked upon its work in the nature of a great trust. It was entrusted with the care of fliers and with the creation of a new type of medicine. The Air Service as represented by its fliers is small in personnel, but great in importance, each flier therefore being an important link in the Air Service. This demands that each flier be handled not only from the standpoint of his individual efficiency, but from the broader point of view of the efficiency of the Army as a whole.

The urgency of war needs concentrated the attention of the board on the war aspects of aviation, and only incidentally on aviation as a commercial and transportation problem. The board has recognized, however, that aviation has infinitely broader and more important aspects than those relating to war, but it feels that the war served to reveal the possibilities of aviation and has accomplished on a broad scale experimentations, investigations and realizations relative to flying which would have been otherwise impossible.

A good beginning has been made, individually aviators have been benefited, the morale of fliers generally has been improved and consequently their efficiency; methods for determining the functional capacity of fliers have been devised or borrowed from our Allies, have been weighed in the balance, their significance and value determined, and have been retained or discarded according to their value. Utilizing these methods as a fulcrum, some important facts have been pried from nature. These have been correlated in some instances, but only such theories as fit the facts have been presented. A group of men has been trained to investigate, treat and care for the flier. Medical problems, many of which are fundamental to success in flying, have been recognized and investigated, in some instances with partial or

Testing visual fields with a Hall Perimeter.

complete success, in some instances without success. These constitute, however, the material for subsequent investigations when more time and greater facilities are available.

The greatest achievement of the Medical Research Board consists of its recognition of the shortcomings of medicine, of the possibilities of aviation and of aviation medicine, and its recognition of the imperative need of a permanent school of aviation medicine and a special medical air service.

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Medical Research Board
Air Service, AEF

The board set up a program to educate aviators in matters concerning health and efficiency. The doctors gave talks on "such matters as the eye, the 'flu' and how to avoid it, the health of the flier, etc." As part of this program they wrote a series of articles for *Plane News*, the camp newspaper of the Third Aviation Instruction Center, the purpose being to preach the "gospel of training and clean living." An abstract from one of these articles was included in the board's report on its work.

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All experience up to date has impressed one crucial fact on medical men: *only the fit should fly.* In the flier, as in men generally, this is dependent upon the simple fundamental things of life, such as sleep, exercise, diet, and habits.

Sleep. Eight hours is a good average. There are but few men who can do efficient work on seven hours or less. Sleep should be taken at night and since the "crack of dawn" comes quickly, an early start is necessary.

Exercise. Without it, physical fitness is impossible. The aviator's life is sedentary, though out-of-doors. Any out-of-door sport ending in a good sweat is all that is needed. It can be followed by a dry rub when a shower bath is not at hand.

Diet. Judging from the number of fliers consulting the board for digestive disturbances, this question is an important one. Four factors should be considered: the balance of the diet, i.e., its food values, palatability, cooking, and serving. In this connection two food experts were here during the last week of October to deal with these very problems. Sugar and starches in the form of breads, cereals, fruits, and fresh vegetables should play a large role in the aviator's diet. It is desirable to have these

types of food preponderate in the early part of the day, while heavy food, such as meats and fats, should be reserved for the mid-day and evening meals.

Habits. In no other line of work is attention to habits more imperative. Despite anything that might be said to the contrary, alcohol is a subtle and deadly enemy to the flier. Worship should be reserved for Mars and Vulcan, as the victims of Bacchus and Venus are easy prey for the Hun. Tobacco in moderation to those accustomed to its use may do no harm; but every man has his limit, and this should be neither reached nor passed. Drugs should not be self-prescribed. The man who needs aspirin should not fly, but he should see a doctor. Coffee, excellent for breakfast, taken in the evening is responsible for many a restless night.

These four great factors can be summed under the one word—training. *Training is essential to fitness.*

Testing near point of accommodation.

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Col. William H. Wilmer
C.O., Medical Research Board

Dr. Wilmer, a graduate of the University of Virginia (M.D., 1885), was professor of opthalomology at Georgetown University. He had been a member of the Medical Reserve Corps since April 1911 and had entered active service on 1 October 1917.

1. The lesson learned from the present war is the great need of careful selection of the flyer and skillful, self sacrificing care of him during training and in combat.
2. For the future the proper facilities for the study [of] these problems by men who by training are fitted to do this work.

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1st Lt. Azro J. Pardee
Surgeon, 104th Aero Squadron

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1. In making any recommendations for the benefit of the service as regards the Medical Department, many things have to be taken into consideration, first of which I would place the Medical Department itself. In the early days of the war, the personnel were picked and assigned to squadrons with the view of getting the best men possible to take care of the health of the command, to care for the sanitary situation, and in short to fulfill all the duties of an isolated Medical Unit. When the Squadrons were placed in training, the great majority of these Medical Officers and Enlisted men were detached and sent out with other units not belonging to the Air Service. Consequently when the training period was over, the Medical Detachment was picked up here and there, with no particular view to fitness, as regards training or intelligence.
2. The second is in regard to the Status of a Medical Detachment with a Squadron. Definite status should be given to the Medical Department, and such duties and obligations as naturally belong to it should be so clearly defined as to allow no opportunity for discussion or misinterpretation by inexperienced officers.

3. Medical Officers without exception should have special training in the physiological aspect of Aeronautics. Without this training, the Officer is incompetent to judge whether or not the flyer is unfit to fly, whether or not high altitudes impede his efficiency and whether or not he is getting stale from too frequent flights.

4. The equipment of a Squadron on active service at the present time is rather indefinite, varying more or less according to the preferences of the Medical Officer, and the transportation available. Inasmuch as Squadrons usually operate in groups of two or more, The Group Surgeon or Senior Medical Officer should carry quite a complete equipment. This should include the ordinary first aid and regimental equipment. Such special apparatus as may be necessary for a cursory examination of flyers and a 6 bed hospital for each squadron. Each Squadron Medical Officer should have a medical truck and trailer, fitted out similarly to the field operating truck or the dental truck, but giving due regard to the particular equipment carried. This would do away with a great deal of unnecessary confusion and loss of property when moving. It would furnish a permanent infirmary, ready to operate at any and all times. A comfortable place for patients to be examined, and reduce the amount of lost property to a minimum. Delays in transportation, lack of transportation, and carelessness on the part of drivers have at different times rendered the work of this department rather difficult. The trailer could be utilized for transport of hospital tentage, beds etc. An ambulance is an absolute necessity. I have found by experience that the Ford ambulance is preferable to the heavier G.M.C. by

Testing stereoscopic vision.

virtue of its weight and simplicity. During wet weather it is impossible to drive the heavier machine across the aviation field.

5. I believe that the Medical Detachment of a Squadron should consist of one Medical Officer, one Sergeant, one Corporal, and four privates, two of whom are motor drivers. This will enable the detachment to care for its own transportation, besides having the same driver all the time.

6. Finally, I would say that there must be a thorough and hearty spirit of cooperation between the Commanding Officer and his Medical Officer. Lack of this cooperation results in a dissatisfied C.O. and an indifferent Medical Officer.

7. I believe that the remarkably low sick rate in this 104th Aero Squadron since its formation at Kelly Field and continuing up to the present is in no small degree the result of the prompt and thorough cooperation which its Commanding Officers have accorded me.

8. The above recommendations are made from purely personal observations covering thirteen months with the 104th Aero Squadron, three of which were spent as Acting Group Surgeon, 5th Corps Observation Group.

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Photographic Section
Air Service, AEF

The importance and value of aerial photography in warfare has been clearly demonstrated to our army during the last few months of military activities. This has been made clear in spite of the fact that photography was certainly not used as fully or as intelligently as it could have been. The following reasons are given:

(a) Lack of knowledge in the army at large as to the value of photography and its uses.

(b) Lack of competent and trained personnel for interpretation and exploitation of photographs.

(c) Division of responsibility for photography between the Air Service and Intelligence Section.

In reference to (a) it would seem advisable that all field officers have a certain knowledge of aerial photography and the role it plays in modern warfare. They should be given illustrated lectures on what photography can do in the way of aiding them, and they should all have a summary knowledge of the interpretation of photographs. It is further recommended that

popular lectures be given to field troops, this chiefly to acquaint them as to how enemy can see, by means of aerial photography, just what they are doing, even miles behind the lines. By illustrated lectures or pamphlets they can be shown that [by being] careless in making paths at the front, or of allowing camouflage to deteriorate etc., they are endangering their lives as well as the success of their operations. It would be well for every soldier to know that the enemy observation planes flying high overhead are a much more dangerous enemy to them than those that come with bombs or harass them by machine-gun fire.

In reference to (b) and (c) the Photographic Section in America gave considerable attention to the interpretation of photographs in training its photographic officers and photographic laboratory men. As a matter of fact there were a number of men in the Photographic Section who, as the result of this training, were better qualified to be entrusted with the responsibility of interpreting photographs than were some of the Branch Intelligence Officers working with the observation groups. It is quite obvious that the interpretation of photographs is, from a military point of view, the most important phase of the work, and too much stress cannot be laid on choosing and training the right men to do the same. The best French and British interpreters have insisted that the essential requisite in the training of interpreters is that they shall know modern warfare, either from having had experience at the front or from having made external study of the actual ground on reconquered territory. The mistakes that are [made] by a student in interpretation whose knowledge has been gained entirely from the study of books and pictures are flagrant; a few hours spent on the battlefield studying the ground and organizations in connection with aerial photographs previously, are of more value than any amount of classroom work. The interpretation of photographs is in no sense an exact science, but is largely a matter of astute deductions, and men picked for this work must have qualifications that will make it possible for them to develop along such lines. The Intelligence Section was not only charged with the interpretation of photographs, but also with ordering them to be made. With the exception of one or two cases the Branch Intelligence Officers know absolutely nothing about photography or its possibilities and consequently were not able to judge as to what could be done or what was desirable. It is believed that the Photographic Interpreter should have a very thorough knowledge of photography. Frequent cases have been noted where an interpreter who knew nothing about photography mistook imperfections in the photographic plate or print for

things recorded by the camera. Numerous British officers have stated that the French get more value out of their photographs than the British do. From observation this is also our opinion, and while recognizing certain racial characteristics in the French that particularly fit them for meticulous and keen work of this kind, the fact that in the French service the interpretation and all matters pertaining to aerial photography rest in the hands of the French Air Service is chiefly responsible for this superiority. The organization planned by the Intelligence Section to handle this work was inadequate, and gradually more and more of the work supposed to be done by the Branch Intelligence Officer and his staff of draftsmen fell upon the shoulders of the draftsmen attached to our Photographic Sections, and the better qualified B.I.O's were quick to realize the value of these photographic men and wisely made use of it. In a similar way the Intelligence Sections planned to take over the mass reproduction of all photographs, the making of assemblages, and the exploitation of

the information contained in the photographs for training purposes. At a matter of fact very little work in exploiting photographs for field training was done by the Intelligence Section. It is reported that the mass photographic printing they planned to do for the St. Mihiel offensive was very unsatisfactory because of slow production, and some of the pictures did not arrive until two days after the attack. In the first Argonne offensive this work of mass printing was turned over to the Photographic Section, all the printing required was done promptly and in due time under very difficult conditions. The extemporized Photographic Section at Ligny-en-Barrois, which did most of this photographic printing, also, with the help of a French officer, did a major part of the interpretation of the oblique photographs that were sent out, as the Intelligence Personnel was insufficient in number to do the work. Furthermore, this division of the work entails a great deal of unnecessary duplication, as, for instance, in the packing for distribution of prints to their ultimate destination. Our recommendation would be that the officer charged with interpretation of photographs at an Observation Group, be a Photographic Officer belonging to the Photographic Section of the Air Service: this would be along the lines of the French Organization.

With aerial photography clearly understood and an organization adequate to exploit same, this Photographic Officer becomes a very important figure in the Air Service. He is chosen first for his special and natural aptitude, such as keenness, imagination, tact, astuteness, and personality. It is desirable that he shall have had previous photographic experience and under any conditions that he take the full course in photo laboratory work. He should also receive the training currently given to an observer and be on a flying status, as it is desirable that this officer make occasional flights over the enemy lines. In this way he will become personally acquainted with his sector and have a better understanding of conditions. He will also in this manner develop the Air Service point of view and will more fully understand his observers and be able to intelligently advise them, as well as secure information from them. He must have the photographic point of view so that he may know just how much he can get out of the laboratory. This will further make the whole Photo Section a more vital working force as it will stimulate the whole section and keep up their interest which is always important where such quantities of work must be speedily turned out. With the aid of the observers and the Photo Section he will interpret the photographs and properly record them. From this point onward the photographic material properly

belongs within the domain of the Intelligence Section, so that this Photographic Officer in reality acts as a liaison between the Air Service and the Intelligence Section. This Photographic Officer should not command or administer the Photo Section proper, but simply direct this work. The administration and laboratory work should be entrusted to a subordinate officer. This Photographic Information Officer should be responsible for the photographs but not for the photography. He should be in a position to know both what is wanted and what can be accomplished. Up to the present photography has been a commodity without enough customers, and each army needs officers qualified to drum up trade and to show the army what they can get and how they can use it.

The Photographic Section was rarely asked to make assemblages except for office ornaments. Stereoscopic prints were only occasionally called for. Not once was [a] large assemblage requested of an entire sector. Initiative in these direction[s] on the part of Photographic Sections was discouraged and there was a general atmosphere concerning these things which suggested it was none of our affair and did not conform to Army Intelligence Regulations.

It was not until towards the end of hostilities and after the Photographic Sections had thoroughly demonstrated their efficiency by promptly meeting every proposition placed before them, that a larger leeway was given and a few more months would have seen the present relationship considerably changed in our favor.

The fact an adequate supply of proper material and sufficient personnel was at last beginning to arrive from America placed us in a position to undertake new things. The following is cited as an instance: A number of specialists, stereoscopic printers, had been trained at the Photo School, 2nd A.I.C., with a view to assigning them to the various Photo Sections at the front. All photo missions could then have been sent out in stereoprints as well as the usual single prints. This would have materially increased the work of the Photo Section in the field. The experiment was successful, and in a short time this would have become a general practice, and the value of the photographs to those studying them would have been very materially increased.

In this connection it is noted that we recommended the adoption of our Richard stereoscope to the Intelligence Section. This was done and the instruments were secured by their Supply Service, but, to the best of our information they were never issued to the Branch Intelligence Officers and the Photographic Sections were consequently never called upon to make the stereo-positives required for use in these instruments. It was on

Capt. Fred Place and the staff of the Photographic School, 2d AIC.

the strength of this failure that the Photographic Section took the initiative and decided to force the stereographs on the market instead of waiting for the request.

In addition to having a Photographic Information Officer with each Photo Section at a Corps Observation Group, a Chief Photographic Information Officer should similarly be attached to the Air Service Army Headquarters Staff. It would be the duty of this officer to co-ordinate the work of the Corps Group officers and to hold the army negative and print files. All negatives from Corps Sections to be sent to the Army Section at the end of two weeks so as to relieve the Corps Section of the task of making the reprints required. This reprinting in a Corps Group during periods of great activity unnecessarily complicates their work. This Army Photo Officer would also receive first copies of all prints from the Corps Sections. He will therefore be acquainted with the work of the army and can furnish adjoining armies with any data of interest to them.

In this case he also forms the liaison for photographic information matters between the Air Service and G-2. His office would also furnish a center from which photographic material could be drawn for training purpose at the flying schools. He would also have at his disposal an army base laboratory plant for making reproductions, assemblies, copies and enlargements for general distribution throughout the army. This base laboratory

plant to be operated by a regular Photographic Section.

Not having a Photographic Officer at Army Headquarters, except during the last few weeks of the war often made the co-ordination very difficult, and it has necessitated the writer's personally taking charge of photographic operations during active periods.

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Capt. Jones.

Capt. Ernest Jones
Chief, Information Section

The following observations are presented as a result of experience in this Section in the Am. E.F. and, previously, in its counterpart in the United States, by the Chief of the Section and by his Executive Officer, 1st Lieut. J. C. Farrer. These relate particularly to such an office in the field and do not attempt to cover operations at home. However, all the criticisms made apply thereto equally well.

The purpose of such a Section is five-fold. Following are these main divisions, with notes and suggestions under each.

a. *To answer general inquiries* of organizations in the Air Service, of other services, of individual officers, who desire information on the wide variety of subjects connected with military aeronautics, the Air Service itself, and that of allied and enemy countries.

Where answers to such questions are not immediately available, the information should be procured; or, as a last resort, direct such inquiries to other channels.

An Information Section is competent only to the extent it can answer all the miscellaneous questions put to it. Its scope, in practice, should be broad enough to allow for the answering of almost any question in reason.

It has been the policy of the Section not to refer inquirers to any other section or branch of the Air Service, or Army, but to obtain the information desired and furnish it, without ado. The Section has become, thus, just what its name implies, and has fulfilled requests on the widest variety of subjects. It could have done better.

Its usefulness is measured directly by its facilities for securing information, and making it available. One adverse criticism which can be made of the Section is the paucity of personnel during the major portion of its existence.

An Information Section, particularly in the field, should not be limited in personnel by a table of organization to a definite

number. The number of liaison officers belonging to it depends directly upon the number of headquarters and branches of the Air Service established and upon their geographical location; though, if these were grouped one officer might cover a number of sections.

Aside from the normal routine work, which takes a certain [number of] personnel, calls are made for special compilations. As one example, the Information Section was called upon, through channels, for a resume of the work done by America in the air; authorized strength of the Air Service in 1914, equipment, appropriations, status at entrance of the U.S. into the war, growth in men and material and the standing at the signing of the armistice.

Here was suddenly demanded a weeks work for one officer and it is obviously improper to sacrifice normal routine to fill one single inquiry.

b. *To collect information on military aeronautics* and our own and other air services, from all sections and organizations of our own and allied air services.

It has been demonstrated that the furnishing of information automatically by departments, headquarters, armies, can not be depended upon.

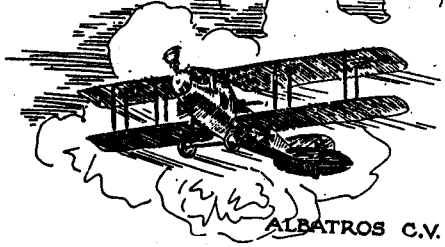
The Section should have a carefully planned liaison system of its own with direct representatives in all training centers, sections and headquarters of the Air Service, with the air services of allied countries, and with the air intelligence office of the General Staff. There should be a liaison officer attached to the Headquarters Air Service of each of the armies in the field. He would be charged with the collection of new developments in tactics, and after obtaining the approval of the C.A.S. of the Army, the forwarding thereof to the Information Section for proper dissemination, among training centers for example, and to the Information Section at home.

The Chief of the Section must be in a position to feel that his files contain exhaustive data on all subjects of interest to the C.A.S. and to the Air Service as a whole.

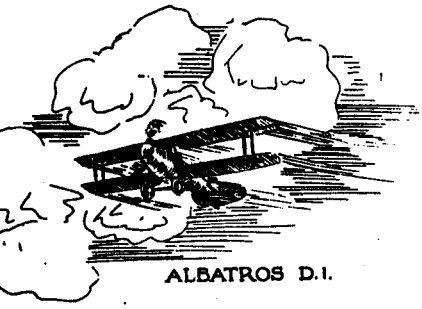
These liaison officers would both secure information and see that information available in the Section is properly disseminated. All information collected by the liaison officers would be submitted for the approval of the chief of the organization from which it emanates.

Reports of programs at home should be filed with the Section and copied for circulation to those directly concerned with the subject discussed.

c. *To distribute information.* Primarily the information would be distributed by means of bulletins. In addition, there are



ALBATROS C.V.



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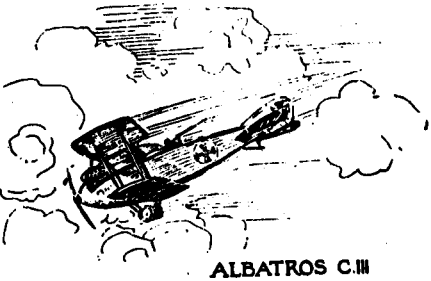


ALBATROS C.III

pamphlets prepared by other services, our own and allied, and the limited distribution among chiefs of departments of matter not of general interest or too secret for issuing as bulletins.

Information on file in some offices is of value only when it can be given to those who can use it or when its presence and availability can be made known.

For instance, it has been found that bulletins and other matter of value which was particularly needed by pilots, observers, or students have not been made available although copies were sent to their headquarters.

The liaison, or information officer, at the headquarters, training centers, and the like, would see to it that information available is furnished to those who can make use of it. At training centers, he would establish a room especially set apart, where every scrap of informative matter would be at hand for perusal. He would keep his Section informed as to needs and see that it supplied those requirements.

It would seem advisable to make the Information Section a branch of the office of the Chief of Staff, or directly under the control of that office.

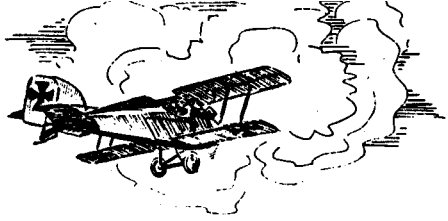
The Chief of Staff, Air Service, would be the final responsible authority for the publication of bulletins and handbooks, obviating a situation where the publication of a manuscript officially approved by the Zone of Advance could be disapproved by the Chief of Training. This plan would afford one authority for the final statement of the many questions of policy which necessarily arise in connection with publications.

All publications of the Section would not, necessarily, be issued as authoritative and final but the decision as to whether or not they were such, or simply for information or interest, would rest with but one authority.

Information of all kinds should be promptly published in some form. It is necessary that production facilities be adequate.

The Section, as it has existed, has depended on the Engineers in Tours and Langres, on the Photographic Section, and, finally, on engraves in Paris, for illustrations. The use of commercial engravers has been the most satisfactory but the ideal plant would include engraving or lithographic facilities.

For the text, mimeograph and multigraph machines are unsatisfactory. Supplies for the former ran out and we turned to the multigraph. The war had nearly ended before a typesetting machine and presses were secured. More speed, better work, larger volume, greater economy can be obtained with typesetting machines and printing presses. A photostat machine should not be forgotten. In addition, there is other machinery required, such as a cutter, stapler, punch, and the like.



F.F.

d. *To act as a central publishing office* of the Air Service for all manner of publications.

All publishing for the Air Service should be done in one central place—the Information Section—whether it be handbooks on rigging and photographic interpretation, folders, tactical bulletins, curricula, technical reports, progress charts or organization diagrams.

ROLAND D.II

The text would, of course, be prepared by the Sections concerned, or compiled by Information Section and submitted for approval, final authorization being given by Chief of Staff.

Uniformity in size is a desideratum for reasons of economy, indexing, filing, binding, press work, illustrating, etc.

All bulletins of the Section have conformed to this principle, but the same remarks apply to all other publications as well, except in some exceptional instance.

All such extraneous publications, however, should dovetail with the bulletins, to the end that the bulletins and their indices provide a definite centralized source of locating published information on any subject.

For instance, were a handbook on propellers published, after compilation by the Technical Section, a single sheet Air Service bulletin would be issued, numbered serially like all bulletins, stating that such a volume had been prepared and was available for issue by the Information Section. The handbook itself would bear the same number. The same would apply in the case of large wall charts on rigging, or diagrams of maneuvers in the air. Thus, there would be brought to the attention of all concerned that such a book, or other, was available.

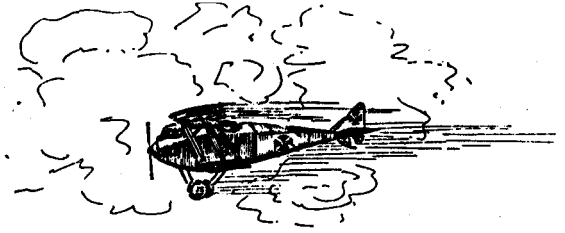
A certain number of bulletins would constitute a volume. At the completion of a volume, the index would again point to the handbook, etc.

A similar method would be pursued with all publications stocked, allied or other. A number of books could be listed in the same bulletin.

e. *To furnish required information* to the C.A.S., Chief of Staff, and other high officials, of statistical or other character, either from time to time or in accordance with a regular schedule.

This Section has been charged with the compilation of historical information[a] (narratives of combats, for instance) while the statistics thereof were attempted by another Section. There is, thus, a conflict of duties on an identical subject and resultant avoidable duplication of work.

It would seem that a Section properly organized, equipped and conducted to furnish the Service at large with information should be the one to post the Chief of Air Service on what is going on



HALBERSTADT

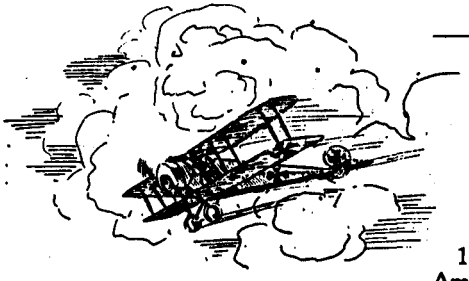
in his world.

All reports, statistical or otherwise, desired by the C.A.S., or the Chief of Staff, should be obtained through the Information Section.

Historical work. It is recommended that historical work be not a part of an Information Section. The sole relation of the latter to a Historical Section would be that of furnishing, like all other Sections, what information it could in connection with the compilation of a history.

Obviously from its scope, the Information Section, as outlined above, could furnish a great deal in the way of narrative and statistics, charts and graphs, but the actual compilation of a connected history belongs to a Historical Section.

A history is a large enough project to require specialization and the organization of trained personnel.



FOKKER

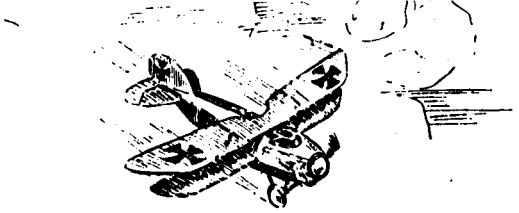
—110—

Capt. R. G. Kincaid
Information Officer
Headquarters, Air Service, First Army

1. From experiences during the operations of the First American Army, it is believed that unlimited opportunity exists for the development of the Air Service Information Section and it is believed that the Air Service performances with the First American Army have demonstrated to a degree hitherto unrealized the importance of the Air Service to an Army in the field. Air Service operations are big enough to maintain an information staff large enough to handle all the Air Service work and it is believed that the Air Service itself should handle most if not all of the Air Service work at present handled by G-2.

2. With personnel experienced in observation and photography, the Air Service could handle both corps work and Army work. Let the Army G-2 or Corps G-2 indicate to the Air Service the work it wants done but let the orders for its accomplishment be issued by the Air Service and make the Air Service responsible therefor. It is not believed that delay in any way would result from such a method. On the contrary, they could more expeditiously be handled by centralizing the control of all squadrons and having at all times machines available for duty on any part of the line.

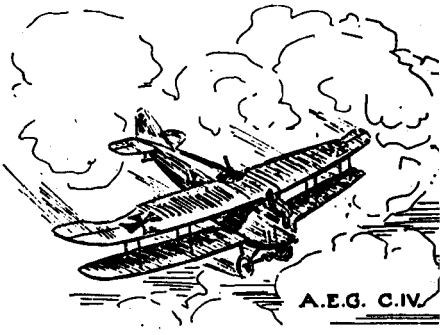
3. The study of photographs also is one that should receive more attention by the Air Service and photographic experts



ALBATROS D III

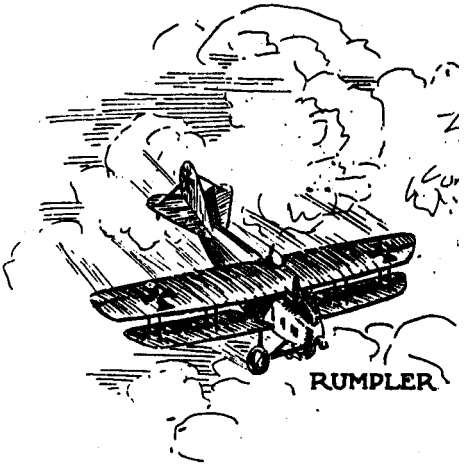
should be made a part of the Air Service Information Section in order that material important to Air Service operations may be made immediately available.

4. The study of enemy aerial operations also presents a fertile field for development. Time and careful study is necessary to intelligently handle this part of the work. Much might be obtained, it is believed from the interrogation of German aviator prisoners. A cursory examination is not usually productive of results but by casual conversations at intervals of days or even weeks, and allowing such prisoners to see a great deal of our aviation activity, it is believed that they could be induced to disclose their own methods, merely by comparison. Arrangements could also be made, if sufficient effort was made, with the Anti-Aircraft and also other front line units to be helpful to the Air Service in the way of promptly reporting enemy aerial concentrations, tactics, and directions of flights. More complete reports of this kind can be obtained from ground stations than from our own planes in the air who are engaged in watching the ground.



A.E.G. C.IV

5. Perhaps the greatest field for development in the Information Section of the Air Service consists in more thoroughly covering the distribution of information to our units. A campaign of education and instruction should be made and should also include other branches of the service who most evidently lack comprehensive knowledge of the uses of aviation, its difficulties, and its limitations. The liaison between Air Service units and Headquarters must be maintained and in order that the men who fly over the lines may improve the quality of their work, they must know the uses that are made of their observations and the reasons for improving their methods.



RUMPLER

—111—

2d Lt. Edward C. Olds
Adjutant, Second Army Air Service

2. Entering the Air Service in the first class of the Adjutant's School at Columbus, Ohio, after six months service with the French Army on the Chemin-des-Dames, I was immediately impressed with the character of the candidates selected to fill Administrative positions in the Air Service. On the whole they were experienced business men, who entered in the hope of securing at a later time some actual training as Pilots or Observers, and with the proper amount of military training would

have made splendid Administrative Officers. However, the need for Officers of this character was so pressing that it was impossible to give them sufficient military training and it is my opinion, that in the future Ground Officers in the Air Service should be detailed from trained Officers of other branches of the Service who have exhibited exceptional Administrative ability. I do not believe that the plan to use former Pilots or Observers as Ground Officers has been a success, as these men have neither the experience nor the temperament for Administrative work.

3. My observation of the Pilots and Observers as they came to the front from the rear convinced me that much remains to be accomplished in the selection of personnel for active duty. All Officers were sent to the front line Squadrons with no accompanying information whatsoever as to their mental or temperamental fitness for work over the lines. This situation might have proven serious had the shortage of Pilots and Observers, which existed at the beginning of November continued through several months of enforced activity. Until Pilots and Observers can be trained by Officers who have had extended front line experience and the unfit eliminated during the training period, I believe the only solution would be to double the flying personnel in Squadrons so that new Officers might be held under observation for some time in daily contact with combatant officers before being given missions to perform over the lines.

4. The question of simplifying the handling of statistical reports and information has been thoroughly covered in previous recommendations to the Chief of Service, which would have gone into effect had not the war ended so quickly. I believe the most serious problem to be solved in this connection is the concentration in one Central Records Office of all essential information so handled as to be instantly available when needed and to which organizations might forward reports directly without the necessity of utilizing military channels. Our organizations were constantly handicapped by overlapping and unimportant demands for reports of all sorts which took time and effort which should have been spent on constructive work. Much has been accomplished in the direction of improving the situation and it is probable that had the war continued a satisfactory solution might have been found.

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Maj. Percy H. Jennings
Chief Disbursing Officer
Supply Section, Air Service, AEF

Business men in uniform filled many important positions in the Air Service, both in the United States and in Europe. Among them was Percy Hall Jennings, who had been born in New York City in 1881 and had been graduated from Yale University in 1904. His father was an attorney and a member of the board of directors of a number of railroads and various other corporations. Before the war the son was associated with American Trading Company, of which he would become chairman of the board of directors in the 1920's. As a captain in the Air Service, he had been made Chief of the Disbursing and Legal Division of the Supply Section in Paris in November 1917.

1. Your memo of December 21st, paragraph 2, e, asked for suggestions for use in case of future need and the following is submitted. These suggestions are not made in the spirit of criticism, for I believe that the Supply Section of the Air Service has done its work with marked efficiency and success; but with the idea that their adoption for future organization would make it possible to carry on the business a little more easily and with somewhat less personnel.

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3. Aside from the difficulties of doing business in a strange country, I believe a principal difficulty which has confronted the Air Service in the S.O.S. has been that of trying to do a business job with military men and on military lines. It has been impossible with existing regulations and traditions as to rank and under existing laws to move officers and men freely from one position to another, to put officers and men in the positions for which they are best fitted by experience and capacity, and to get rid of them easily when there is no use for them. For an S.O.S. in the future I would recommend that the Chief of Supply and the chiefs of the various divisions under him be civilians, not commissioned officers, and that as many of the men under them as possible consistent with proper control and hold on the clerical force be also civilians. The Chief of Supply and the chiefs of the divisions under him could get their authority in dealing with the army outside of the section from the Chief of Air Service, and in dealing with the men under them, through a few

captains and lieutenants handling the military control of the force. The belief that an organization would succeed under civilian management and comprised largely of civilians is forced on me by the success of Colonel Dunwoody's organization. He has handled the proposition for the Supply Section of the Air Service as a business one. The chiefs have been made to feel that they were expected to exercise independent judgment and to assume responsibility. There has been a freedom in the method of carrying the business that other supply branches of the A.E.F. appear to have lacked. I believe this has been largely responsible for the success of the organization.

4. The main difficulty which has been encountered in the disbursing line has been the inflexibility of our laws and regulations governing appropriations and disbursements. I do not think it would be a good thing to have one appropriation for the whole A.E.F. because each bureau is held responsible by Congress for its own business and the proper disposition of funds appropriated for its use. I believe it is easier to obtain the larger appropriations under the present decentralized system of

Fuselage supplies.

finances. But I would urgently recommend that there be a general appropriation, in as large an amount as Congress is willing to grant, to cover any emergency and any expenses, legal or illegal according to U.S. laws, arising out of the necessities of the A.E.F. This appropriation should be made for expenditure under the direction of the C.-in-C., putting the full power to decide as to what it should be used for in him and in his bureau chiefs.

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—113—

Maj. Charles W. Godfrey
Post Quartermaster
Third Aviation Instruction Center

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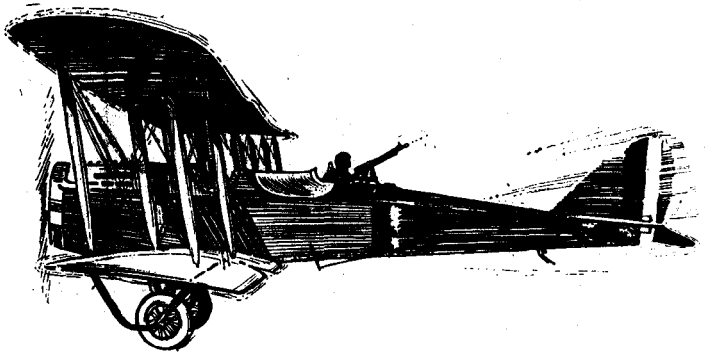
As Quartermaster of this important Aviation Center, it has been emphatically impressed upon me that proper food for officers engaged in flying duty was essential to their safety and success. The garrison ration is suited to men engaged in physical labor, but men engaged in flying where the mental effort is strenuous and the physical exercise light, every effort should be made to supply them with a varied diet, particularly laxatives in the form of fresh and evaporated and condensed fruits.



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Lt. Col. George W. DeArmond
Chief, Personnel Section
Air Service, AEF

Upon graduation from the U.S. Military Academy in 1906, DeArmond had been commissioned a second lieutenant in the Cavalry. His assignments before the United States had entered the war included two tours of duty in the Philippines and one as instructor in mathematics at West Point. Commissioned a major in the Aviation Section in August 1917, DeArmond had been stationed at Kelly, Rich, and Scott Fields before being sent to France in April 1918.

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When I became Chief of Personnel the latter part of August, I found a section excellently and logically organized internally into sub-divisions, the heads of which were without exception intelligent and capable young officers. And yet, there seemed to be something amiss. It appeared to me that the Chief of the Personnel Section[a] had endeavored to carry in his own hands or even in his own head alone, too many of both the policies and the details with which the Section was charged. The young officers charged with the operation of sub-divisions seemed in some cases to feel uncertain as to just how to proceed or where to go for information on doubtful points. They seemed loath to proceed on their own initiative for fear of making the mistakes natural to their lack of familiarity with military procedure and to their often only half knowledge of the policy and prior action concerning the matter at hand. In my opinion an organization is not as good as an organization if, in order to carry on its regular functions, it is greatly dependent upon its head as an individual. Before being made Chief of the Personnel Section I had for some months been in a position to observe rather closely its general operation, and I had formed a general opinion as to the cause of its deficiencies. My first act was to abolish the pomp and ceremony that seemed to precede or preclude access to the Chief of the Section. I endeavored to make myself readily accessible to not only all members of the Section itself but also to anybody else who might have business with me. I tried to make the officers under me feel that each one was charged with the operation of his own part and was supposed to know all about it, and that they were at all times free to come to me for

decisions on doubtful points. I announced that I was entirely willing to take the responsibility for their mistakes provided they would use their intelligence to the end of making as few mistakes as possible and of not making the same mistake twice. The personnel composing this Section was most excellent and the reponse therefore was almost immediate. The large bulk of the work of the Personnel Section consists on handling details, matter which day after day is of much the same order, and as doubtful points were cleared up and method of procedure established, the Section soon become practically automatic in its operations. I endeavored to adhere strictly to the principle that the duty of the Personnel Section was largely service to other sections and that it was not charged with running or attempting to run the Air Service. On the 11th of November 1918, the Personnel Section was in my opinion an efficient machine, operating in close and friendly harmony with all other sections of the Air Service. The flexibility of the Section was shown when after the cessation of hostilities the Personnel Section was charged with the details of the evacuation of Air Service troops from France. By close liaison with the Adjutant General's Office and the Sections concerned of the General Staff of the S.O.S., the procedure entailed was quickly established and the necessary machinery quickly put in motion. I have been told that the machinery of evacuation in the Air Service was working smoothly at a time when that of some of the other Staff Corps had barely been started. This I attribute not to myself personally but to the excellent organization of the Personnel Section and to the initiative and intelligence of my subordinates whose plans and suggestions I merely had to approve. The evacuation is now proceeding most satisfactorily and at the present time the operations of the Personnel Section are almost entirely automatic and independent of me as an individual and that in my opinion, is as it should be.

Of the lessons to be learned, in general I should suggest the following points:

1. As to the Personnel Section in particular, handling as it does that in which individuals are most vitally interested, namely themselves, I believe its operations should be as automatic and impersonal as possible.

2. In dealing with the supply and demand of personnel in time of war, I believe it to be almost axiomatic that a pool or generally several pools must be formed, in which to accumulate personnel from the source, and from which to draw it to satisfy the demand. The demand can never be smoothly and satisfactorily filled by direct requisition on the source.

3. Considering the same number of men involved, I believe it

is a sounder principle to furnish replacements to old organizations rather than to move up new ones. Old organizations already broken in furnish in themselves a quick and ready school for raw replacements, and if kept filled to strength are practically always ready for satisfactory action. Under the circumstances as they actually existed and developed, I believe the Air Service of the American E.F. would have been benefited if more replacements and fewer squadrons had been sent from the United States.

4. Unless the necessity be great I believe it to be inadvisable during active operations to change radically, as to numbers of enlisted men and especially as to grades, the specified organizations of units. If the number is increased there follows a sudden and unusual call for replacements, which can often be supplied only by breaking up other units. If the number is decreased it usually involves the reduction of many deserving noncommissioned officers. In either case I believe the effect is liable to be a reduction in morale.

5. A fault which I think I have sometimes observed is the application in military affairs of the spirit of the selfish competition of business and commercial affairs, the desire to build up one service or part of the service at the cost of another. This spirit has no proper place in the military service. The one object of war is to win it, and this result can be accomplished against a strong enemy only by co-operation, not destructive competition, within an army. For many reasons, but largely on account of practical every day human nature, I believe the Air Service should never at any time be separated from or independent of the Army and the War Department. So far as I have been able to learn or observe, the first law of human nature has never yet been repealed nor have its subsidiary laws fallen into disuse. The Air Service should never be in a position to compete, especially in manufacturing fields, against the Army as a whole, nor should it ever be in a position to feel that it is other than an auxiliary arm of the Army, entirely subservient to the success of the Army as a whole and to the command of the Commander in Chief.

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Capt. Frederick W. Zinn
Chief, Personnel Section
Zone of Advance

Capt. Zinn.

A large proportion of the matters concerning personnel handled through this office, during the time Colonel Van Horn[a] was in charge, had to do with the American flying personnel which was then attached to French units for training. Over these Officers this office had entire control. A certain number of pilots were flying with the French during that period but a considerably larger number of these attached officers were Artillery Observers . . . . who were attached to French Observation Squadrons. When the system of attaching personnel to French Units was first inaugurated it was realized that these officers might, or might not, do a large amount of work over the lines, but in the case of the Observers particularly, it was assumed that given an opportunity to study the actual working conditions of a Unit on the Front, the officer would absorb a knowledge of a squadron operations and of liaison between the Air Service and the other Arms of the service which would be of inestimable value to him when he began work with an inexperienced American Unit. In actual practice it was found that these observers during this stay with the French Units had on the average very nearly 10 hours of flying each. The result was that when the 1st, 12th, 88th and 91st Squadrons went to the front, they were practically experienced squadrons. The inexperience of the pilots was more than compensated for by the war experience that the Observers had gained while with the French.

Approximately 165 Observers were attached for varying periods to French Squadrons. Through the French Mission attached to this office, arrangements were made so that a total of approximately 80 places were held available in Observation Units belonging to 4th, 6th, 7th and 8th French Armies. The exploitation of this privilege would have enabled at least 50 Observers a month to receive actual service training, but very shortly the number of Observers arriving in the Zone of Advance became insufficient even to keep our own squadrons up to strength.

It has always been considered by this office that a very serious mistake was made by the Training Section in failing to appreciate the opportunity herein afforded. If student Observers had been given a single course in an Observation School as was frequently recommended, either in America or in France, with a course in

gunnery, and had been sent immediately to this station for assignment, it is evident that the shortage of observers during critical times would have been eliminated. The unduly long course of training in America followed by a long delay at St. Maixentb while on the waiting list for 2nd Aviation Instruction Center and the course at 2nd Aviation Instruction Center which was apparently a duplicate of the course as given in America, held back the supply of Observers so that during the two offensive operations in which the American Army took part, the number of Observers available was so low that in many squadrons it was necessary to use in work over the lines Ground Officers and sometimes even the non-commissioned officers of Observation Squadrons. No agreement would have been required by the French as to the length of time an Observer was to be attached to a Unit and 48 hours notice was sufficient to bring back to this station, any, or all of the Observers who were with the French. A pool of at least 80 Observers could have been continually maintained ready to be called at any moment.

Aerial view of Aviation Field #3, Issoudun.

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Lt. Col. Philip A. Carroll
Assistant Chief, Training Section
Air Service, AEF

Like Raynal C. Bolling, Carroll had begun his flying lessons at Mineola in 1915. The following year he had organized the Governors Island Training Corps to give civilians flying training, a project patterned after the Military Training Camp for Business Men at Plattsburg. In May 1917 he had been among the men, including Bolling, who had organized the 1st Reserve Aero Squadron. When Bolling left for Europe in June 1917 on a mission for the War Department, Carroll had taken charge of the squadron, which he led overseas in August 1917. Redesignated the 26th Aero Squadron, Carroll's unit had helped to establish the Third Aviation Instruction Center at Issoudun. Carroll had become assistant to Lt. Col. Walter G. Kilner, Chief of the Training Section, in May 1918.

1. This Memorandum is written in response to the direction of the Chief of Air Service to submit a frank statement of lessons learned in the A.E.F. It does not purport to lay a basis for definite recommendations, but is intended merely to call attention to certain principles which, though often obscured, are believed to be of more or less governing force under all circumstances.

Difference Between Civil and Military Effort

2. Civilians are slow to realize the difference between civil and military life. Almost universally their first impulse is to judge a military enterprise in comparison with some well established business with which they were previously connected. The result is naturally unfavorable to the Army.

3. This sort of comparison is unjust. No basis for comparison as a matter of fact exists. Neither the results to be accomplished, the motives for their accomplishment, nor the methods used to attain them are the same in the Army as in business. In business, the balance sheet and profit and loss account are the dominant factors; in a military enterprise they play only a minor part. In business the measure of success is the success of the individual; in the Army it is the success of the whole expedition. Competition is the mainspring of civil activity; co-operation and united effort are the mainsprings of military effort. What in civil life would be a laudable effort toward self-advancement may become in military life, a menace to a Service.

4. The means at the disposal of the business manager are much more varied and powerful than those given to the military commander. He can generally employ whom he pleases; he can pay what he pleases; he can reward whom he pleases; he can discharge whomever he sees fit. His object is single—the success of his own business.

5. The military commander on the other hand is subject everywhere to rigid limitations. He must pay all men of the same grade the same wages, give them the same food and provide them with the same equipment. His rewards can as a rule be given only for most exceptional service. His punishments are confined to the most flagrant examples of worthlessness or misbehavior. He is limited in his choice of men, not only by an arbitrary number made available by higher authority, but also by the necessity of accommodating his organization to their respective ranks.

6. He must rely on a system of discipline based on implicit obedience, his power of promotion and demotion, and his ability to create in his organization a high morale and esprit de corps, which will replace in some measure the positive stimuli of civil life. *In order for him to succeed he must be given by his superiors the widest scope and the firmest backing in the use of his limited resources.*

Discipline and Morale of the Air Service

7. The problem of maintaining discipline in an Air Service has presented extreme difficulties in all Armies in the present War. While many reasons for this fact have been put forward, it seems to me that one of the main reasons, namely, that the Air Service is in effect the voluntary service, has not been given sufficient consideration, and has frequently been entirely overlooked.

8. The voluntary nature of the Air Service becomes apparent when it is considered that it is impossible to teach a man to fly or to become an observer against his will, and that it is extremely difficult, even after he has been taught, to get effective use out of him except by his most whole-hearted co-operation. The reason for this is that the management of highly complicated machinery cannot be made the subject of order and direction in the same manner as can the handling of a rifle or the management of a pack. The Infantry officer can be ordered into the Line and when once there his conduct is more or less insured by the intensely strong desire not to appear in a despicable light before his men. The Aviator on the other hand can say without fear of losing caste, that he has "lost his nerve" or that his physical condition is such that he cannot fly. He can present a hundred excuses relating to his machine, and if his

record is otherwise tolerably good, he can escape the loss of caste which a confession of weakness would bring to him in the Cavalry, Artillery or Line. The reason for this is that the operation of an airplane requires more than moral courage. While troops can proverbially be led by an officer who, although suffering from intense physical fear, is buoyed up by moral courage, an airplane cannot be successfully flown by a frightened man, any more than an express train can be run by a timid engineer, or a racehorse ridden by a jockey who has lost his nerve. The feeling that he ultimately and in effect is the judge of what he has to do is, I believe, the basic reason for the lack of discipline of the Aviator. It is increased by his extreme youth and by the fact that as a rule he has no responsibility placed upon him outside of operating a machine.

9. In the case of the enlisted men, the situation is analogous. You cannot make a man a good mechanic. Many soldiers of the

Pinup girls boosted morale for the officers of the 96th Aero Squadron.

most estimable character utterly failed to comprehend the intricacies of the modern airplane, which are such that they can be mastered only by a comparatively small number of men, and the failure to master them, therefore, cannot render a man amenable to discipline, or in fact reflect on him in any way.

10. In the Infantry, discipline has been maintained and improved for thousands of years by methods of life, drills and kindred exercises. These exercises all bear some relation to the work which the Infantry soldier does, and perfection in them results in a high standard of morale and efficiency in the Field. In the Air Service, however, the drills, hours and general methods of life of the Army bear little or no relation to the work which the enlisted man is to do. His worth is judged necessarily more by his ability to take care of a motor than by his soldierly appearance, and the relation with his officer who pilots the machine in his charge cannot be the relation of the Private in a Infantry Company to his Captain or Lieutenant whom he must implicitly obey, but is rather the relation of an advisor and guardian to the man whose life depends on the advice and care given.

11. It is not a question of there being necessarily less discipline in the Air Service than in any other branch of the Service, but it is rather that the discipline must be of a different sort, and that the means of attaining it, which work in other branches of the Army are in many cases not applicable to the Air Service.

12. Such being the case, the only remedy in sight is first, to procure the best possible personnel by careful selection and strict elimination; second to encourage the highest morale and esprit de corps. This should be borne in mind continually, and everything that favors high morale should be done, and everything that tends against it should be strictly avoided.

13. In the present War, the advertising and notoriety given to the Air Service was sufficient in the beginning to secure for it a personnel of most exceptional quality. It is due to this fact, and especially to the extraordinary quality of the enlisted personnel, that such successes as have been attained in the Air Service can be attributed. To this exceptional quality of personnel also is due the fact that the morale of the Air Service was able, more or less, to resist a number of unfortunate factors which were calculated to destroy it, such as: the early promulgation of a program so large that it was sure to fail; the selection of officers for important commands who were wholly ignorant of the activities they commanded; the unequal pay of flying officers; the delays in training which reduced candidates to a frame of mind bordering on despair; the unequal assignment of duties which brought about in many cases the result that the willing and

competent were kept on disagreeable and routine duty while the less estimable were permitted to go forward to the duties they desired; the inability to give recognition to deserving enlisted men; the inability for a long time to secure necessary promotion and effective elimination, and lastly, the attitude of ignorance, contempt and disdain assumed by the Line of the Army on whose opinion in the last analysis the morale and esprit de corps of every Service must rest.

14. These matters are not to be treated in a spirit of criticism. They were in large measure the result of circumstances which could not be controlled. However, they should be carefully studied with a view to avoiding them in future as their repetition will be to a greater or less extent destructive of any Air Service hereafter created.

15. The selection of Air Service officers and their promotion deserves special consideration. In addition to all the difficulties which this subject presents for the Line one has the fundamental fact that men, highly trained in technical lines, resent in all manner and ways the command of others who have less knowledge of their specialties than they have. Though this applies, in my opinion, only to immediate command, it renders the selection of officers extremely difficult because those qualified in technical knowledge and training so often lack the ability to organize and conduct even a fair sized command.

16. In any future War it is going to be necessary again to call largely on newly made officers and on officers of the Regular Army who have had no experience by which their capacity can be judged. Only the most inadequate means of grading these officers are on hand at the beginning of a campaign, and the artificial difficulties caused by improper ranking do not need exposition. The experiment of promotion by selection may, so far as the Air Service is concerned, be regarded as a failure, and there is little hope that it can be improved. The only possible solution seems to be the adoption of a system of "acting rank" as distinguished from the "temporary rank", supplemented by a system of promotion by seniority with necessary elimination. The difference between acting rank and temporary rank is that acting rank follows the position and is lost when the officer is relieved from the duty which gave it, while temporary rank continues until action is taken to reduce it. In the one case the burden is on the officer to hold his increased rank, in the other, the burden is on the Government to take it away. The difference is vital.

17. As a matter of practice, in our Army the loss of temporary rank, which can only be brought about by a decision of a Board, savors so much of demotion that its value in properly readjusting

the grades of officers is absolutely useless. If a system of acting rank were adopted, however, officers could be tried out for responsible positions and be relieved and lose their rank without any obloquy attaching to them. Under the present system, officers have been put into high positions with a rank which was entirely inadequate to enable them to fulfill their duties, simply because one could not be sure that they would make good and be deserving of what practically amounted to permanent promotion for the period of the War. This is not fair to the officer and tends to defeat the purpose for which the trial is given. For instance, at Issoudun outlying fields have been placed in charge of First Lieutenants who commanded $2,000,000 worth of property, 400 enlisted man and 500 officers. Only one in every two or three of these men made good and when he did so, it was due to a natural force and character so unusually high that no system based on it can be uniformly successful. If a system of acting rank had been in vogue the officer, on being assigned to the command of such a field, would ipso facto, through the action of, say, the Commanding General, been promoted to the rank of Major which rank with the prestige that it gave him he would have held during his command. On relief from his command, for any reason, he would have reverted to his permanent rank, unless his services were so exceptional, and his ability so marked, that it was deemed advisable to promote him permanently to a higher grade. The same system would have applied with equal advantage to the command of squadrons at the Front. Indeed, it would have been immeasurably helpful in all branches of the Air Service. It prevents recommendation for promotion based on other than military reasons by giving to higher authority a ready means of checking the judgment exercised by C.O.'s in making assignments.

Problems of Organization

18. In general, the problems of Air Service organization do not, in my opinion, differ materially from those presented in other forms of military activity, and the general theories of military organization are adequate to cover them. Curiously enough, these general principles are constantly overlooked, and their study should be encouraged. The fixing of definite responsibilities, the placing in the hands of the responsible officer the control so far as practicable of all agencies on which the success of his particular enterprise depends, the establishment of workable channels and the strictest adherence to them, both in correspondence and in oral directions are as applicable to the Air Service as to any other branch of the Army. In the last analysis, however, the value of an organization will depend on

the character of the officer in charge and on his ability in selecting personnel.

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Col. Walter C. Kilner
Chief, Training Section
Air Service, AEF

A graduate of the U.S. Military Academy, Kilner had been detailed to the Aviation Section in November 1914 and had received his Junior Military Aviator rating in June 1915. After duty with the 1st Aero Squadron he had been Commanding Officer of the Signal Corps Aviation School at Mineola before being sent overseas in October 1917. After nearly six months as commander of the Third Aviation Instruction Center at Issoudun, Kilner had become Chief of Training for the Air Service, AEF, in May 1918. In the following report, dated 26 December 1918, Kilner made use of, and in places copied, the report which his assistant had given him on 21 December and which had been forwarded to the Chief of Air Service (see Document 116, above).[a]

Col. Kilner.

1. In compliance with your telegram 2534D requesting a frank statement of the most important Air Service lessons to be drawn from our experience in the present War, the following report, based on my own ideas and those of my principal School Commanders and Training Department assistants, is submitted.

2. This report is divided into: First, Lessons which concern general Air Service policy; Second, Lessons which concern Training. No attempt is made to go into the details of Training, as its problems are fully treated in the report on Training submitted from this Section on December 31, 1918.[b]

Lessons Concerning General Policy

3. Morale. The most important element which makes for the success of an Air Service is morale.

4. It is impossible to teach a man to fly or to become an Observer against his will, and it is extremely difficult, even after he has been taught, to get effective use out of him, except by his wholehearted co-operation. The Line Officer can be ordered into the Line, and when once there his conduct is practically assured by an intensely strong desire not to appear in a

despicable light before his men. I believe it is safe to say that, could the average Line Officer follow his own wishes at certain times in an action and separate himself from the fight without fear of criticism or reflection being cast on him, many would follow that desire. The Aviator, even though he be a part of a formation may put the nose of his machine down and immediately leave the fight at any time. He can present many excuses relative to his plane or engine, and if his record is fairly good, can escape without difficulty the loss of caste, which a confession of weakness would bring to him in the Line. While troops can be led by an officer who, although suffering from intense physical fear is buoyed up by moral courage, an airplane cannot be successfully flown by a frightened man.

5. This I believe to be an essential difference between the Air Service and the Line. The flying man must have more than high moral courage; he must be backed by the best of traditions; must feel himself a real part of the organization which he represents and must be willing at any time to sacrifice his life for the cause, even though he might very easily at his own volition escape with absolutely no reflection being cast upon him. Therefore, I put morale as the highest factor toward the making of a successful Air Service.

6. The morale in the Air Service, particularly as applies to flying personnel, has been lowered due to various causes stated below:

(A) The promulgation at the outset of the War of a program so large that it was sure to fail.

(B) The selection of officers, for important commands, who were wholly ignorant of the activities they commanded.

(C) The unequal pay of flying officers.

(D) The delays in training which reduced candidates to a frame of mind bordering on despair.

(E) The unequal assignment of duties which resulted in the willing and competent being kept on disagreeable and routine duty while the less estimable were permitted to go forward to the duties they desired.

(F) Delay in securing the necessary promotion for junior officers who did exceptional work.

(G) The lack of speedy and effective elimination of worthless personnel, especially officers.

(H) The fact that wings and rank were given to pilots who simply passed an elementary test in the U.S.

(I) The fact that newly made officers were quartered in

barracks in large numbers, permitting one malcontent to influence a considerable percentage of the whole.

(J) The issuing, in many cases, of petty orders by higher authority which did not apply to the Air Service.

(K) The rapid promotion of many non-flying officers in contrast to few promotions of flying officers.

(L) The fact that, due to lack of discipline and of a sense of responsibility, a small percentage of flying personnel did not behave as officers and gentlemen, resulting in restricting to a considerable extent the freedom of all.

(M) The fact that it was practically impossible, over a long period of time, to obtain leaves for flying officers whose nerves were shattered or who were run down, except through long delay.

(N) The fact that many officers who remained in the U.S., junior to those in the A.E.F., were promoted over the heads of equally competent officers in the A.E.F.

(O) Lack of an efficient system, after a man had completed his training, of moving the flying personnel to the Squadrons in which they were to work.

(P) The fact that one specialty of Aviation—Pursuit—was widely advertised, thus making the other specialties unpopular.

(Q) The fact that flyers were, in many cases, commanded by non-flying officers.

(R) Treatment of Cadets as school children, causing irresponsibility.

(S) Ignorance of Line Inspectors, of Aviation Schools.

(T) The attitude of ignorance, contempt and hostility assumed by the Line of the Army, on whose opinion in the last analysis the morale and exprit de corps of every Service must rest.

7. A number of these points to which it is desired to call special attention, are dealt with below in greater detail.

8. (B) Selection of Officers: Men highly trained along technical lines, resent the command of others whom they know have less knowledge of their specialties than they themselves. This is most applicable to immediate command. It renders the selection of Air Service officers extremely difficult, because those qualified in technical knowledge and training often lack ability to organize and conduct even a small command.

9. In my opinion, promotion by selection has been a failure, and the best solution appears to be the adoption of a system of "acting rank," distinguished from "temporary rank," supplemented

by a system of promotion by seniority, with necessary elimination. By "acting rank" is meant the system at present in vogue with the British. This system always makes the rank fit the command, and when an officer is moved from a large command to a smaller one his rank is reduced. Under our present system, the loss of temporary rank which can only be brought about by the decision of a Board, savors so much of demotion that its value in properly readjusting the grades of officers is useless. Under the system of "acting rank", officers could be tried out for responsible positions and could be relieved without any obloquy attaching to them. Under the present system, it has been necessary to place officers of junior grades in positions which properly called for senior officers. At Issoudun, for instance, Outlying Fields were in charge of First Lieutenants, commanding $2,000,000 worth of property, 400 enlisted men and 500 officers. Very few of these First Lieutenants proved up to the mark, and their failure was largely due to the lack of authority resulting from inadequate rank. When they did succeed, their success was due to a natural force and character so unusually high that no system based on it could be uniformly successful. Under a system of "acting rank", on being assigned to the command of such a Field, the First Lieutenant would immediately have been promoted to the grade of Major, with which rank and prestige he would probably have been able to hold his command. On relief from his command, for any reason, he would have reverted to his permanent rank, unless his services were so exceptional and his ability so marked that it was deemed advisable to give him the higher grade permanently. This same system could have applied with equal advantage to the command of Squadrons at the Front.

10. (D) Delays in Training: Under our system of training, a man was sent to a ground school after a considerable delay. Here he received possibly three months instruction on ground subjects. From this ground school, he was usually ordered to a Pool. At this Pool he did Infantry drill, fatigue, etc., and usually succeeded in forgetting practically everything that he learned in the ground school. The delays here varied considerably, but in some cases it covered a period of months. When a vacancy occurred at a flying school, men were selected from this Pool and sent to the flying school. Here also there might be another delay for a short time. Finally, the man become an R.M.A. He was then ordered to another Pool and was informed that he was ready for service in the A.E.F. There was a delay at this last Pool, varying in length of time, but often amounting to months. Finally, the Cadet was ordered Overseas, received at a Port where there was another short delay and from thence, ordered

to another Pool where he was again delayed. Finally, he was ordered to an A.E.F., flying school. Here there might be another slight delay due to weather, etc., and then he was obliged to take a finishing course in order to fit him for service at the Front. When he completed this finishing course, he was ordered to Colombey-les-Belles, where there was possibly still another delay. Meanwhile, in many cases, the prospective Aviator had probably spent over a year in reaching the Front. During his training in the U.S., there were still other delays, caused by the fact that the schools were situated in various parts of the Country, necessitating long trips by train.

11. Is it any wonder, after having passed through a system as complicated as this, that the prospective Aviator often wondered whether he would ever get to the Front? This training should have been accomplished in six months at the most. The result of this complicated system produced pilots at the Front who were already "fed up" on flying and who had lost much of their former keenness.

12. (G) Elimination of Worthless Pesonnel: Usually, when a student arrived in France, he was already commissioned as a Second or First Lieutenant. He had just received his commission and, while he was well versed regarding his privileges and rights as a commissioned officer, in many cases his past training had not really fitted him to be an officer, and he was still extremely irresponsible and undisciplined.

13. The percentage of worthless personnel was low. However, one worthless officer, barracked where there were many other young and impressionable officers, would often influence ten officers whose tendencies and characteristics were generally good. This worthless officer would, in the course of time, usually get into some sort of trouble. If the trouble were serious he could be punished by Court-martial or eliminated from the Air Service by the decision of a Board. If he were punished by Court-martial, he would probably live in the same barrack, having nothing to do except talk and spread discontent for a period possibly of three months, while he waited for the sentence of the Court. If he were eliminated by a Board, the delay was not so great, varying between two weeks and six weeks. In due course of time he might be eliminated. If it were in the U.S., there was a great possibility that he would be reinstated. If it were in the A.E.F., he would probably be reclassified and sent to another Service, still wearing his wings. Both methods were unsatisfactory. There was too much delay, and the example was not sharp enough to influence the other officers. The Commanding Officer of the school should have been able immediately to eliminate this worthless officer from the Service.

14. (H) The Giving of Wings and Rank on Passing an Elementary Test: This resulted in greatly increasing the difficulties of instruction. Many instances arose where officers of high rank had to pass through A.E.F. schools before being fit for the Front. These officers were usually instructed by First or Second Lieutenants. This naturally had a bad effect. There was a tendency for these officers of higher rank to dictate and belittle the authority of the instructor at the schools. Men who were to be sent to the Front should not have been commissioned until they had taken a complete course and were absolutely fit to fly at the Front.

15. (M) Leaves for Flying Officers: It is believed that flying personnel should be given as much freedom as possible and as much comfort as their work permits. Comfortable living and ability to get away occasionally from their work are the great compensation for flying officers. The policy of holding them unnecessarily because of the hostile feeling of the average Line Officer toward their enjoying liberty, should be discarded. Pilots and Observers at the Front should be given a leave after, at the most, three months service. This leave should be compulsory and should be of considerable duration, at least a month. There should also be a definite system of leaves for the instructor personnel at schools. There are very few young men strong enough to go through more than three or four months of uninterrupted work at the Front or as instructors, without going to pieces, particularly if there is no definite leave to look forward to. A system similar to that of the British is recommended.

16. This matter of leave should be in the hands of the immediate Commander of the flying personnel and there should be no delay in obtaining it, especially in the cases of men sick, wounded or with shattered nerves.

17. (P) Advertising Given to Pursuit: The wide advertisement and publicity received by certain pursuit pilots probably did more harm to the other specialties of Aviation than any other one thing. It was the ambition of every young pilot to become a pursuit pilot. Nothing else was regarded as worth while. In fact, other specialties were looked upon with a certain contempt. This may have resulted in a certain small raising of the morale of pursuit squadrons, but was certainly more than counterbalanced by the harm done in the other specialties. In fact, the feeling between non pursuit organizations and pursuit organizations was very strong. Steps should be taken at once to eliminate this idea.

18 (Q) Command of Flyers by Non-Flyers: The fact that non-flying officers often commanded and dictated the work to be done flying officers resulted in much dissatisfaction. A flyer is not

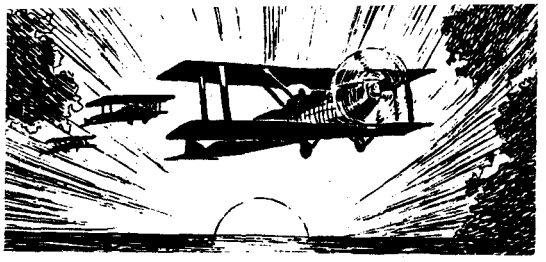
fond of risking his life at the direction of an officer whom he feels is totally incompetent to direct him. It has been a fact that many positions of responsibility, both at the Front and in the rear, pertaining directly to the ordering out of flyers on dangerous missions has been in the hands of officers who have never ridden in a flying machine and are totally unfamiliar with the point of view of the flyer. It is hardly necessary to point out the harm of such a system.

19. (R) Treatment of Cadets: It is believed that a system of training must be adopted which will throw upon the Cadet a certain amount of responsibility. One of the greatest deficiencies of our flying officers has been this lack of responsibility. It is believed to be entirely due to the fact that these officers, throughout their career of instruction were practically treated as school children. The British system is based on the idea of giving a certain amount of responsibility to every student, and apparently has been successful. In this connection, I do not believe that commissions should be granted immediately to a man who completes a flying course, but that a grade such as Pilot or Aviator, carrying the pay and privileges of a Second Lieutenant, should be created. Officers should be selected and examined for commissions from this class. In this way, the number of officers could be greatly cut down, more control over the personnel could be exercised and there would always be an incentive for doing the best possible work.

20. In our Air Service, during the past year, once a man had obtained his commission as Second Lieutenant he had practically nothing to look forward to. Promotion for junior officers was so slow and uncertain that it was hardly considered probable by most Second Lieutenants that they would ever be promoted. For these young and keen men, there should always be a direct reward in the shape of promotion for exceptional service rendered.

21. (S) Inspection: The usual Army Inspector of an Aviation School is quite likely to neglect entirely the idea of the school, namely: to turn out finished pilots or observers, and usually devotes himself to such details as apply strictly to Line Troops. This results in the lowering of morale, as the most efficient flying school where the best results are being obtained is often liable to sharp criticism for details which really have little to do with the main idea of the school. The Army Regulations were written before an Air Service existed and are often not applicable to problems which arise.

22. In closing the subject of morale, it is my belief that, in the present War the advertising and notoriety given to the Air Service sufficed to secure for it a personnel of exceptional



quality. Due to this fact, such successes as have been attained in the Air Service can be attributed. To this personnel is also due the fact that the morale in the Air Service has been able to survive the unfortunate factors which have just been mentioned. These factors are not referred to in a spirit of criticism. It is fully appreciated that they arose in large measure from circumstances beyond control. However, they should be carefully considered in order that the unfortunate results which follow from them may be avoided so far as possible in any future organization of the Air Service.

23. Discipline. The discipline of the Air Service is essentially different from that of the Line. No amount of discipline can make a good Aviator, a good Observer or a good Mechanic.

24. According to Line standards, there has been a lack of discipline in the Air Service. This has been due in a large measure to the extreme youth of the officer personnel and the lack of responsibility placed upon him outside of operating his plane. It has also been due to the example set him by the Air Services of other Countries, namely: France and England. The flying man feels that his duty is a voluntary duty. This is absolutely true, and this fact has not been given sufficient consideration and has been frequently entirely overlooked. The feeling of the flying man that he ultimately is the judge of what he is to do is, I believe, the basic reason for this apparent lack of discipline of the Aviator.

25. The situation is analogous in the case of the enlisted man. A good soldier is not necessarily a good mechanic. Many soldiers of the best character fail utterly to comprehend the intricacies of the modern airplane. Failure to master them cannot render the soldier amenable to discipline or reflect on him in any way.

26. In the Line, discipline has been maintained and improved for thousands of years by methods of life, drills and kindred exercises, all of which bear some relation to the work which the Line Soldier does, and perfection in them results in a high standard of morale and efficiency in the Field. In the Air Service, however, drills, hours and the general methods of life in the Army bear little relation to the work which the enlisted man has to do. His worth is judged by his ability to take care of a motor rather than by his soldierly appearance. The relation existing between him and the officer who pilots the plane in his charge cannot be the relation of the Private in the Infantry Company to his Company Officer, but is much more intimate. The Pilot practically relies upon his mechanics for the safety of his life.

27. It is not a question of there being necessarily less discipline in the Air Service than in any other branch of the Service, but it is rather that the discipline must be of a different sort and that

the means of attaining it which work in other branches of the Army are in most cases not applicable to the Air Service.

28. Organization. In my opinion, the various activities for which the Air Service is responsible should be directly under Air Service control. I refer to such instances as the Engineers having all authority regarding construction, the Ordnance responsible for the training of Armorers and Armament officers, the Signal Corps charged with the training of Radio Operators, and the Motor Transport Corps controlling all Motor Transport. This division of authority has resulted only in slowing up the various projects and the submission of numerous requisitions and letters through various channels in an attempt to get something done, when no one was certain exactly who was responsible for the doing. The Air Service schools were all practically built by Air Service personnel, in spite of the fact that the Engineers were charged with this work. The Armorers were trained, in the main, by the Air Service and also the Armament Officers. The same applies to the wireless personnel. It has been my observation that, one branch charged with the training of personnel for any other branch, is not so vitally interested in the excellence of the product, nor the speed of production, as would be the branch for whom they are going to work.

29. The squadron organization tables call for a number of non-flying officers. I believe that the number is excessive. One non-flying officer in a squadron, namely, a Supply Officer, is in my opinion sufficient. The Engineering Officer, the Photographic, Radio, Armament, and Compass Officers could be done away with and their places taken by pilots and enlisted men, with a gain in efficiency and at less cost.

30. A considerable amount of confusion in Training has been caused by the fact that, while all details of Training were carried out by the Chief of the Training Section at Tours, Section G-5 of the General Staff, from time to time, interposed its authority to modify or direct the training to be done. As G-5 could not possibly keep in touch with the situation and problems of Air Service Training, its action often resulted in uncertainty. It is strongly recommended that whatever system be adopted in the future, the control of all Air Service Training be placed under one responsible head, to avoid the diversity of channels and directions which can only result in the inefficient working of any system.

Lessons Concerning Training

31. Engineering. Engineering is one of the most important departments of a flying school. Upon it depends largely the general efficiency of the school. It is desired to bring out the

importance of trade testing in this connection. Though many good mechanics were sent to the A.E.F., they were often improperly placed, due to the fact that they had not received an efficient trade test. Trade testing should not be done in a half-hearted way, but, due to its importance, a special installation should be furnished and men should actually be tested out upon the various tools and at their various trades. The result of this trade test must be a matter of record and go with the man wherever he is sent. Trade testing should be conducted by specialists in the various trades. In the past this was done largely by Army Officers who were not sufficiently educated in these various trades and therefore the results obtained were poor. The squadrons first formed in the U.S., at Kelly Field, were good examples of this routine method of selection. Wood workers were rated as machinists; farmers as mechanics, and good mechanics were given fatigue duties. Clerks were made mechanics and good mechanics were made clerks, and then the entire squadron would be turned over to a supposedly technical officer for further training and assignment to duty. Under such conditions it is not strange that mechanical work progressed slowly and that much of it was not properly done.

32. The selection of Engineer Officers should receive special attention. It has been found that the best Engineer Officers are men of practical education, not necessarily college graduates, but men who can utilize the material at hand and who are authorities on the subject so that the enlisted men may look to them for example and real help. It is not possible to make a good Engineer Officer from a man who has had merely business experience and is not a mechanic by trade by simply sending him to some institution for a three months' course. To be an Engineer Officer the man should actually have had experience in running shops and should be thoroughly familiar with the tools used in the ordinary shops and also should have had organization experience. He should be first and last a practical man. I venture to state that fifty percent of the Engineer Officers sent to the A.E.F. could have been eliminated without material damage to the Service.

33. The importance of shops at Aviation Centers is often minimized. The shop should be one of the first buildings constructed. It should be a comfortable place to work in, and there should be plenty of room. Without an efficient shop no Aviation Field of any nature can be a success.

34. With reference to the enlisted men who work in the various shops, a system should be inaugurated so that these men receive their promotion in the squadron, due to their mechanical ability as shown in the shops. Various Sergeants,

First Class Sergeants, and Master Electricians should be the non-commissioned officers in the shop in charge of the various departments.

35. Gunnery. Sufficient attention was not given the subject of Aerial Gunnery. Since most of our training, due to location, was largely influenced by the French, pilots were led to believe that Aerial Gunnery was more or less a minor matter. This has been disproved. It was formerly the idea primarily to teach a pilot to fly and to take a little Aerial Gunnery on the side. The Germans discovered very quickly the fallacy of this method and insisted on a very systematic and detailed course of Aerial Gunnery. The British were quick to follow and now the French are also devoting more time to this important subject. All types of pilots and observers must obtain a maximum amount of Aerial Gunnery. The various records at the Front have shown that those men who lacked interest in gunnery have not been

Wing repair shop, Issoudun.

successes, and those men who were keen students of gunnery have made a success in spite of the fact that they were oftentime mediocre flyers.

36. Navigation. Navigation as pertains to aircraft has been largely developed during the last year of the War. The training of every pilot or observer should include a thorough course of Navigation. Especially should they be taught the use of the compass thoroughly and the reading and making of maps. It must be an instinct for a pilot or observer to find his way home. There are many cases of pilots being lost during our operations at the Front. It must be remembered that in a fight where many machines are engaged, the least of one's concern is to keep one's self oriented. Therefore, when the fight is over, he must be able to locate himself (and it is extremely difficult) in order that he may return to his own lines and not those of the enemy.

37. Observation. Observation is without doubt the most important of all Air Service specialties. Upon efficient Observation depends the safety and success of ground troops. There was a tendency, about the time of our entrance into the War, to minimize the importance of all branches of Aviation except Pursuit. This has been a very expensive fallacy. Observation, for the pilot and observer, requires the very highest type of personnel. Due to the newspaper campaigns and advertisement of certain pursuit pilots, Observation was a very unpopular branch of Aviation. Every effort must be made to eliminate this false idea by propaganda such as newspaper and magazine articles which show the real importance of the Observation Branch of the Air Service. The Observation Pilot must be every bit as good as the Pursuit Pilot. He takes as many chances as the pursuit pilot and must be able to handle his machine as well. The Air Service should be responsible for the training of Observers in all branches of his instruction. That is, technical training in radio, photography, aerial gunnery, etc., should be under Air Service control.

38. Especially has the importance of training with the Line Troops been brought out during the past year. No matter how efficient a squadron may be, if the Staff and Line Troops are ignorant of how to use the Air Force and also ignorant of its limitations, it is impossible to obtain results. Therefore it is necessary that a very close liaison be established with the Line and that Staff Officers and Line Officers receive special instruction regarding the importance and use of the Air Service.

39. Observers and Pilots should be on exactly the same basis, should belong to the Air Service and be responsible to the head of the Air Service for their promotion. When an observer has demonstrated his fitness for command he should be taught to fly

before being allowed to command a squadron or higher command.

40. Supply. The problem of Supply in the Air Service is one of the most difficult and the most important, especially as applies to training. This makes the adoption of a standard type of training airplane and motor of paramount importance. The training in the A.E.F., has been, from the start, a makeshift. This has been due to the fact that we have been absolutely dependent upon foreign governments for our planes and spare parts. Therefore, a training system had to be built up, based on the types of airplanes that could be obtained, not on those types which were really desired. What this has resulted in is well exemplified at Issoudun where there were over thirty two types of airplanes and over thirty thousand items carried in the supply warehouses. This condition of affairs has decreased the production of pilots and observers materially. Many types of spare parts could not be obtained and additional work was thrown on the shops as these spare parts had to be made up at the School. Had there been

A horse-drawn vehicle used to supply airplanes at the 1st Air Depot.

an ample supply of spare parts, the number of planes kept in commission would have been very much greater. The amount of breakage at a flying school where fast and delicate airplanes are handled is tremendous. This means that the amount of overhead material carried must also be tremendous. This point is usually overlooked by officers not familiar with aviation problems at schools.

41. Officers who are selected for the duties of Supply Officers should be chosen with great care. These men should be thoroughly familiar with the regulations concerning supply, should be able to utilize material at hand and must be of the most energetic type. Experience in the A.E.F., has shown the younger type of business man to be the best for this duty. However, strictest elimination only will result in efficient Supply Officers.

42. A very close liaison must be kept between the various Supply Depots and the Central Headquarters. Oftentimes one Depot has an excess of certain articles which are vital to the efficiency of another, which has none. A close liaison would eliminate this failing.

43. In order to handle Aviation Supplies efficiently, warehouses should be built among the first of the buildings of the project. They must be waterproof and well constructed, due to the fact that aviation material is subject in the highest degree to deterioration and a great loss of public funds will result if this property is not most carefully protected.

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Lt. Col. Philip A. Carroll
Assistant Chief, Training Section

Colonel Gorrell personally reviewed the reports on lessons learned. When he had questions, as he often did, he sent a memorandum, letter, or cable asking for clarification or additional information. In a report forwarded on 26 December 1918 (Doc. 117), Kilner had listed 20 things that had lowered the morale of the Air Service. Gorrell asked questions about three of

these and wanted to know what had been done in each instance to correct the condition. Carroll sent the following memorandum in reply.

1. Referring to the annexed memorandum; further discussion of the criticisms contained in the letter of the Chief, Training Section of December 26, is given below:

(F) Delay in promoting Junior Officers: I think an examination of the records will show that from the arrival of the A.E.F. in France to October 1918, not one Junior Flying Officer was promoted. All these officers were of the rank of First and Second Lieutenant, except one or two who had been promoted to Captain in the U.S. This meant either that of the 3000 odd flying personnel in Europe at the end of the Summer, 1918, not one man had done anything worthy of advancement or, it meant that the system of advancement was defective either in conception or application.

The result, of course, was ludicrous. The largest school in the A.E.F., was commanded, during the Spring and Summer by a Major; outlying fields having a personnel of 500 enlisted men and 300 or 400 officers, all of them First and Second Lieutenants, were commanded by a First Lieutenant; the officer in charge of Day Bombardment Training, who made a notable success, was a First Lieutenant, although a man of thirty-six years of age; likewise, the officer in charge of Observation Training was [a] Lieutenant, and a number of Squadrons at the Front were commanded by First Lieutenants.

In July, it is believed that a number of recommendations for promotion went through, however, the only promotions which were cabled were those of Senior officers to Major and above, the others being sent by mail. The result was, while a number of Headquarters Officers . . . holding no particular jobs received promotion, . . . men who had really been doing the work received none until much later.

(K) I am unable to give comparative figures on the promotion of flying and non-flying officers. I am inclined to think that in-so-far-as this criticism is not explained by the above, Colonel Kilner meant the word applied to officers who were engaged in regular flying duty and actually flew. The promotion of officers in the U.S. over the heads of officers in Europe also led to dissatisfaction. The creation of a Promotions Board in August(?), which regulated promotions and whose recommendations were approved at G.H.Q., did a great deal to remedy these conditions and would in time have worked out a solution quite satisfactory.

(Q) Many schools in the U.S. were commanded by non-flyers, with the result that pilots reached Europe with an ingrain[ed] contempt and disgust for Commanding Officers. One important school in the A.E.F. was commanded by a non-flyer, with unsatisfactory results. For the rest, the criticisms must be taken to mean that, in a number of cases men were commanded by officers who were nominally flyers who never flew. Those matters were being remedied during the summer and Autumn of 1918.

Remedies Applied to Criticism:

(A) No remedy possible.

(B) Was in the course of being remedied during the Summer and Autumn of 1918, by more judicious selection of Commanding Officers and by wider acquisition of Air Service knowledge.

(C) Attempt to remedy this situation made by cable _____. No result up to this time.

(D) Delays for the most part were unavoidable owing to peculiar situation and delay of production program.

(E) Was being remedied in the Summer and Autumn of 1918 by careful watching of the records of individual officers and their advancement so far as possible in accordance with their merits shown.

(F) See above.

(G) Remedied in the Spring of 1918 by resort to reclassification.

(H) Could not be remedied.

(I) Could not be remedied under housing conditions in Europe.

(J) Could not be remedied.

(K) Remedied largely by appointment of Promotions Board in August, 1918.

(L-R) Could not be remedied (the question of handling this kind of personnel does not seem to be as yet fully understood). No definite recommendations can be made. The question involved is an extremely complicated one and demands serious consideration.

(M) Remedied in October 1918 by action secured at G.H.Q.

(N) Could not be remedied. I believe attempts were made in August or September 1918 to secure co-operation of the U.S. in equalizing promotions.

(O) Could not be remedied under the system of organizing Replacing Squadrons at the Front, which had necessarily to be used.

(P) Could not be remedied, though efforts were constantly made to do so, dating from January 1918.

(Q) Was by way of being remedied in the Autumn of 1918.

(S) Could not be remedied. Would doubtless have been

much alleviated by the work of Air Service Inspectors of the Air Service Inspection Department put in operation in the last months of the war.

(T) Could not be wholly remedied but was being gradually overcome at the close of hostilities.

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Maj. Thomas G. Lanphier
O.I.C., Training
Third Aviation Instruction Center

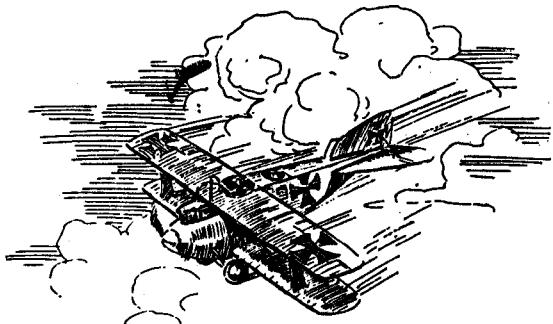
Lanphier, the father of the pilot credited with shooting down Admiral Yamamoto in World War II, was a graduate of the U.S. Military Academy in the class of 1914. An infantry officer, he had arrived in France with the 8th Machine Gun Battalion in April 1918. As he indicated in the following report, he had been with his battalion in the Chateau-Theirry Sector when he received orders to report to Chief of Air Service.

1. In compliance with Office Memorandum No. 6, Office of the Chief of the Air Service, dated January 7th, 1919, the following is submitted as having been the most important lesson learned by the undersigned while serving with the U.S. Air Service.

In June of the year 1918 I was ordered from the front lines, where I was then serving as a Captain of a Machine Gun Company in the Third Division, to report to the Chief of the Air Service for examination to determine my fitness for detail in that branch of the service. In July I was attached to the Air Service and reported to the Third Aviation Instruction Center for duty. I was placed in command of the Headquarters Detachment, which detachment was then composed of some eight hundred Student Flying Officers. I am mentioning all this because the situation gave me an excellent opportunity to compare the attitude of the men whom I had just left fighting in the front lines to the men who were in a few weeks expected to meet the Hun in the air. The contrast in morale was appalling. The Student Flying Officer at that time seemed to fail to realize that he was really in a serious game. He seemed to lack that sense of responsibility which should have been shown by one who was soon to hold the lives of many men in his hands. That All-Important factor—Pride of Organization, or Esprit de Corps—was entirely lacking. This resulted in lack of interest in training and in consequence a poor quality of pilot was produced and there was very little keenness to get to the front. The cause for this lack of interest

did not rest with the pilots themselves. As soon as they were told how important, how serious and how valuable their services and their training was, and as soon as they realized that everything that was being done at this Center was for their good and for the attainment of the best results in the cause, and when it was impressed upon them that team-work was most essential in this game and that their work was most important and necessary to any good results that might be attained, their increase in sense of responsibility and in enthusiasm and morale was just as striking as the contrast which their previous attitude had been to that of the men at the front. The result of making the Student Pilot realize that he is the All-Important thing in the aviation game, was a vast increase in morale and the generation of a genuine Esprit de Corps. This was manifested in the surpassing of all previous records at this Center, both in the performance of the pilots and of the enlisted personnel, and also by the quality of the pilots graduated.

The lesson gained from this was: that the success of an Air Service depends primarily upon the Esprit de Corps of the pilots, and that this Esprit de Corps must be fostered and that the preliminary training of all pilots should be carried on with that predominating idea in view at all times.



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Maj. Howard S. Curry
C.O., Headquarters Detachment
Third Aviation Instruction Center

1. The most important lesson I have learned is the power of discipline or lack of it for good or poor results.

2. Training has been hampered by extreme lack of discipline among flying officers, particularly those undergoing instruction. Few of them have ever handled any men either in civil life or in the army, and have [no] conception of the responsibilities of an officer.

3. I have fully considered the disadvantages under which the Air Service has been compelled to develop, and do not mean this as a criticism of any persons or policy, as it is much easier to judge things from the standpoint of after knowledge than to plan and develop things which scarcely have a precedent. Wonderful results have been accomplished but it is felt that these results would have been more satisfactory if properly handled.

4. Have personally seen cases of gross disrespect to superior officers under circumstances which made it impossible to tell who was guilty, and have heard from lips of some other officers at whom mud had actually been thrown while drilling officers. It is felt that officers capable of such things do not have discipline to the extent that would "enable them to sub-ordinate the law of self-preservation to implicit obedience to the will of a superior."

5. Having attended training camp for Line of the Army, and been originally commissioned in Field Artillery I may be stating this from a biased viewpoint, but having had to check up on the misdemeanor of several hundred of them for more than two months I feel fully qualified to write.

6. It is felt that much better results would have been attained if kept in cadet companies to the very end of advanced flying training, under rigid discipline such as prevailed in Reserve Officers Training Camps.

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1st Lt. Lewis A. Smith
Police, Prison and Labor Office
Third Aviation Instruction Center

1. Nothing is so productive of results from the enlisted personnel of an organization than proper discipline. Men who are trained to follow instructions promptly and accurately, whether it be in the matter of saluting, obedience of squad-room regulations, appearance at formations, or personal appearance, will be most efficient in their regular work. On the other hand, those who are allowed to be sloppy in their personal habits, who are not corrected for violations of regulations, and who are not thoroughly drilled in the essentials of a soldier, cannot be expected to show results in the duties to which they are assigned.

2. Observe the actions of a man who is undependable and "stalls" on his job, and you will find that he has no snap in his salute, that he hides trash under his bed-sack, and that he does not button his coat before addressing an officer. No matter what the branch of service may be, the soldier must first be trained to respond instantly to the commands of his superiors, and to obey to the letter the regulations imposed upon him.

3. This discipline is best secured not by the "drive" method, but by forceful, kindly handling of the men, constant regard for their welfare, and by conduct on the part of the officers that is exemplary and thoroughly military.

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Capt. Harry L. Wingate
Executive Officer
Third Aviation Instruction Center

. . . . . .

I have been very forcibly impressed by the inefficiency of a great number of the officers in the Air Service. The inefficiency of these officers is not the fault of the officers altogether, but the lack of proper training for this branch of the service.

It has been very forcibly impressed upon me the disadvantages of officers in the Air Service, such as Adjutants, Supply Officers, Commanding Officers of training fields, and Commanding Officers

Lt. Col. Walter G. Kilner, commanding Aviation Training at Issoudun, watches with his staff as a student aviator takes off.

of squadrons, by their not having any knowledge whatsoever of flying. For an officer to hold a commission in the Air Service, I think it is very important that he should have a thorough knowledge of the technical end of the game as well as the flying. It has been very clearly shown that an officer trained for the Infantry, Cavalry, Artillery, or other branches of the service, cannot be thrown into an equal position in the Air Service and carry on efficiently, without any knowledge of that branch of the service. I firmly believe that there should be some means of giving officers in the Air Service a more thorough knowledge of the technical end of the game as well as the flying than there has been heretofore, and that before an officer receives his commission in the Air Service, he should be a finished pilot.

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Capt. Lester E. Cummings
Adjutant, Third Aviation Instruction Center

1. The most important lesson I have learned during the present war is that the scheme of organizing the Air Service along the lines of other organizations of the army was not productive of as good results as might have been obtained, and that a scheme similar to the following should be followed in the Air Service of the permanent military establishment and for any war which may occur in the future.

There are too many officers and noncommissioned officers. No flying officer should be commissioned in the Air Service until he is a finished pilot and has demonstrated that he has the other requisite qualifications to be a commissioned officer. Other expert personnel should not be commissioned until it is determined that they are qualified therefore in addition to their mechanical and other technical knowledge. A rating such as "Aviator" and "Expert Mechanic" should be provided for this class of personnel, which rating could carry a rate of pay commensurate with their duties. There should be no more than one noncommissioned officer to each 15 other enlisted men. The mechanical and other technical personnel of a squadron should be carefully classified and rated by a board of officers competent to do the work. A rate of pay should be provided for each classification, such as—Clerk, $35.00; Motor Engine Mechanics, $67.00; Blacksmith, $50.00; Brazier, $45.00, etc. For instance, to appoint a mechanic a Sergeant 1st Class and expect him to command the respect due his grade is a serious error, for the reason that experience has proven that the majority of mechanics could not, with any amount of training, become good noncommissioned officers. This applies equally to the flying and mechanical commissioned personnel. Nothing is so productive of results as proper discipline and this cannot be obtained if commissions and warrants are issued to persons in order to provide a rate of pay suitable to the class of labor they are capable of performing and expect those same persons to properly function as officers and noncommissioned officers.

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1st. Lt. *Louis H. Kronig, Jr.*
C.O., Field Three
Third Aviation Instruction Center

1. In compliance with a request for the written statements of the most important things learned in the Air Service, during the present war, the following are respectfully submitted as suggestions whereby this branch of the Service might be improved as seen from the viewpoint of an officer, transferred from the Infantry.

2. Under the present tables of organizations, an Aero Squadron has too many noncommissioned officers. Mechanical ability should be recognized and rewarded with extra pay, which is met in the present organization by making these mechanics, noncommissioned officers. This tends greatly to lower the standard of discipline for several reasons. First, the proportion of noncommissioned officers to privates is entirely too large and consequently "familiarity breeds contempt" and the respect due the noncommissioned officers by the other men is missing. Unless the noncommissioned officer happens to be a man with exceptional personality, he is unable to command the respect that a man of equal grade would do, for instance in the Infantry.

Expert mechanics perform a preflight inspection, Issoudun.

The reason for this is that an astonishingly large number who are the exceptional mechanics would never make noncommissioned officers with any amount of training. These exceptional mechanics are the men who deserve the extra pay, but it is an injustice to the service to make them noncommissioned officers, and if they are not given warrants, a great injustice is done the man who deserves the extra pay because of his mechanical ability. My suggestions to remedy this very evident fault of the present organization is to eliminate all noncommissioned officers from the Squadron, except the First Sergeant, the Sergeant Major, the Supply Sergeant, and the Mess Sergeant who would hold the rank of sergeant 1st class; four M.E.'s who would have charge of the work on the field. In addition, six Sergeants, and four Corporals would assist these men and fill the other places in the Headquarters and Supply Sections. These men would form the Squadron noncommissioned staff. All the other enlisted personnel would be rated as privates, privates 1st class, mechanics, mechanicians, and mechanicians 1st class. With pay of privates, privates 1st class, corporal, sergeant, and sergeant 1st class; respectively. Under this system, the deserving mechanics would receive the pay due their ability, but they should have no rank, and on the other hand, the noncommissioned officers would hold considerable prestige among the men, because they would be a very few, carefully selected men, chosen for their ability to command men and obtain results, and not for mechanical ability alone.

I would further suggest that the enlisted personnel of a Squadron be increased to 200 men, because the present number is inadequate to furnish the Guard and Squadron Fatigue, as well as the mechanics, when a Squadron is operating alone.

3. I would further suggest that cadets, after receiving their brevet, be given a rating as an Aviator with allowances and pay slightly less than a Second Lieutenant, and that after a fair trial the best men from the class be commissioned, and from this class, the Aviators, shall become the source of Officers for the American Air Service. This would decrease the numbers of officers, while not decreasing the number of pilots, and without injustice to the pilot individual. The Air Service has, in the past, suffered from the high proportion of officers to enlisted men, and consequently discipline has lagged. I would further recommend that every officer in the Air Service below the rank of Major, who is commissioned in the Reserve, be given not less than 2 months strict discipline and training, and at the same time receive very thorough instructions in his duties as an officer, if this officer has not already received such training either in other branches of the Service or Infantry Training Camps.

4. The above suggestions are offered as a result of my observation and study of the Air Service personnel, and organization, since transferring into this branch of the service from the Infantry in December 1917. Most of my time in the Air Service has been as Squadron Commander, and these suggestions are written from the point of that office.

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2d Lt. M. S. McCullough
O.I.C., Transportation
Third Aviation Instruction Center

The undersigned has found that the majority of the men in the Air Service, with whom he has come in contact, are young and practically inexperienced. Their technical knowledge, if any, has been acquired through study. They may have a general idea of the work assigned to them but they lack a thorough understanding of it as a whole. For instance, about 50 percent of chauffeurs and truck drivers are good men at the steering wheel but if there is any trouble with the motor they are ignorant of how to locate said trouble or how to repair it. Thus occurs a great loss of time and labor.

Of course, these man in time can become first class workers in whatever work that has been assigned for them to do, but should it happen that they were assigned to a different line of work their previous experience would be useless. They would have to commence at the very beginning again. And, as you know, efficient mechanics and chauffeurs cannot be made within a few months.

I believe that if technical schools were established at large camps, instructed by men thoroughly familiar with the different branches of work, whereby soldiers and officers could attend several hours each week, they would be rendered more efficient and a higher standard obtained.

Members of Staff, Headquarters, Issoudun: (bottom, l. to r) Capt. W. M. Conant and Maj. L. H. Byam; (top, l. to r.) 1st. Lt. R. H. Merkle and Capt. H. L. Wingate.

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Maj. L. H. Byam
Engineering Officer in Charge of Construction
Third Aviation Construction Center

1. The most important lesson that I have learned from the war is that it is entirely possible to train good soldiers from the personnel available in the United States within a period of six or eight months. It is impossible to properly train officers from civil life in the same period of time. From observation and reports it appears that the enlisted men at the front displayed qualities equal to or better than similar troops of other countries. The officers both from civil life and from West Point appear to have been deficient in training suitable to enable them to handle large bodies of men effectively.

2. In order to have a sufficient number of trained officers ready in event of future wars it would seem absolutely necessary that a standing army of at least 500,000 troops be maintained in the United States which would serve as a nucleus from which to draw trained officers and non-commissioned officers for the higher grades in event of hostilities. Under the old system in the United States with a small standing army few officers had opportunity to handle troops in larger units than companies or platoons. When such officers were suddenly placed in command of regiments, battalions and larger units they lacked sufficient training to handle them.

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1st Lt. George W. Eypper
O.I.C., Aerial Gunnery
Third Aviation Instruction Center

1. No provision had been made to take care of an organization to run a school of gunnery. Proper promotions were not possible thereby cancelling the logical incentive for the best work. Men doing an unusually high class of work, viz: instructing officers drew the pay of buck privates and quite naturally were not accorded the respect which their knowledge and training warranted.

2. Men were withdrawn from the squadrons to train as gunnery instructors. Instead of drawing the older and mature man in each instance, it seemed as though the squadron had detailed their youngest and least desirable men for this work. This meant that the individual had not the confidence in himself which tends towards the efficient and productive instructor.

3. The aviator learns to fly so that he can use his machine gun in the air. The mediocre flyer if skillful with his guns, as most Americans proved themselves, kills Huns. The flyer, no matter what his ability as a flyer, who cannot shoot might just as well stay on his aerodrome. He is merely a source of expense to the government. These facts were not recognized and gunnery was relegated to second place.

4. The material and supplies necessary for this work were held up on all hands, no central organization equipped with the knowledge necessary for it was in power and little effort made to improve matters.

5. Proper liaison between the states and this country was delayed. Students arrived here competent to handle guns they would not use.

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1st Lt. Richard H. Merkel
O.I.C., Field No. 10
Third Aviation Instruction Center

In my opinion student flyers should receive more military training to make them better soldiers. Under the present policy of commissioning cadets before their course of training has been completed, instructors cannot enforce discipline as rigidly and easily as if the students under them were on a cadet status. As C.O. of the 37th Aero Squadron, and later as Adjutant of Field No. 7, and O.I.C. of Field No. 10, 3rd A.I.C., I have had a splendid opportunity to follow the flying training of two enlisted men of the 37th Aero Squadron. I interviewed their instructors and was informed that they were both exceptional students, and in every case the Instructors volunteered the information that they were very much impressed with the respect and courtesy with which these men regarded them. On the other hand, I have seen student officers going at some of the less interesting details of their course in half hearted way, thinking that as officers they should not be called upon to perform any of the "ordinary Army routine".

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Capt. Charles M. Fleischmann
Army Air Service Headquarters in Italy

1. In accordance with verbal instructions I hereby submit a recapitulation of the history of the American Aviation Camp at Foggia, Italy. . . .

2. During the time that I was commandant of the school I observed the following details which might be of interest in the future:

I. That it does not seem good policy to give preliminary training by contract. The time needed for each man varies considerably; some pilots, though able and willing, take necessarily a longer time to master the first elements than others, and every opportunity should be given such a man and he should not be discontinued just because he has flown more hours than called for by the contract.

II. It was not possible to give any man "acrobatics" at the school at Foggia, as the Farman type machine is not suited to such work, and further, acrobatics are not necessary in a plane of the Caproni type, but it is thought that an acrobatics course, even of the simplest form, gives a man added confidence, which aids him a great deal when in a difficult place.

III. American student pilots should have American instructors. Temperament and language have so much to do with instruction that very often a great injustice is done a student by an instructor, through his lack of understanding of an explanation or direction.

IV. A Commissary should be put at any post where the number of men necessitates it, as it is found that American men do better work and are much better satisfied when they are fed on food they are accustomed to, even though it be of the simplest kind.

V. That care should be taken that no American Commanding Officer be sent to a foreign school who has higher rank than the Commanding Officer of the foreign school. The foreign officers stand a great deal on etiquette and rank, and it causes embarrassment which might be avoided if both officers were of equal rank or the American of lower rank.

VI. Looking back over the training at the school and what it has accomplished, I believe that the training in Italy was a valuable thing, and if the war had lasted six months longer this fact would have been proven. Pilots were beginning to arrive who had had their preliminary training in France and England,

and it would have been a matter of an extremely short course to make them efficient as Caproni pilots. A navigation course was just being begun, and a sufficient number of planes were being assembled to take care of the Americans.

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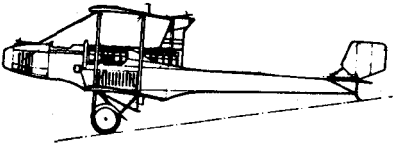
Capt. Remington Orsinger
Operations Officer
1st Army Observation Group



On February 21st, 1918, I entered the School for Aerial Observers at Fort Sill, Oklahoma. On November 20th, 1918, I arrived at the front. Nine months had elapsed from the time I transferred from the infantry and the time that I arrived on the front. The first 4 months were spent in Observation and Aerial Gunnery Schools in the states. One month was spent in crossing the Atlantic. The last 4 months were wasted in Aviation School of the S.O.S. in a useless repetition of the courses followed in the states.

My case is one of several hundred similar cases. While these officers were held in the S.O.S., squadrons at the front were short of observers. The shortage of observers was so great that in one squadron, the 91st, an Ordnance officer had to be sent up to do the work of an aerial observer; in another, the 24th, the Radio officer volunteered for the work and was gladly accepted.

The point that I want to emphasize is, that even though there was a shortage of observers at the front, officers who had been completely trained in the work before leaving the states were being held in the Aviation Schools of the S.O.S.

Courses of study in the Aviation Instruction Centers for "Aerial Observation for Artillery" were based on regulations contained in Confidential Bulletin No. 80, G.H.Q., A.E.F.[a]

This bulletin furnished some valuable information as to the manner in which aerial observation was used in carrying on an "Artillery Reglage." The information was not detailed in many cases and had to be supplemented and interpreted by the instructor.

I was at the 2nd Aviation Instruction Center at Tours August to October. During that time there were no less than five different instructors in the course on Artillery Observation. Information was often given by one instructor which was later contradicted by another instructor. This contradictory instruction confused many of the students.

A cursory study of the bulletin will show that no difference is made between the manner in which a battery of 75's fires a problem and the manner in which a battery of 155's fires a problem. This difference is of fundamental importance, yet it was not in the bulletin and had to be conveyed to the classes verbally.

There was plenty of time to publish a suitable manual of regulations on Aerial Observation for Artillery. Other Branches of the Service are furnished with such manuals, but up to the time of this writing the Air Service has only Bulletin No. 80, which the writer considers insufficient.

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Lt. Col. John F. Curry
Chief of Staff, Air Service, Second Army

The reports on lessons learned were full of suggestions for things to be done in the future. In addition, General Patrick asked some key officers to submit separate recommendations for the postwar, peacetime Air Service.

In compliance with telegram from C.A.S., American E.F., in reference to after-the-war Air Service activities, I submit herewith my views on this matter.

1. For Work with the Army.

(a) Mobile. The size of this branch of Air Service will depend naturally on the size of the Army after the war. Experience has shown that for each division there should be one observation squadron, one balloon company, and one photo section. Besides this, there should be further observation units for Army use as distinguished from corps and divisional use. In addition to the observation aviation, there should be a small nucleus of pursuit and bombardment aviation for the development of the technical end of these branches and in order that we may have something around which can be built up a strong pursuit and bombardment force upon the outbreak of war.

(b) Coast Defense. Certain squadrons will have to be provided for and definitely assigned to coast defense work around the harbors along our coastline. Recommendation as to the number of these has already been made to the General Staff by the Air Service in the United States.

2. Postal and Passenger Carrying Services. It is believed that

the future of Postal and Passenger Carrying Air Service in our country, except in special circumstances, will not be very great. Our experience to date with the Postal Air Service has shown that the cost far outweighs any possible advantages. A machine to be successful in the Postal or Passenger Carrying Services must be large and have a large carrying capacity, thereby necessarily slowing down the speed and bringing it to the same plane as regards competition with the railroads, with none of the reliability and cheapness of the latter. However, I do believe that there will exist many special situations for which it can be used to great advantage.

3. Geological Survey, Mapping, Etc. Here it is believed a great future exists for the Air Service. Our Country is very largely unmapped in the true sense of the word. Accurate photographic maps can be made rapidly and cheaply provided the triangulating is done in advance by the Geological Survey. A greater need for maps has never been better shown than by the difficulties experienced by the Air Service in obtaining accurate maps of the country surrounding the aviation field. All squadrons not otherwise engaged could assist in this work, but there should necessarily be a large number of squadrons moving from place to place over the country doing no other class of work. Herein lies a great future for the Air Service and one in which it can be of value, not only to civil activities of the country but a very reliable and dependable force which, with the addition of some training, can be thrown into the field immediately upon the outbreak of hostilities.

Photo room, 91st Aero Sq.

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Col. Frank P. Lahm
Army Air Service Commander, Second Army

1. . . . I forward herewith:

(a) My recommendations concerning provisions that should be made in the United States for after-war Air Service . . . .

(b) Recommendations as to changes in Air Service Tables of Organizations . . . .

1. The Air Service of the U.S. Army to consist of:

For Garrison Duty in U.S. and overseas possessions:

4 Observation Squadrons
4 Balloon Companies
4 Pursuit Groups (each of two pursuit squadrons & one park)
4 Bombing Squadrons
8 Photo Sections (for the 4 Observation & 4 Bombing Squadrons)

Total permanent squadrons maintained at full strength—16

Total permanent Photo Sections maintained at full strength—8

Total permanent Balloon Companies maintained at full strength—4

Total permanent Parks maintained at full strength—4

Training Cadres:

For 16 Infantry training divisions:
16 Observation Squadrons
16 Photo Sections
16 Balloon Companies

For 4 Cavalry training divisions:
4 Observation Squadrons
4 Photo Sections
4 Balloon Companies

For training of Corps Troops:
4 Observation Squadrons
4 Photo Sections for same
4 Balloon Companies

For training with Coast Defense Training Cadres:
8 Observation Squadrons
8 Photo Sections
8 Balloon Companies

For training in pursuit work:
4 Groups, each Group consisting of 2 squadrons & 1 park. Total—8 Pursuit Squadrons

For training in bombing:
4 Bombing Squadrons
4 Photo Sections
Total of Training Cadres:
32 Observation Squadrons
8 Pursuit Squadrons
4 Bombing Squadrons
or
44 Squadrons
4 Parks
36 Photo Sections
32 Balloon Companies
Aggregate of the permanent forces and training cadres:
60 Squadrons
8 Parks
44 Photo Sections
36 Balloon Companies

Each Squadron, Company or Section at full strength to consist of the following:

Observation Squadron:
27 Officers
130 Men
12 Planes
Pursuit Squadron:
20 Officers
180 Men
18 Planes
Bombardment Squadron:
40 Officers
180 Men
18 Planes
Park Squadron:
6 Officers
180 Men
Balloon Company:
8 Officers
170 Men
1 Balloon
Photo Section:
0 Officers
12 Men

Each training cadre to consist of the following permanent personnel:

Observation Squadron:
7 Officers
20 Men

Pursuit Squadron:
6 Officers
30 Men
Bombardment Squadron:
8 Officers
30 Men
Park Squadron:
2 Officers
30 Men
Balloon Company:
2 Officers
30 Men
Photo Section:
0 Officers
4 Men

In addition to the foregoing, there will be necessary school detachments at the various aviation schools which may later be determined as necessary for the instruction of candidates training as pilots and observers.

While it is realized that it is objectionable to disperse the Air Service, particularly the pursuit and bombing which are in small numbers, at the same time it is believed necessary for the Army as a whole to become acquainted with all forms of the Air Service, not only observation, but pursuit and bombing as well. Furthermore it is believed that the pursuit should be where it can work with observation squadrons and also with bombing squadrons, consequently at one point in each of the four Corps Areas there should be:

1 Observation Squadron, with its Photo Section
1 Balloon Company
1 Pursuit Group of two squadrons, with its Park
1 Bombing Squadron, with its Photo Section, all under the command of an Air Service Officer of suitable rank.

2. Training.[a] Men to be trained as pilots or observers will be selected from volunteers who possess the necessary physical and educational qualifications.

The United States will be divided up into three districts for the purpose of assigning Air Service candidates to training schools.

1st: The East—With a school at Langley Field, Virginia.
2nd: The Center—With a school in Texas.
3rd: The West—With a school in Southern California.

Langley Field at Hampton, Virginia, for the Eastern District, Ellington Field at Houston, Texas, for the Central District and Rockwell Field at San Diego, California, for the Western District, are already built and ready for use. If sufficient space is not

available at Langley Field for the number of men to be trained in the Eastern District, use can be made of the fields at Arcadia, Florida, to which should be sent all the men to be trained from the Southeastern States, those from the Northeastern States going to Langley Field at Hampton, Virginia.

Assuming that the following personnel must be trained each year:

320 Observation Pilots
320 Observers
128 Pursuit Pilots
64 Bombing Pilots
64 Bombing Observers,

all bombing pilots and observers would report to Ellington Field, Texas, for instruction, pursuit pilots would be divided one-third or approximately 43 at Langley, Virginia, one-third at Ellington, Texas, and one-third at San Diego, California.

One-third of the observation pilots and observers or approximately 107 pilots and 107 observers would report at each of the three fields, i.e., at Langley Field, Ellington Field and Rockwell Field.

All pilots and observers should be men of the class to be called to the colors during the year, should be volunteers for aviation, and should report at the various schools on January 10th.

By April 1st there would be sufficient time to determine which are unsuited for aviation. These should be eliminated and should report for duty with their class which begins its training in divisions on April 1st.

The training of flying personnel should be divided into three periods:

1st: Ground School & Preliminary Flying—January 10th to April 30th (3-2/3 months)

2nd: Specialized Training & Gunnery—May 1st to July 31st (3 months)

3rd: Work with Unit—August 1st to October 31st (3 months)

It is believed that the best results will be obtained by concentrating in a few large schools and combining various kinds of training at one place rather than by having separate schools for ground school training, preliminary flying, specialized training and gunnery. The latter system was necessary when we were turning out large numbers of students in a minimum length of time.

It is believed that flying and theoretical training should be carried on at the same time as the student can fly but a limited number of hours in the day.

German observation post.

It is further believed that the preliminary training of all flying personnel should be the same, as it is to consist largely in disciplinary training and the elements of aviation.

I believe that 9-2/3 months, or the time from January 10th to October 31st, is sufficient for training Air Service flying personnel and that it is not necessary for them to report November 1st. If the training began on November 1st, it would be interrupted by the holidays and, as many candidates will come from a long distance it would be impracticable for them to return to their homes without using up a considerable length of time. On the other hand, by reporting January 10th, all Air Service candidates, as well as the permanent instruction force, would be better prepared to start the year's work.

On November 1st, pilots and observers trained that year, pass into the First Reserve. The following year, i.e., during their 21st year, they report to the Division, Corps and Coast Defense Training Squadrons on September 1st, for a month and a half of training. In their 22nd year they report to these same squadrons on August 1st, for a month's training, in their 23rd year they report on July 1st, in their 24th year they report on June 1st. On November 1st, of their 24th year, they pass into the Second Reserve, remaining their until the completion of the calendar year containing their 31st birthday. No further service will be required in either Reserve except in emergency.

The above plan contemplates maintaining in the four Corps Areas into which it is assumed the United States is divided:

4 Training Pursuit Groups, each of 2 Pursuit Squadrons & 1 Park.

In the same way each Group Area would have:

1 Training Bombing Squadron.

The schools should be utilized after July 31st, i.e., after the departure of the year's class to its units, for training pilots and observers for the permanent personnel. In general it is believed that the permanent personnel would be supplied from the temporary personnel that would apply for transfer. These applications might be expected from men of the First Reserve at any time up to their 25th year and would cut down by just that many the number that would return for their month's training in the training squadron.

The same general plan would be followed in training enlisted men with the Air Service. Their instruction, if practicable, should be carried on at the same three training centers and they should go to their training units the same as the pilots and observers, on August 1st. They should report during their 21st, 22nd, 23rd and 24th years the same as the flying personnel, thus mobilizing at full strength all the training squadrons beginning June 1st of

each year and lasting through until October 31st of each year.

Balloon personnel should be trained according to the same general plan as the heavier-than-air personnel, utilizing the present Balloon Schools. There would be approximately 192 Balloon Observers to train each year. They should be divided between the three schools at Omaha, Nebraska, Arcadia, California, and Camp John Wise in Texas. This would give approximately 64 Officers at each. While the three heavier-than-air training centers are selected in parts of the United States where weather conditions in winter are particularly favorable, this is not true in the case of the Balloon School at Omaha. However, I believe that past experience has shown that balloon work can be carried on at Fort Omaha in the winter time. In the case of balloon training the severe climate of the northern part of the United States is much less of a detriment than in the case of aviation training.

3. Relations with G-2. The British system of handling information has been in effect in the A.E.F., and we have had the opportunity of comparing it with the French system. I have seen this question, first from the view point of the Army Staff during the time I was assigned to G-3 of the First Army in the Chateau Thierry, St. Mihiel and Argonne Offensives and later as Army Air Service Commander of the Second Army during its operation on the Toul Front. I do not believe the system we have used is successful as far as its relations with the Air Service are concerned. When the Staff, particularly the Chief of Staff and G-3, want information during operations they want it at once, and have not time to apply for it through G-2. As a matter of fact, information gathered by the Air Service was transmitted to G-2 but also directly to G-3, and this was a necessity. In the same way, when G-3 wanted information procured by the Air Service, it applied directly to the Air Service and not to G-2. Our plan calls for reconnaissance missions being given by G-2, but in order to make it practicable for G-3 or the Chief of Staff to secure information more quickly, command airplanes were placed at their disposal. This is simply beating around the bush.

In some Corps the only missions given by G-2 were photographic missions, the Group Commander prescribing all visual reconnaissances on his own initiative or by direction of the Corps, usually the Corps Chief of Staff.

The argument that information furnished by the Air Service is not complete and should be carefully weighed and considered with information from other sources before being acted upon, is not sound. In fixed warfare in a quiet sector, this plan could be followed, but not during mobile warfare when conditions are

rapidly changing. Under these circumstances information provided by the Air Service relative to the location of the enemy, his numbers and activities, must be acted upon by G-3 without stopping to compare it with information from other sources. The latter is desirable and should be done and is a function of G-2; the studies made by G-2 should then be transmitted for use by G-3, but action by the latter cannot and need not be held awaiting G-2's reports.

The further argument that the Air Service is no longer interested in information of the enemy after it has been secured, is not sound. That is the Observation Air Service's most important duty and is to it, intensely interesting.

It is reasonable to expect the one who assigns a mission to know how it should be executed and that the one who executes a mission should understand what will be done with the information he secures. Missions are given by representatives of G-2 who are not familiar with the Air Service and who are not qualified to prescribe them. Observers on their return from reconnaissances are questioned by a B.I.O. who is not a flyer, who is not capable of intelligently asking questions to bring out what the observer has seen and, moreover, the observer knows this and is not so likely to respect his interrogator as he would if he knew the latter was conversant with what he was talking about. The B.I.O. or rather the one who questions the observer on his report of a reconnaissance, should himself be an expert observer, preferably the senior or oldest observer in the squadron. He should be a flyer and should frequently go into the air to study the ground on which he is to receive reports.

4. Organization.

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I recommend that armorers be Air Service personnel and not attached from the Ordnance Department.

Rifles should not be provided for Air Service Enlisted Men except truck drivers. In time of war mechanics do not have time to care for rifles and have little or no use for them. All officers and men (except truck drivers) should be armed with the pistol and instructed in its use.

I recommend that *all Enlisted Men* be instructed in the use of the machine gun. Lewis guns are available in all but pursuit squadrons and the latter should be issued 3 for instruction purposes. The increasing importance of the machine gun makes it expedient that all officers and men should be familiar with its use. Officers receive gunnery training as part of their regular instruction—Enlisted Men do not, consequently the above recommendation.

Engineer Officer. Unless the Engineer Officer is a well trained technician, he will devote his time simply to collecting, compiling and forwarding reports and to assisting in securing supplies which are properly the function of the Adjutant and Supply Officer.

Engineer Officers should be graduates of Technical Schools who have afterward specialized on airplanes and motors. In an old squadron long used to its equipment the mechanics under the direction of the Flight Commanders are probably capable of handling all engineering difficulties and Squadron Engineer Officers are not necessary, the Group Engineer Officer being sufficient. Until we have standard equipment and are sure of the ability of our Enlisted Mechanics, the Squadron Engineer Officer should be retained but should be a man more highly trained than the average we have had in France.

Machine shop, Issoudun.

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Col. Frank P. Lahm
Army Air Service Commander, Second Army

I send herewith the report called for on January 10th . . . . I trust that it is all you want, if not, write to me and I will be glad to supplement or add to it anything that is desired.

I must apologize somewhat for the haste with which the "After the War Activities" was gotten up as I have had a lecture to write and other matters which have come about the same time.[a]

This expresses my general views on the subject, the salient points of which are:

1st: Schools to be concentrated and in parts of the United States where climatic conditions will interfere least with the training. For instance the excellent climatic conditions of St. Diego [sic] are equivalent to having a larger field and larger training forces at a point such as Mineola, as the number of hours in the air during a given period will be so much greater.

2nd: The Air Service to be with the Army and become acquainted with it. This applies not only to the observation but to the pursuit and bombing as well. A large part of the Army will never know there is such a thing as a bombing or pursuit squadron unless we put some out for them to see. That is the reason I recommend putting pursuit and bombing squadrons in the four Corps Areas.

3rd: Having aviation of different kinds work together and become acquainted. For that reason I put observation, bombing and pursuit together in each of the four Corps Areas so that they may cooperate as they are required to do in time of war.

I have made no provision for additional personnel that should be put into training beginning January 10th to allow for the ones who will be eliminated by April 1st. In other words there will be lacking to fill the training squadrons to their maximum number, just the number that are eliminated during the first part of the training period. As a matter of fact this probably will give an opportunity for training worthy enlisted men who thus would have the opportunity for promotion to commissions and the positions of pilot and observer after the requisite examination.

There is no doubt a great future for the Air Service in the Post Office Department and in Mapping. Whether this should come under the direction of the Director of Military Aeronautics or whether all aviation, both civil and military, should come under a separate department of aeronautics of the Government, is a question to be determined. Personally I rather think they should be separate in time of peace and in time of war the

military should draw on the trained civilian aviators who would then be available for mobilization. In the same way certain industries are civilian in the time of peace but are militarized in time of war.

In any event I am still satisfied that the Air Service has a great future before it.

Trust you will let me know what further you want and assuring you that it will be cheerfully furnished. . . .

P.S. My plan is based on Gen. Pershing's "Military Policy" which designates 4 corps areas in the U.S., with 16 training divisions.

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Col. Thomas DeWitt Milling
Army Air Service Commander, First Army

1. All plans for the reorganization of the Air Service should be correlated with the reorganization of the Army as a whole. The Air Service is of value to the military establishment only insofar as it is correlated to the other arms. Ignorance of the functions of the Air Service, its possibilities and limitations, which has prevailed on the part of most line officers throughout the war, has been one of the heaviest tactical handicaps under which the Air Service has labored. Unless the Air Service problems are considered by the General Staff as problems of the Army, the gulf that has hitherto existed between the Air Service and the remainder of the Army will not be bridged.

2. Since the plan for the reorganization of the Army is not known, no attempt will be made to base these suggestions upon that plan. . . .

(l. to r.) Lt. Col. William C. Sherman, Col. Thomas D. Milling, and Lt. Col. John Paegelow.

2. Since the plan for the reorganization of the Army is not known, no attempt will be made to base these suggestions upon that plan. . . .

3. The question of organization of the Air Service for work with our seacoast defenses of the continental United States, Hawaii, the Philippines, and the Canal Zone is not entered into as these questions have not come within the experience of members of the Air Service of the American E.F. during the past 2 years, and it is believed that those who have been engaged on such work are better able to handle the subject.

4. The war has clearly demonstrated one thing that was always clear to those who have been connected with the Air Service for some years and that is that regardless of the money available for creating and expanding such an arm the expansion of it, due to industrial reasons chiefly, will take its allotted time for development and on the whole is a slower process than the expansion of other arms of the service. It must be borne in mind that a service airplane represents the acme of human engineering and scientific achievement and that its development and production cannot be extemporized within a few weeks.

5. Based on the above fact, a professional Air Service should be maintained that is larger in proportion to the Army than is commensurate therewith. Due also to the fact that the prime use to which the Air Service in its present stage of development lends itself is land warfare, the creation of a separate Air Service combining all branches of the Government pertaining to aviation is not recommended for the following reasons:

(a) If such a service is formed, it will undoubtedly be placed under a civilian head, as a consequence of which the continuation of the development of aviation from a military standpoint will undoubtedly be subservient to its development commercially. By this is not meant that the commercial end should be neglected. Considering, however, as stated before, that a service airplane represents the acme of human effort, and also that as a general rule a commercial airplane may be considered as entirely different and inferior to those of military types, it is believed that the commerical types will be attained in our efforts to develop the best types of two and multi-place airplanes. As a general rule, it may be considered that the development of those of commercial type, and also those for coast defense or naval use, will take place with those for military development. In this connection, it may be stated that while the development of commercial aviation by civilian firms will afford some help, it is not believed that commercial aviation possesses great possibilities for the development of military aviation.

(b) When aviation has reached a stage of development for commercial use, it may be safely assumed that sufficient private capital will be forthcoming to support it.

(c) Aviation has not yet reached the stage where it can be efficiently employed in naval warfare. Under our present organization, different from other powers, in which our Coast Artillery forms part of the Army, we have been charged with the development and maintenance of machines for water flying. Up to the present time, the principal basis of all appropriations for naval use have been for coast defense purposes.

6. An experimental field should be established by the Army Air Service for the development of all types of airplanes, motors, aviation material and accessories. This should be available to civilian firms and engineers in developing new and untried inventions. In connection with this plant, a practical school for aeronautical engineers should be established for the completion of training of our Army aeronautical engineers.

7. The personnel should be of three general classes: first, a permanent body of regular officers with commensurate rank for all higher commands and staff work; second, regular officers detailed in the Air Service for duty as pilots, squadron and group commanders; third, officers in reserve corps to be called to active duty or not depending on the exigencies of the service. Easy provision should be available to retire the first class with three-quarters pay when they become useless to the service; to relieve and send back the second class to their branch at any time; and to discharge the third class when deemed necessary. It is also recommended that the present rate of increase of flying pay be retained but that no increase of rank for the pilot rating be allowed. Special schools similar somewhat to our line and staff schools should be established for the instruction and development of regular officers in the command and employment of the Air Service.[a]

8. All Air Service officers should be pilots or observers. Exception should be made only for nonflying officers who have served satisfactorily during the war and who express at the present time a desire for commission in the Reserve Corps. This opinion is due to the fact that it will build up esprit and will make for efficiency inasmuch as a flying officer cognizant of the problems of aviation is a more efficient Air Service administrator (Adjutant, Supply Officer, etc.) than an officer to whom the peculiar problems of aviation [are] foreign.

Present indications lead to the belief that commercial aviation, aerial mail carrying, etc., will not provide a large number of pilots suitable for military purposes, as it is considered doubtful whether they would possess the necessary qualifications for

receiving commissions in the Army. Since the Air Service can select its personnel from a large number of applicants, definite standards must be maintained to exclude "aerial chauffeurs" who are neither desirable as officers nor are capable military aviators in time of war.

9. The United States should be divided into [a] number of training areas where flying fields should be established near the centers of population and properly equipped. These will be available for training reserve pilots and will provide facilities for those reserve officer pilots not on active duty to fly throughout the year, this is in addition to the period each year when they will be called to active duty. Experience has shown that facilities of this nature will be taken advantage of without compulsion, especially on Saturdays and Sundays.

10. The Reserve Air Service should be organized into squadrons, groups, and wings, and the flying material for these units should be maintained at all times in addition to the material necessary for training. As this material becomes obsolete, it can be utilized for training purposes when replaced by up-to-date equipment. It is realized that this policy entails great expense but unless industrial facilities are utilized in time of peace in the design and production of service types of military airplanes, these will not be forthcoming in time of war.

11. In conclusion, it is recommended that the highest possible standard of personnel be maintained and that the fact be faced squarely that without the expenditure of large amounts of money in the development of strictly military types of airplanes, an adequate Air Service cannot be created.

Part II
U.S. Bombing Survey

Part II:
U.S. Bombing Survey

Introduction

The reports on lessons learned were only a small part of the vast collection of material that Gorrell assembled at Tours during the first weeks of 1919 for the "History of the Air Service, AEF," and General Patrick's "Final Report." As this pile of papers grew day by day, Gorrell realized that something was lacking. Remembering his days in the Strategical Section and his plans for a strategical bombing program, Gorrell wanted to find out what effect aerial bombing had had on the enemy.[1] For that information, he turned to the Intelligence Section (G-2) of GHQ, AEF.

Brig. Gen. Dennis E. Nolan, Assistant Chief of Staff G-2, designated Capt. Emery A. Greunke and 1st Lt. L. J. LeTourneau of the Air Intelligence Section (G-2, A-7) to supervise the work of obtaining data for the project. The task, Nolan said, was "to secure as complete and reliable information as possible upon which the Air Service may base its future bombing plans."[2]

The First Army was asked to assign men to report to Greunke. The acting G-2 of First Army, Capt. Donald S. McWilliams, noted that the area where much of the bombing had been done

The damage above, caused by a 230-lb. British bomb, was termed "considerable" by World War I assessments.

had formerly been occupied by the First Army but had since been turned over to the Second Army. McWilliams suggested that the request for people be sent to Second Army.

When the request was made, Lt. Col. Charles F. Thompson, Second Army G-2, opposed the assignment of Second Army personnel to the project. He thought that information concerning the effects of bombing was no longer available. Thompson, however, was the only officer Greunke met who thought the investigation doomed to failure. A visit to Trier and Coblenz satisfied Greunke that the information could be obtained. If G-2, GHQ, AEF, could not get the German-speaking officers needed for the investigation, Greunke thought that the project should be turned over to the Air Service so Air Service personnel could carry on the investigation.

Noting the difficulty that G-2, GHQ, AEF, had had in trying to find the large number of German-speaking personnel required for the job, Nolan suggested to the Air Service that the Air Service take over the project. Instead, the Air Service detailed officers from various units to work with Greunke. These included 2d Lt. Richard W. Bonneville, A.S., Ferry Pilot, Orly; 2d Lt. Arthur A. Coleman, A.S., 22d Aero Squadron; 2d Lt. Otto C. Epp, A.S., 100th Aero Squadron; 1st Lt. Frank W. Letzig, A.S., Supply Officer, Third Aviation Instruction Center; 2d Lt. Henry T. Pratt, A.S., O.I.C., Machinery Department, 667th Aero Squadron; 2d Lt. Fred A. Spitznagle, A.S., Observer, 163d Aero Squadron; and 2d Lt. Robert Steinberger, A.S., Buyer, Procurement Division, Paris. Four other officers were obtained from other units of the AEF: 1st Lt. Marcus Thomas Bauch, Q.M.C., a member of a bakery company; 1st Lt. Harold J. Hotton, F.A., G-2, VIII Corps; 1st Lt. William S. Reid, Inf.; and 2d Lt. Theodore N. Beckman, Inf.

Twelve teams were formed, each consisting of one officer and two enlisted men (a photographer and a chauffeur). The Instructions given to the teams began as follows:

> The Allied Air Services have spent millions of dollars in preparing and executing a plan of bombardment against the industrial centers of Germany. The opportunity is now afforded to investigate just what amount of damage was caused and the value of this branch of the service in future wars.
>
> In order to gain this knowledge, a systematic investigation of the different towns is to be carried out . . . .

Detailed instructions were given as to what was desired. The information was listed under five headings: (1) General, that is,

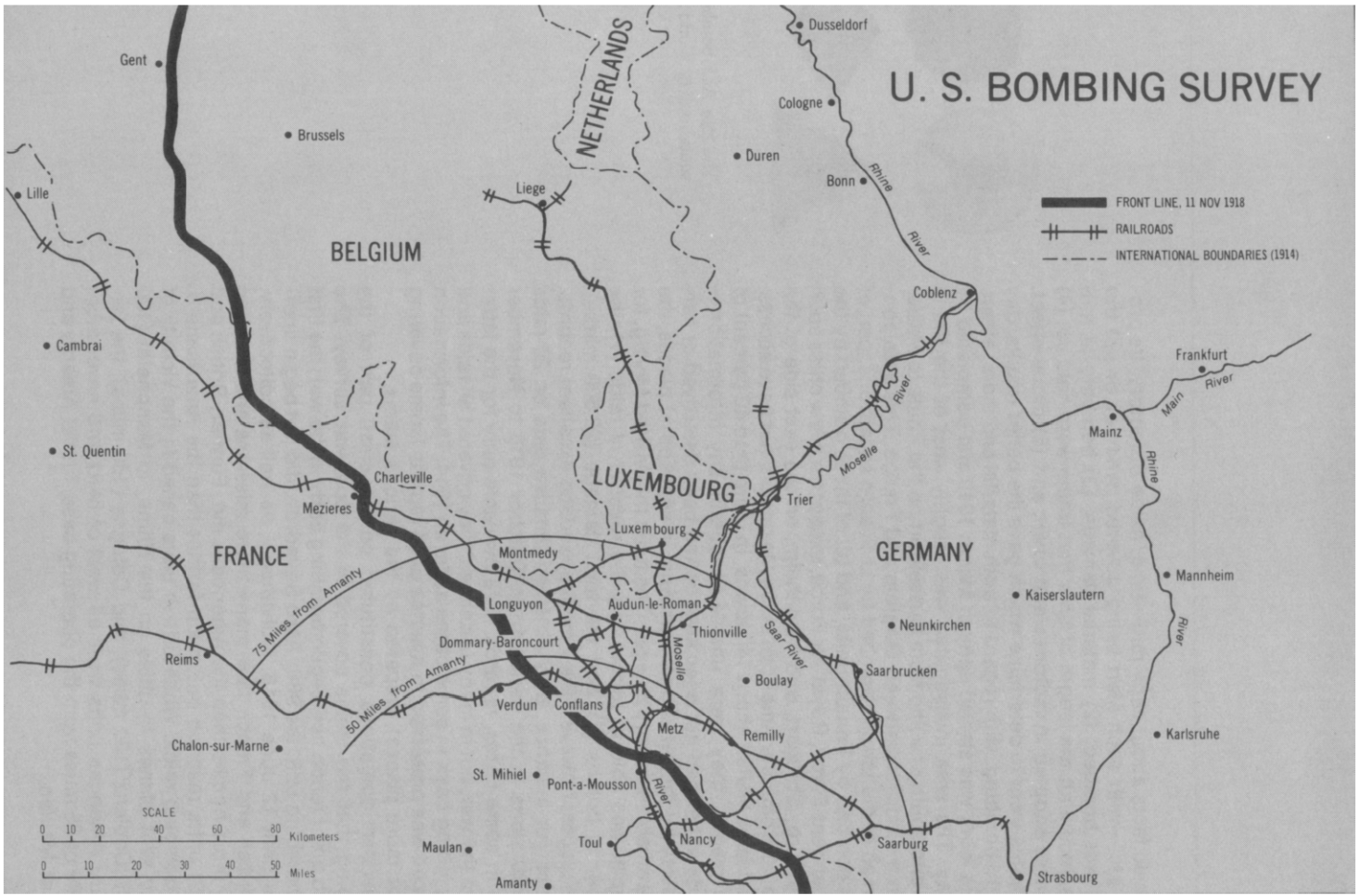
the basic facts about each raid—time, name of factory, its product, etc.—with each alert being covered, whether or not the place was bombed; (2) material damage; (3) bombing of railroads, including the length of time that trains were held up; (4) measures adopted in factories and town; and (5) moral effect. The teams were to determine which gave the better results, day or night bombing, with regard to both material and moral effect.

Field work was started early in March 1919 and completed by 20 May. The area investigated was roughly west of the Rhine River and south of a line from Dusseldorf on the Rhine to Mezieres on the border between Belgium and France. This area contained all of the targets bombed by U.S. aero squadrons, part of those bombed by French units, and all of those bombed by the Independent Force, Royal Air Force, except for a few cities such as Freiburg, Stuttgart, and Mannheim, on the east side of the Rhine, to which the American survey teams did not have access.

The teams visited about 140 towns. In more than 40 percent of these places, they were unable to obtain any information—records either had not been kept or had been destroyed or carried away by the retreating Germans. In some other places, the data available was very meager. The team that visited Merzig, for example, was able to report only the number of raids (1), the number of bombs (4), and the total damage (22,600 marks). Some places, however, the Americans found excellent records. At Trier, for instance, they obtained detailed data on 20 raids and 120 alerts in the period from October 1915 to November 1918. In some cases, records were available only for the latter part of the war, but in many instances, they covered all raids and alerts, going back in some cases as far as 1914. The information obtained was presented in a series of 65 reports (some covering two or more places) prepared by the various teams.

American operations constituted only a small part of the bombing that the teams covered in the post-war survey. The British and French had begun bombing early in the war; the first U.S. bombing unit, the 96th Aero Squadron, did not begin operations until 12 June 1918. Individually, as well as collectively, the British and French flew many more missions and dropped many more bombs than the Americans did. Further, British and French units reached out much farther than the Americans in their bombing raids. While British units based in the vicinity of Nancy sent planes to cities on the Rhine, to Mannheim (120 miles), Coblenz (130 miles), and Cologne (160 miles), the targets for American units were all west of Metz and never more than 60 or 65 miles from the operating base, first at Amanty and later at Maulan.

The four AEF bombing squadrons of World War I.


U. S. BOMBING SURVEY
FRONT LINE, 11 NOV 1918
RAILROADS
INTERNATIONAL BOUNDARIES (1914)
NETHERLANDS
BELGIUM
LUXEMBOURG
FRANCE
GERMANY
Gent
Brussels
Lille
Liege
Dusseldorf
Cologne
Duren
Bonn
Rhine River
Coblenz
Cambrai
St. Quentin
Charleville
Mezieres
Luxembourg
Trier
Moselle River
Frankfurt
Main River
Mainz
Rhine River
Mannheim
Kaiserslautern
Neunkirchen
Saar River
Saarbrucken
Boulay
Montmedy
Longuyon
Audun-le-Roman
Thionville
Moselle
Dommary-Baroncourt
75 Miles from Amanty
50 Miles from Amanty
Reims
Verdun
Conflans
Metz
Remilly
Chalon-sur-Marne
St. Mihiel
Pont-a-Mousson
Toul
Nancy
Saarburg
Strasbourg
Karlsruhe
Maulan
Amanty
SCALE
0 10 20 40 60 80 Kilometers
0 10 20 30 40 50 Miles

Between 12 June, when it began operations, and 12 September, the beginning of the St. Mihiel offensive, the 96th Aero Squadron dispatched 278 sorties on 35 missions and dropped about 60,000 pounds of bombs. The targets were railway stations and yards at Conflans, Longuyon, Dommary-Baroncourt, and Audun-le-Roman, all west and northwest of Metz. In September 1918 the 96th Aero Squadron was joined by two more squadrons, the 11th and 20th, which were formed into the 1st Day Bombardment Group. During the Battle of St. Mihiel, their attacks were directed against German troop concentrations immediately behind the lines, with lines of communication, including bridges and bridgeheads on the Moselle, as secondary objectives. Later, in October, another squadron, the 166th, joined the 1st Day Bombardment Group. During the Meuse-Argonne Campaign the group continued to direct its main effort against troop concentrations, with lines of communication its secondary objectives, until the end of the war. During the entire period of American operations, the 96th, 11th, 20th, and 166th Squadrons, the only American bombing units that saw combat during the war,[3] dropped a total of about 275,000 pounds of bombs.

After the war, the American survey teams attempted to obtain data on the effects of bombing attacks that American squadrons had made on troop areas in the Argonne in the last days of the war. Unfortunately, local records were not available. These areas had also been under artillery fire, and without local records it was impossible to determine what damage had been caused by aircraft and what had been done by artillery. Consequently, most of the raids covered by the survey were made by British and French units engaged in operations against industrial or communications targets some distance behind the lines. Only eight places covered by the bombing survey reports —Conflans, Dommary-Baroncourt, Longuyon, Montmedy, Gorze, Corny, Bayonville, and Arnaville—appear on the AEF's map of places attacked by American bombing squadrons.[4]

In addition to the 65 reports compiled by the 12 teams, the full report of the survey includes narrative and statistical summaries, evidently prepared in G-2, A-7. The last two sections of the narrative summary are of especial interest, one being a criticism of bombing as it was done during World War I, the other some suggestions for the future.[5]

Reports

—1—

Metz
Railroad Stations

Metz, situated at the confluence of the Seille and the Moselle Rivers, was conquered and fortified by the Romans, sacked by Attila the Hun, taken by the French in the 16th century, beseiged and captured by Prince Frederick Charles in 1870, and made part of Germany with the annexation of Lorraine at the end of the Franco-Prussian War. Heavily fortified, Metz had a place in the defense of the German frontier similar to that which Verdun, some 35 miles to the west, occupied in the defense of France in pre-World War I military plans. One of the important military installations in the Metz area during the World War was Frescaty airdrome, southwest of the city, a target frequently attacked by French and British bombers.

Metz also was the center of the great metals industries of Lorraine. To the north and west, in the region around Briey, were mines that produced 80 percent of the iron ore used by German industry. Some ore was smelted locally, but much of it was shipped to the Saar, where there were coal mines to provide fuel for blast furnaces and foundries. The metals industry depended on a vast network of railroads radiating in every direction from Metz. In addition to carrying ore and pig iron and coal and steel, trains on these lines hauled troops and supplies for German armies on the Western Front.

Disruption of traffic in this rail system was one of the chief objectives by French, British, and American bombing operations. The targets selected for attack were mainly railway stations, particularly those at important junctions. Three stations at Metz were targets for Allied bombers. The main station was at Sablon, where the various lines converged in the southeast part of the city. Another was in the west end, at Montigny, near where the rail line running westward to Conflans and Etain crossed the Moselle. The third was at Woippy, just north of Metz on the line to Thionville and Luxembourg. The following report, prepared by the American team that visited Metz to investigate the effects of Allied bombing, is concerned with raids on the Sablon and Montigny stations.

Resume of Results of Bombing

Number of Raids	92[a]
Number of Bombs	1,187
Number of Duds	124
Number of Killed	50
Number of Wounded	57
Number of Hours Lost Due to Raids	98 Hrs. 15 Min.
Damage to Railroad Buildings at Metz	615,000 Francs
Damage to Locomotive and cars	1,004,000 Francs
Damage toTrucks	36,000
Damage to Railroad Building at Montigny Station	60,000 Francs
Damage to Locomotives and cars at Montigny Station	35,899.10 Francs
Number of Locomotives Damaged	14
Number of Cars Damaged	287
Bonus per month to Railroad Employees	100 Francs

Four hours is the average time required to repair tracks when a direct hit is made.

The continuous bombing of Metz had a tremendous effect upon the morale of the workers and civilians. They lived almost entirely in their cellars and it was stated that should the bombing have continued a month or so longer, it would have been impossible to keep employees at their duty.

A crew of 250 civilians as well as several hundred soldiers were kept on hand to repair the damage from bombs.

.....

—2—

Conflans

The place most often and most heavily attacked by U.S. bombing squadrons was Conflans, some 15 miles west of Metz. There, the rail line from Metz to Etain crossed the line from Charleville to Nancy. From Conflans, a narrow gauge track ran to Briey and Audun-le-Roman, the latter being another rail center on the target list for American bombing units.

In the first 3 months of American bombing operations in France (12 June-11 September 1918), the 96th Aero Squadron, the only U.S. bombing unit in combat during that time, dis-

Breguets of the 96th Aero Squadron.

patched 15 missions (119 sorties) to this target. On another occasion, on 4 September, the 96th dropped its bombs at Conflans when weather made it impossible to attack the assigned target, another rail station, at Dommary-Baroncourt. Later, during the Battle of St. Mihiel, the 96th and other squadrons of the 1st Day Bombardment Group flew three more missions to Conflans. In these raids, U.S. units dropped a total of about 39,000 pounds of bombs at Conflans. Unfortunately, the team sent there to collect information about bombing by U.S. and Allied units was able to obtain very little, for the reason given in the report which follows.

The following information is obtained from the Mayor, and French workers employed at the railroad yards during the occupation of Conflans by the Germans.

No official figures as to the amount of damage done could be obtained owing to the fact that this information was taken into the interior by the retreating forces. It was stated that during the 10 days between Sept. 12 and Sept. 22, 1918, when long range artillery was especially active, that more damage was done than by all the previous bomb raids combined, the range of the guns being very accurate.

Damage:

Water tank and purifier. . . .

Round house struck by one bomb, all windows broken and roof partly destroyed. . . .

Damage to interior of round house. . . .

Side tracks and yards were repeatedly hit by bombs but caused very little damage.

Traffic was delayed only to the extent of about half an hour when the yards and side tracks were hit, owing to the large number of tracks making it possible to switch trains around.

Whenever the main track was hit, which happened only once, traffic was held up for about two hours. All traffic was held up for 15 minutes to half an hour during every alert which was given.

One company of pioneers, consisting of about 250 men, together with 50 or 60 Russian prisoners and approximately 100 French civilian laborers, were kept on hand for repair work.

Conflans was protected by 3 anti-aircraft batteries, and numerous searchlights, as well as by neighboring pursuit squadrons such as Richthofen's Flying Circus during the last part of the war. As far as admissions were made by employees at the time of this investigation, very little effect on the efficiency of the employees was caused by repeated bombardments.

—3—

Dommary-Baroncourt

Dommary-Baroncourt, 14 miles northwest of Conflans, was on the main rail line between Charleville and Nancy, at a junction of a branch line to Audun-le-Roman. The rail yards there were the target for the 96th Aero Squadron on its first mission, on 12 June 1918. The 96th made several more attacks during August and early September, but American bombers were not sent to Dommary-Baroncourt after the beginning of the St. Mihiel offensive on 12 September 1918. The bombs dropped by American airmen at this place totaled about 15,000 pounds.

The following information was obtained from civilians working here during the German occupation. Diaries were kept at first but their holders were held as spies and were obliged to destory them.

No official figures as to the amount of damage done were obtainable owing to the fact that they had been taken into the interior of Germany by the retreating forces.

Damage:

1 store house, 50 meters by 15 meters, filled with grain, entirely destroyed.

Hits on railway track destroyed provision train.

Pioneer encampment hit, killing one officer and 3 men.

Three lines cut, numerous cars destroyed as well as damage to railroad storehouses and machine shops.

Longuyon-Conflans line cut; troops were obliged to detrain outside of town and walk a considerable distance to the train on

Pilots and observers of the 96th Aero Squadron gathered for a briefing (above) prior to the bombing mission to Dommary-Baroncourt on 12 June 1918. The lead plane (below) was flown by Major Harry M. Brown, commanding officer of the squadron.

the other side of the break. This line was repeatedly cut following Sept. 12, 1918, delaying the regular schedule for 20 days.

Trains were very much retarded by continual bombardments, there being only one line to Longuyon and also but a single line to Conflans and Audun-le-Roman.

. . . . . .

The damage done in the yards did not hold up traffic to any great extent, repairs being completed in from one-half to one hour. When the main lines were struck during September, 1918, traffic was held up for about 20 days, due to the almost continuous bombardment and the accuracy of the bombing. During "alerts" all personnel were forced to take refuge in bomb-proofs.

A special crew of pioneers, consisting of about 60 men, together with a few other laborers, were kept on hand at all times for repair work.

The town was provided with anti-aircraft batteries and searchlights and numerous bomb-proofs were built near the station.

The efficiency of the employees was materially affected by continual bombardments, and great fear resulted from the accuracy of the bombing.

—4—

Longuyon

Longuyon, 14 miles northwest of Dommary-Baroncourt on the rail line to Charleville, was another of the rail centers attacked by American bombing units. From Longuyon, there was a main line to Longwy and Luxembourg and a branch line to Audun-le-Roman. The team that visited Longuyon during the bombing survey obtained data on 18 raids during the period from mid-February 1918 until the end of the war. Eight of the 18 attacks were made by U.S. squadrons.

The first three bombing missions sent to Longuyon by the Air Service, First Army, were failures, the first one, on 26 June, because of mechanical difficulties, and the other two, cn 28 June and 5 July, because of weather. On the first successful mission, on 14 August, the 96th Aero Squadron dispatched nine planes, including two supernumeraries, from Amanty at 0830. Staying west of the St. Mihiel salient, the planes flew northward to Verdun before crossing the lines, and after the attack they came out the same way, thus holding to a minimum the time over enemy-held territory. One supernumerary turned back at the front. Three planes, unable to keep up with the formation, dropped out. Five reached the target. Noting that visibility was good, the 96th Squadron reported that "three bursts were observed on the tracks in front of the station, balance about station and among warehouses." Three enemy pursuit planes followed the bombers from Etain to the target and back to the lines. Shots were exchanged at long range without damage to the Americans. Two of the bombers were hit by shrapnel, but all returned home at 1105.

Another mission of nine planes was sent to Longuyon on 18 August, but because of weather all planes turned back before crossing the lines. Two days later another mission, seven planes, was dispatched at 1705. All crossed the lines and returned safely at 1920. Because of thick clouds at Longuyon, the Americans dropped their bombs on railroad tracks at Flabeuville, about 3 miles northwest of the station at Longuyon.

The following day, 21 August, the 96th Squadron dispatched nine planes to Longuyon at 1000. Six reached the objective.

Visibility was excellent. The squadron reported: "All bursts well bunched, on yards between station and locomotive repair shop."

On 25 August, 7 of 9 planes dispatched by the 96th Squadron in the afternoon reached Longuyon. "Bombs hit short of objective and struck northeast of railroad yards." Visibility was good.

Unable to attack Longuyon on 30 August because of high winds, the 96th Squadron dropped its bombs at Dommary-Baroncourt. On 2 September, bombs dropped by the 96th Squadron at Longuyon "fell short of objective and landed east of railroad yards." Visibility was excellent.

The next day, 3 September, nine planes took off for Longuyon. Two dropped out before crossing the lines. One developed motor trouble, dropped its bombs at Dommary-Baroncourt, and returned home. Six reached Longuyon, where members of the 96th Squadron observed "seven bursts on eastern end of yards on tracks to Dommary-Baroncourt; two bursts on locomotive repair shop, and two bursts observed on buildings northeast of repair shop."

The next attack, on 15 September, after the organization of the 1st Day Bombardment was flown by the 11th and 96th Aero Squadrons. Bursts were seen "on eastern edge of yards and among buildings."

Three squadrons, the 11th, 20th, and 96th, took part on 16 September in the last U.S. raid on Longuyon. The 1st Day Bombardment Group reported "four bursts in town."

The following information was obtained from the Sergeant de Ville who remained in Longuyon during the German occupation, from a French engineer who had taken notes on the damage done in this area, and also from a French civilian who kept a diary on all aerial bombardments.

Damage. (Taken from diary mentioned above).

Feb. 15/18. 10 P.M., 5 bombs fell on aviation park south of station.

Feb. 16/18. 10 P.M. Bombs fell at same place but damage small.

Feb. 18/18. Night. 6 bombs fell on a storehouse near baraquements,[a] destroying some grain, etc.

Feb. 19/18. 3 bombs fell in woods.

Feb. 26/18. 3 barracks destroyed near R.R. tracks and some men killed.

March 7/18. Bombs fell on tracks, small damage.

March 9/18. 5 bombs fell in the Bois des Sergeants and a granary was destroyed.

March 14/18. 9 bombs fell near bridge on route to Longwy.

March 18/18. Munition train hit by bombs, doing large damage.

Aug. 14/18. During the day 15 bombs were dropped near baraquements, one partly demolished. Also near station.

Aug. 20/18. Bombs fell on tracks near Vezin.[b] Trains held up about 45 minutes.

Aug. 21/18. 3 alarms during the day; at noon, bombs fell near water tank, destroying same. It is stated this was serious and all trains held up for many hours.

Aug. 25/18. Bombs dropped by about 12 planes but no results.

Sept. 2/18. 20 bombs fell near farm, small damage.

Sept. 3/18. 15 to 20 bombs dropped, some destroyed main line in depot. 3 locomotives destroyed near repair shop. It is stated trains were held up 3 or 4 hours.

Sept. 15/18. Bombs fell on private house; otherwise no damage.

Sept. 16/18. Tracks damaged slightly and probably took half hour to repair them; also believed that 9 locomotives were put out of commission.

Oct. 29/18. Many bombs dropped but no damage to R.R. 15 to 20 bombs fell on Longuyon.

Munition train hit on March 18, 1918, which, in turn, destroyed the station and surrounding buildings, also a train of soldiers and another train carrying aviation personnel and equipment. Also telephone and telegraph lines were destroyed.

Lines to Audun-le-Roman and to Nancy were cut, requiring 3 hours to repair. Special tracks were built to a nearby hospital where munition trains were parked during bombardments.

.....

One munition train was struck on March 18, 1918, making it impossible for trains to run for 2 or 3 days, and it took about 3 weeks to put the entire line in good condition again. The average time required to repair the tracks sufficiently for the trains to pass after bombs fell on the line was about one hour. Bombs dropped in the yard did not delay traffic to any great extent as trains were easily switched around on other tracks.

About 30 men were kept on hand for making repairs to telephonic and telegraphic equipment and about 30 men repaired the tracks. At the time the munition train was hit, 2000 men were employed in repairing the damage.

Four of five anti-aircraft cannon and searchlights protected the town. About fifty percent of the trains carried machine guns to be used against airplanes.

The efficiency of the employees was greatly affected, some engineers refusing to run their trains. Workmen and soldiers were very discontented, saying that they were obliged to work all day, and then were unable to get any rest at night.

Night bombing was found to be more effective than day bombing, as the machines could fly lower, thus dropping their bombs with more accuracy.

—5—

Montmedy

The only other rail target attacked by U.S. bombers and covered by the report of the post-war bombing survey was Montmedy, a town of some 2,000 people situated about 12 miles northwest of Longuyon. From Montmedy, on the main rail line between Nancy and Charleville, a branch line ran northeast to Virton, Belgium. American bombers attacked only once, on 4 November 1918. With 47 planes airborne, this was one of the largest missions mounted by the 1st Day Bombardment Group during the war. Thirty-seven planes reached their objective, dropping a total of 3,887 kilograms (about 8,500 pounds) of bombs between 1520 and 1537 hours. Reporting fair visibility, the crews said they observed bursts on the railroad yards, on a warehouse, and in the southeastern, southern, and southwestern parts of town. But neither this raid nor any of those by other units succeeded in disrupting rail traffic at Montmedy, or such was the information obtained by the team that visited the town after the war to survey the effects of Allied bombing.

The following information was received from the Maire of the town, who was there during the German occupation, the Sous-Prefect and various employees of the railroad.

Damage.

Depot de Revitallement destroyed, together with a quantity of grain (about 50 wagon loads).

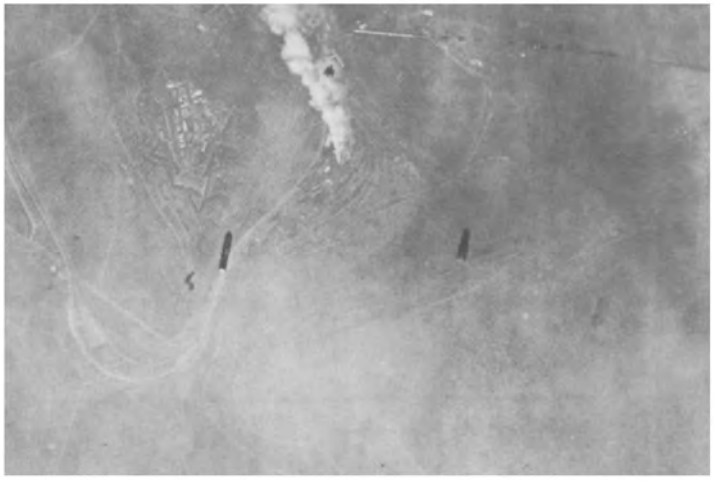
Completely destroyed a vegetable storehouse.

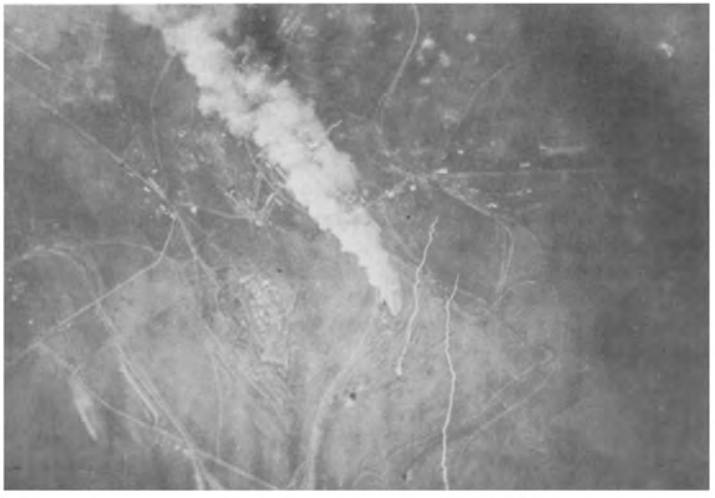
Two private houses destroyed.

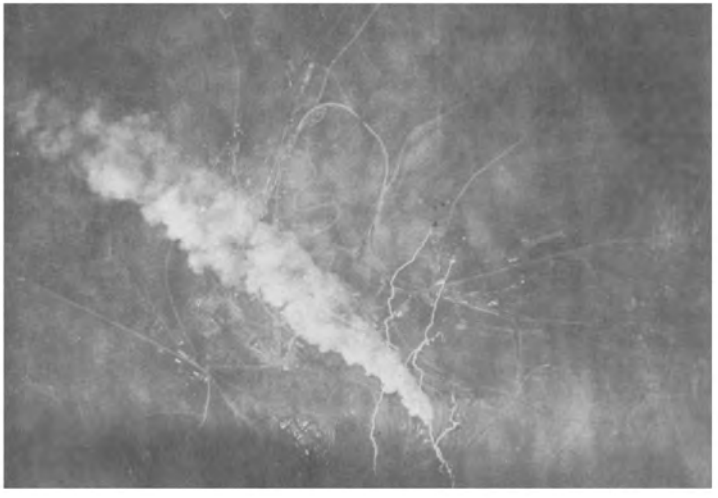
43 bombs fell on a hospital.

Magasin de Revitallement completely destroyed. (Valued at nearly 1,000,000 francs.)

Delay of Traffic. Trains were never held up in this town owing to no bombs having fallen on the tracks.







Sequence of aerial photos showing the bombing of Montmedy on 4 November 1918.

Special Repair Crews. About 400 men were kept on hand to do general repairing.

Protection. The town was protected by searchlights and six anti-aircraft guns.

—6—

Mars-la-Tour

Mars-la-Tour, west of Metz, was on the rail line that ran south from Conflans, through Chambley and Arnaville, to Nancy. It also was the site of an important German airfield.

The following information was received from the Maire of the town and an employee of the railroad who was in the town during the German occupation.

Damage.

Center of two principal tracks on Conflans-Chambley line; trains held up for two hours.

Telegraph and telephone lines and water main were cut, resulting in loss of communication for two days.

Aviation field near the town was bombed, all hangars and 13 airplanes being destroyed.

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Delay of Traffic. The average time required for making repairs was from 30 minutes to one hour, although at one time when the main tracks were hit, traffic was held up for two hours.

Special Repair Crews. Russian prisoners and French civilians were kept on hand for this work.

Protection. The town was provided with 8 anti-aircraft guns as well as 2 or 3 anti-aircraft guns mounted on autos.

Moral Effect. Loss of sleep during the night resulted in decreased efficiency.

—7—

Ars, Noveant, Corny, Arnaville, Bayonville, Gorze, Orny, Remilly, Courcelles

Information about Allied bombing of the following towns in the region south of Metz was presented in a single report:

Ars, a small industrial town on the Moselle, about 5 miles from Metz. The railroad from Metz to Nancy crosses from the right to the left bank of the Moselle just below Ars.

Noveant, about 4 miles south of Ars; German customs station before the war.

Corny, across the Moselle from Noveant, the two towns being connected by a suspension bridge.

Arnaville, the junction of the rail line from Conflans with that from Metz to Nancy. Before the war, the French customs station was nearby, at Pangy, where there was a bridge over the Moselle.

Bayonville, just west of Arnaville on the rail line to Conflans.

Gorze, about 3 miles north of Bayonville and the same distance west of the Moselle.

Orny, about 7 miles southeast of Metz.

Remilly (Remelach), southeast of Metz on the rail line to Saarburg. (Additional information about Remilly was submitted in a separate report, which follows.)

Courcelles-sur-Nied, on the rail line about half way between Metz and Remilly.

The towns and bridges on the Moselle were important targets for Allied bombing during the Battle of St. Mihiel. As noted previously, Corny, Arnaville, Bayonville, and Gorze were targets for U. S. bombing units.

Town	Damage (francs)	Protection (francs)
Ars	40,000	2,000
Noveant	70,000	
Corny	89,377	
Arnaville	58,000	
Bayonville	35,000	
Gorze	30,000	
Orny	3,700	
Remilly	36,000	6,000
Courcelles	74,306	230,000

—8—

Remilly

In making the survey of the effects of bombing, the American teams frequently obtained copies of German documents. The following, which makeup the report on Remilly (Remelach), were translated by G-2, A-2c (Press and Translations Branch of the Information Section, Intelligence Division), GHQ, AEF.

June 26, 1918.

At 2.30 a.m. bombs were dropped by several hostile planes on the stretch from Remelach to Metz, 100 meters north of the station. The track system was not damaged and no one was injured.

Hoffmann.

July 1, 1918.

At 11.30 p.m. bombs were dropped by hostile planes 300 meters to the right of the Remelach-Metz line. At 12.15, bombs were dropped 250 meters to the left of the same line, the number of planes and bombs could not be determined. The tracks were not damaged, and so far as can be determined, no one was injured.

Hoffmann.

July 2, 1918.

At 11.35 p.m. bombs were dropped 150 meters to the right of the Remelach-Metz line. The number of planes and bombs unknown. No damage was done.

Hoffmann.

July 12, 1918.

About 1.10 a.m. bombs were dropped about 150 meters north of the Remelach-Metz line. The number of planes and bombs unknown. No damage.

Hoffmann.

July 29, 1918.

About 11.30 p.m. one hostile plane dropped 4 bombs 150 meters to the right of the Remelach-Metz line. They were aimed at the railroad station. No damage.

August 17, 1918.

Air raid at 11.05 p.m. Number of planes unknown. Five bombs

dropped which fell 5 meters to the right of switch No. 5. The objective was the railroad station. No damage.

Hoffmann.

August 30, 1918.

At 11.10 p.m. enemy raid. Number of planes unknown. Seven bombs dropped fell in the immediate vicinity of the tracks between the railroad station and line 117. Objective railroad station. Damage unknown. No interruption to traffic.

Hoffmann.

August 31, 1918.

As determined today, in addition to the 10 bombs reported as being thrown last night, 11 others of the heaviest calibre were dropped. All of them fell about 50 meters to the right of the Remelach-Metz line. A hole was made 5 meters deep and 10 meters in diameter.

Hoffmann.

September 20, 1918.

Enemy air raid about 10.20 p.m. Number of planes unknown. Five bombs dropped, one of which destroyed a track on the Saarburg-Metz line, the others fell about 50 meters to the right of the railroad station. Track No. 2 out of commission for 6 hours, tracks Nos. 5 and 1, for 3 hours. Through traffic was shifted to tracks Nos. 6 and 7. No great damage done and no one injured.

Hoffmann.

September 21, 1918.

At about 11.15 p.m. 10 bombs were dropped 2 kilometers southwest of the railroad station, at about 11.35 six bombs were dropped about 300 meters east of the railroad station. Number of planes unknown. No damage.

Hoffmann.

Kurzel,[a] October 17, 1917.

About 11.53 p.m. immediately before the arrival of the local train No. 945, an enemy aeroplane dropped two bombs close to the right of the Kurzel-Remelach line, destroying the block and telegraph lines between Kurzel and Sanringen.[b] Connection was possible between Metz and Remelach by telephone and trains were reported by this method. Trains 144, 146, 150, 36 and 57 were late. About 2.43 traffic with Sanringen was restored.

Kerth.

Kurzel, October 17, 1917.

About 4.00 a.m. the track between Pelter[c] and the Remelach was torn up by an attack of about 20 enemy planes. Between Frontemingen[d] and Kurzel countless bombs fell in the vininity of the track. About 4.15 both main tracks between Kurzel and Frontemingen were damaged by a bomb. Traffic was interrupted. The track between Pelter and Kurzel could be used again by 5.30 and single track traffic was again begun. About 8.15 the Kurzel-Pelter track was in commission and double track traffic was resumed by local train 135 about 8.40. All trains until further notice received their orders to stop.

Kerth.

—9—

Maizieres

In the great industrial region north of Metz, there were many towns that provided excellent targets for Allied bombing planes. One of these was Maizieres, about 7 miles from Metz.

Number of raids: 17
Total damage to town: 62,009.17 Marks

—10—

Hagondange

Hagondange (Hagendingen), about 10 miles north of Metz, on the rail line to Thionville, was the center of the iron founding industry of the Orne Valley. The Americans who investigated the effects of Allied bombing collected information not only about Hagondange but also about Rombas (Rombach), on the Orne, 3 miles west of Hagondange (Report 11, below), and three other towns—Joeuf, Homecourt, and Auboue—farther up the valley (Report 12).

Other towns surveyed in the same general area were Uckange (Ueckingen), on the Moselle, about 4 miles north of Hagondange (Report 13), and Hayange (Hayingen), a short distance to the northwest, in the valley of the Fentsch, on the rail line between Audun-le-Roman and Thionville (Report 14).

Railroad Station[a]

22/7/17	2 bombs near tracks, Hagondange-Gendringen.
23/7/17	Kil 171.5, bombs 100 meters east of tracks.
24/7/17	Bombs fell between Maizieres and Woippy. No communication from trains.
4/9/17	Duds dropped on track #4.
4/9/17	Bombs fell near tracks between Richtung-Woippy.
5/9/17	5 bombs on steel works. 1 dud between tracks 14 and 15.
16/9/17	Direction of Gendringen at 10:00 PM. 3 bombs. 2 bombs between Bussingen and (?). All telegraph and telephone lines in direction of Gendringen cut off. First communication with Gendringen at 2.24 AM.
22/9/17	50/60 bombs in vicinity of station.
23/9/17	Passenger track between Machern-Hagendingen damaged. Gas pipe in the steel works and one house in Stalheim were hit. One child wounded.
17/10/17	13 bombs on steel works. Telegraph lines and windows destroyed. One person severely wounded and 3 others slightly wounded.
21/10/17	Bombs dropped on tracks between Roplingen and Moueuvre.
21/10/17	Bombs dropped on tracks Nos. 2 and 4, between Hagendingen and Mochern.
30/17/17	8 bombs dropped north and south of R.R. crossing Kil. 170.86. One car derailed and damaged. 8 wires broken. 3 bombs in steel works. No damages.
6/12/17	8 bombs dropped on steel works where the main gas conductors were hit; one started to work the same evening, the remaining furnaces not working until next day.
27/12/17	Bombs dropped on track #1, between Maizieres and Hagendingen.
14/1/18	Bombs fell on steel works.
19/2/18	10 bombs dropped in steel works. 10–12,000 marks damage. Canteen Schmitt very badly damaged.
15/3/18	At 11:50 PM, some bombs were dropped on steel works
24/3/18	4 bombs dropped on east side of station. Road bed damaged
15/5/18	Bombs dropped on station of Edingen.
24/5/18	12 bombs dropped south of R.R. station. One R.R. watchman slightly wounded; one peasant killed. Several telegraph lines broken.

8/6/18	Bombs dropped on steel works. One person severely and five slightly wounded.
9/6/18	Bombs dropped near freight station Kil. 171. Tracks Nos. 16 and 17 torn up. 3 cars derailed.
13/6/18	About midnight, 4 bombs dropped southeast of steel works; no damages.
29/6/18	5 bombs dropped on steel works Thyssen; only windows broken.
16/7/18	One bomb fell in steel works in eastern part of Thyssen. 2 soldiers wounded, some trucks damaged; also the switch at blocking place and switch #137 damaged.
15/8/18	7 bombs dropped on steel works Thyssen on and near an electric railway. Two Russians were killed. Traffic delayed a short time.
20/8/18	Bombs fell south of station, Kil. 169.900. Track torn up. 12 telephone wires broken.
21/8/18	Bombs fell on Uckingen main tracks, derailing train #3918 and wounding two men.
9/10/18	Bombs near Mendelingen between Hq and Macheren and in vicinity of station. Light switches broken. One bomb fell in northern section of village Hagendingen.
23/10/18	Bombs on steel works.
29/10/18	Bombs dropped on roadbed near station of Machern. Trains on main track held up.

The bombs were dropped generally not on the passenger station alone, but also in the vicinity, in the southern freight station, on the main tracks, and on the Thyssen railroad station and steel works.

No bonuses were paid employees at station.

Forges and Steel Mills[b]

1915

April 16 — On April 16 at about 9:30 in the morning enemy aeroplanes dropped five bombs on Maizieres[c] and Hagondange.

One bomb fell on the Maizieres Factories, two in the vicinity of these factories, one in the plain and one on the blast furnaces of Hagondange.

This last bomb fell on the cowpers and exploded on the last concrete base without causing any great damage. A few plates of the cowpers and some mains were damaged.

The work was not stopped.

April 18 — On April 18 enemy aeroplanes again bombed our establishment. Four bombs exploded in the factory.

1916

March — During the night of March 29-30 bombs were dropped on our factories. Seven of them exploded. Four of them fell near the central shops damaging the western facade and breaking all the windows.

May — Thirty-nine incendiary bombs were dropped on our colony during the night of May 17-18. No damage was caused but they provoked a panic among the inhabitants of the colony.

July — Five bombs were dropped during the night of July 1-2. One of them fell on the Thomas Steel Mill, one on the house of the headquarters, three on the railroad. Some material damage was caused.

During the night of July 25-26 seven bombs fell on our establishments. One of them fell on the Russian prisoner of war camp. One hit the western portion of the air line leading to the storage batteries of the blast furnaces. Three fell right beside the lime-kilns and the mixers, another on the blast furnace shops and one between cowper I, blast furnace I and the storage batteries.

The principal damage caused was the breaking of all the windows in the neighborhood including those of the Russian prisoner's camp.

Three men were slightly wounded and one man severely wounded by pieces of the bomb.

August — Due to the rainy weather there was only a single air attack during the second half of the month of August.

The bombs which were thrown fell outside of the factory and of the colony. No damage was done.

September — During the night of September 10-11 twenty-eight bombs were dropped. Considerable damage was done to the establishments and to the material which was in storage. The roofs of building 16, 18 and 17 suffered greatly. The corrugated iron roofing and the gutters were pierced.

Several traverse cables were damaged on the rolling bridges.

Considerable damage was done to the steel cross sections which were being stored.

Beams were damaged and a large portion of the iron which was in storage was rendered unfit for use.

One bomb fell in front of building No. 1 of the blooming mill.

In the slag dump one bomb fell on a car full of slag and one of the buffers was torn off.

The windows on the western side of the Thomas Steel Mill were broken.

A laborer was seriously wounded.

A bomb exploded in front of the assay shed of our mineral crushing shops. No serious damage was done.

October — During the night of October 22-23 five bombs were dropped between the central shops and the office of the machine shop.

All the windows of the central shop were broken as well as those on the southern side of the building containing the generators. Many of the windows were also broken in the rolling mills 6, 7 and 8.

Damage was done to the main steam conduit leading to the center of pressure.

The executive office itself suffered greatly. The windows were broken, the doors torn off, the roof damaged and the interior ruined.

Great damage was likewise done to several

cars which happened to be on the tracks.

On October 23, aeroplanes flew over the colony at noon. Two squadrons of about 7 to 10 planes followed each other at a short distance. Part of the aeroplanes succeeded in flying over the factory. Seventeen bombs were dropped. They fell in the following order:

1) Three beside the porter of the cement factory; they formed funnels of four to 4.50 meters in diameter.

2) Four in the coke dump. It is here that the largest funnel was formed. It had a diameter of seven meters and a depth of 3.50 meters.

3) One bomb in building No. 16.

4) One bomb in building No. 6.

5) One bomb in front of the northern facade of building No. 3. This bomb did not explode and was unearthed intact.

6) Two bombs on the roof of building No. 1.

7) One bomb in front of building No. 1.

8) Four bombs on the steel mill.

The bombs which fell on building No. 6 and 16 and on the steel mill caused serious damage to the roofing and to the windows of the establishments.

November

During the night of November 9-10 two workmen were instantly killed by bombs and one engineer was wounded in his arms and legs.

Only a small amount of material damage was done.

During the night of November 10-11 the storage batteries and the vacant lots situated between the Rombas railway and the blast furnaces were, as the French communique says, literally sprinkled with bombs.

The extreme darkness of the night was the cause that all the bombs, fortunately for us, missed their objective.

Approximately 15 bombs fell in the mineral accumulators without causing any serious damage.

Unfortunately for us one bomb fell in the station which distributes the current to our mines. It went through the switchboard and stopped the transformers so that the mines

remained for a long time without current. In view of the water pressure in our Jacobus Mine this accident might have had very serious results. Thanks to the energy and skill of the personnel of the electrical center it was fortunately possible to start the current again after a few hours of work.

The exact number of the bombs which fell cannot be given, for many of them exploded close together. It is estimated that at least 50 must have fallen.

1917

February — During the night of February 15-16 several bombs fell on the rolling mills, on blooming mills I, II, and III and on building No. 7. Some damage was done.

The roof of the mixer and of the lime-kiln was damaged.

Several small sheds were completely destroyed.

One bomb fell in the middle of the barracks of the Russians in which there were about 1,000 Russians prisoners. Four of them were killed on the spot, 15 were severely and 10 slightly wounded.

In building No. 7 one woman and one man running the moving bridges were severely wounded.

April — During the night of April 13-14, torpedoes were dropped on the establishments.

No material damage was done. All the torpedoes (nine in all, of which 3 did not explode) fell in the vacant lot situated to the north of the rolling mill No. 18.

May — During the night of May 2-3 about 22 bombs were dropped in the plain between the rolling mills and the Thomas slag mill. No damage was done.

June — During the night of June 3-4 fifteen bombs fell on the colony. Only a slight amount of material damage was done.

One bomb fell on the steel mill without causing any particular damage.

July — During the night of July 23-24 a large number of bombs were dropped in the Hagondange district.

Four of these bombs damaged the tracks at our station and caused some damage to the material which was piled up there.
Twenty-two bombs fell in the neighborhood of the pumping station near the Moselle.

September — During the month of September particularly during the second portion of the month the Hagondange Mills were very often attacked by enemy aeroplanes.

All branches of the service were considerably disturbed due to the fact that consecutive alarms would sometimes last until 8 o'clock in the morning. There were also several daylight alarms.

On September 22 at noon a strong squadron, undoubtedly American,[d] sprinkled the district between Thionville and Metz with several hundred bombs. Within a few minutes 160 points of fall were noted within the mills. However, the damage was not very great.

One bomb broke the gas main and several others damaged the railroad.

There were no victims.

October — During the nights of the 1-2, of the 16-17, of the 17-18, of the 29-30 and of the 30-31 enemy aeroplanes dropped a total of about 118 bombs inside the mills.

Material damage was again done.

December — During the first half of the month of December the mills were obliged to stop work for several hours during the night alarms of the 4-5 and of the 5-6.

Daylight alarms on the 4, 5, and 6.

The attack of the 6th was particularly violent. At about 1:15 in the afternoon 38 bombs were dropped around and in the gas station. The generator of a gas machine was very very seriously damaged.

Gas mains, compressed air mains, water mains and steam mains were broken. This caused a complete stoppage of work.

All the tueirons of the blast furnaces which were working were completely destroyed. It was only about 30 hours after that the first blast furnaces could be started again.

1918

February — Alarm at 9:40 in the evening during the night of February 19-20. The main gate was damaged by a bomb. The damage is estimated at about 10,000 marks.

March — During the night of March 12-13 at 11:10 a bomb pierced the tunnel which leads from the main gate to the offices of the mill.

Three bombs fell in the neighborhood of the rolling mills near a womens' rest room which was almost completely destroyed. There were no victims.

The bomb which fell to the north of this room damaged the canal system which is situated about 3 meters below the ground. This caused a stoppage of the blooming until 7 o'clock on the morning of March 15. The damage done amounts to approximately 30,000 to 50,000 marks.

Damage caused by a 1,600-lb. British bomb.

May	On May 24 one of the foreman of the electrical station was killed by a bomb and one man was wounded.
June	During the last weeks of the month we suffered enormously from air attacks. The attacks became more and more frequent and extraordinarily violent. Several bombs were dropped during the attacks of the 8th, 9th and 13th. The damage was not very serious. Nevertheless the office of the cement mill was destroyed and the roof of the cement packing building was seriously damaged. A few mains were damaged. Damage was done to a gas valve in the gas dry refining establishment. No victims. The chief engineer, Mr. Knuettel, was struck by several pieces of bombs. His condition necessitated his removal to the hospital in Metz. A foreman of the cement mill was slightly wounded. During the night of June 29-30 several more bombs were dropped. Beyond breaking some windows and damaging some roofing no important damage was done.
July	The attack of July 17 resulted in nine victims. Fourteen persons were severely wounded and were removed to the hospital. Several of them died of their wounds. The unfortunate ones were the victims of their imprudence. Instead of following orders and going immediately to the special dugouts they remained outside in order to watch the aeroplanes out of curiosity. A large number of the workmen who were slightly wounded were able to take up their work again after a short time.
August	During the attack of August 13 one workman was mortally wounded. During the night of August 15-16 the station of the air line leading from the Jacobus mine to the blast furnaces was very severely damaged. Two workman were killed.

During the attack on the night of August 20-21 four bombs fell inside the mills.

No important material damage was done. A weighing station and two pointers were damaged.

There were no victims.

October

A great number of bombs fell during the attack on the night of October 9-10.

No damage was done.

—11—

Rombas

Damages to houses and other buildings
of the factory of Rombas: 164,540.20 Marks
of the factory of Maizieres: 86,446.99 Marks
Total: 250,987.19 Marks
Cost of shelters
Near the houses: 40,000.00 Marks
Near the factories: 150,000.00 Marks
Total: 190,000.00 Marks
Cost of buildings for barrage balloons: 185,000.00 Marks
Losses due to diminution in production:
Salaries during stoppages of work in the factories: 1,224,576.67 Marks
Inferior products caused by stoppages in work: 178,404.50 Marks
Deficit in production in the rolling mills: 4,092,334.99 Marks
Total: 5,495,316.16 Marks
Bonus paid to the laborers and employees because of the damages resulting from aerial bombardment: 1,162,497.50 Marks
Insurance premiums paid for employees against accidents by airplanes: 16,509.00 Marks
Total: 7,300,308.85 Marks[a]

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—12—

Joeuf, Homecourt, Auboue

1. The above are three French towns southeast of Briey and

very little information can be given regarding the bombardments here, as there were but few raids on these towns, and these were not disastrous. Although there are mines and smelters in these localities, the smelters were all shut down, and but few of the mines were in use. Being French towns under German military occupation, the effect on morale does not enter into consideration, but even if it did, the raids were so few that it was negligible. Following is all the data available for each town:

2. Homecourt. Although thirty bombs in all were dropped in and around this town, most of them outside the town limits. Two bombs dropped sometime in mid-summer of 1918, partly destroying two houses, and other bombs at various times damaged fences, windows, etc., the total value estimated around 15,000 francs.

3. The smelter was shut down by the Germans, who only kept the mines partially working, and no damage was done to either mine or smelter.

4. Joeuf. About forty bombs were dropped in and around this town, ten of which dropped on the Wendel smelter works. Neither the smelter or mines were in operation, the works being used by the military as a bakery and saw-mill, and later, toward the end, as an ordnance repair depot. All damage was immediately repaired and no records are available, but one of the French directors of the works, who was evicted during the German Occupation, estimates that about 30,000 (thirty thousand) francs' worth of damage was done by the bombing itself, and about 40,000 francs' worth of indirect damage was caused by shrapnel from anti-aircraft gun fire dropping on the roofs of some nine hundred houses owned by the company.

5. In the town itself, the heaviest damage was also caused by antiaircraft guns; about 40,000 francs is the estimate of the damage to the roofs of the town. In addition, three bombs dropped on some small houses and damaged them to the extent of 10,000 francs. The other bombs hit mostly in the surrounding fields and no damage was reported.

6. Auboue. . . . About two hundred bombs in all were dropped in and around Auboue, and a considerable number hit the smelter and iron-mine property located here, and was worked by the German military authorities, who employed between 1,000 and 1,500 Russian prisoners to work in the mine and smelter, under the supervision of engineer officers and men. Monsieur Munier, the present director of the plant (which is part of Cie des Founderies de Pont-a-Mousson) explained that it was impossible to ascertain a definite sum for the damage done by bombing, as the Germans, in evacuating, destroyed a considerable part of the works, the value of which will run into

millions. However, he estimated that the direct damage by bombing might be approximately 400,000 francs, and this figure was also given me by a Belgian engineer who was director of the plant during the German occupation. Of course, if the material damage is as high as this, the indirect damage in loss of production, etc., will be very large also, but unfortunately no figures are available. (However, when we consider that comparatively few raids were made on this plant. . . and further, that nearly all work was performed by prisoners of war, this production loss might not be so large after all, and labor costs would not increase at all.

. . . . . .

8. Of course, as this town was under military control, the effect on morale of the French civilian population that remained does not enter consideration, and the effect on the German troops is obviously impossible to ascertain. However, on the 25th of Sept., 1917, over a hundred bombs were dropped in one night, and one of these, striking in the Russian prisoner barracks, killed six Russians, and caused a panic and uproar among the remainder to the extent of necessitating the strengthening of the guards.

9. Joeuf, Homecourt and Auboue each had an anti-aircraft battery stationed near the town, and in addition about four other batteries were stationed in small towns in the vicinity, notably two or three batteries stationed on the hills near Moutiers, a small town between Briey and Joeuf. In addition, a number of searchlights were used, but no further protection against planes (such as balloons, etc.) was taken.

—13—

Uckange

Number of raids: 6[a]
Total damage to town: 69,148.57 M
Total damage to factory: 9,463.00 M
Expenditure for protection by town: 6,500.00 M
Expenditure for protection by smelter: 7,650.00 M.

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Railroad Information

1. The railroad station at Uckange was bombed three times,

resulting in the following damage: About December 6, 1917, a number of bombs (about eighteen altogether) was dropped on tracks and railroad property, but comparatively small damage resulted. About two tracks were wrecked, also one switch, and a number of signal and telegraph lines. Traffic was delayed very little, as trains were switched over other tracks. Some time in April, 1918, a bomb exploded on roof of railroad station, tearing off roof, but otherwise doing very little damage. On July 20, 1918, three bombs hit tracks and damaged two of them for quite some distance, also put signal lines out of commission.

2. Two bomb proofs were built at Uckange, one by the railroad costing about 7500 marks, and the other by the military authorities costing about 25,000 marks (used chiefly by troops passing thru). Another large bomb-proof was built at the Florange station (between Thionville and Hayange) costing about 33,000 marks. An agitation was made in the summer of 1918 for a "flieger-zulage" (increase in wages due to danger from air raids) but this was not granted. No additional men outside of regular workers were used to repair damage caused by bombs, provision being made to communicate by phone to Thionville if additional labor was required. This was not necessary at any time. The morale of the railroad workers does not seem to have been very much affected, as the raids on this station were very few.

Town and Smelter

1. The smelter employed between 400 and 450 men, but about 200 of these were Russian prisoners. A bonus of 250 marks was

The Uckange factory.

paid a short time ago (by order of the Soldiers' and Workmen's Council) to the regular workmen, as a recompense for braving the dangers of air-raids. In addition, the Smelter constructed a bombproof, costing about 7,650 marks, and suffered material damage from bombs to the extent of 9,463 marks (taken from records).

2. The number of raids over the town was comparatively small, consequently the morale of the people did not suffer as much as elsewhere. However, from various interviews, I judge that toward the end the workers were beginning to show signs of distress, which would undoubtedly have increased considerably had not the armistice intervened.

—14—

Hayange

Wendle Steel Mills[a]

Damage from bombs, including the mine building and 10,000 Mk. for repairs, charged directly to maintenance: 63,290.70.

Damages from A.A. bursts, including about 10,000 Mk. not yet repaired: 28,910.90.

Protection against aviators: 51,510.16.

Taking down of protection: 15,000.00.

Expenses for barracks (A.A. Defence): 20,990.87.

Installation of sirens: 3,294.38.

Anti-aircraft insurance, personal, 2 years: 40,000.00.

Anti-aircraft insurance, real estate, 2 years: 72,000.00.

Loss of salary during alarms: 720×355×1MK=255,600.00: 650,596.51 M.[b]

Loss of production: 1,283,900.00 M.

Bonus paid to employees: 369,233.00 F.

As a result of the irregular operation of the furnaces during the alarms, it was necessary to keep the ovens warmer than usual in order to assure the possibility of work at the steel works, as a result of which there was an increase in the consumption of coke of 50 kg. per ton for the average oven; 50 kg. × 330 T × 2 × 365 days = 12,045 T × 50 Mk: 602,250.00 M.

Furthermore, in order to avoid stopping the furnaces, it was necessary as a precautionary measure, to use steam blowers en route and to keep more heaters in operation. The increase in the consumption of oil per day may be estimated at 15 T. 15 T. × 625 days × 25 Mk: 234,375.00

There also must be reckoned an increase in the consumption

of ferro and Spiegel (sic) at the steel works, as a result of burned steel, which we value at 20,000.00.

Town

Hayange itself suffered but slightly (in material damage) from actual bomb hits, the majority of damage resulting from the surrounding anti-aircraft gun batteries.

About six anti-aircraft batteries were stationed near Hayange, and served to protect the smelter of Wendel & Co., and also the plant located in the neighboring town of Nilvange. Numerous

Damage in Hayange.

small searchlights were also used at first, but later, these were replaced by a few highpowered searchlights located at strategic points. The balloon barrage, about 45 of them, completely encircled the plants mentioned above, and were only used as a protective measure against nightraiders, being hauled in during the day.

No protective measures were taken by the town itself against air raids, people generally taking refuge in cellars during an alert. The morale of the people, as in other towns in the vicinity, was much effected, especially towards the end, when the raids became more numerous. Night bombing seems to have been the most effective here, in fact, comparatively few day raids were made, and a comparison of the two is practically impossible.

—15—

Thionville

Thionville (Diedenhoten), situated about midway between Metz and Luxembourg, was a fortified town of some 10,000 people. Having large iron and steel works, and being an important rail center with lines running in all directions, to Trier, Saarbrucken, Metz, Longuyon, and Luxembourg, Thionville was frequently visited by French and British bombers during the latter part of the war.

Resume

Results of Bombing on the Town of Thionville
- Number of Raids: About 60[a]
- Amount of Claims Filed: 1,672,466 Marks
- Amount Paid by Insurance Companies on Claims not Included in Above: 2,000,000 Marks
- Approximate Amount of Unfiled Claims: 300,000 Marks

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Results of Bombing on the Karlshutten Steel Works
- Number of Raids: 22
- Total Material Damage: 85,413.96 Marks
- Total Indirect Damage: 242,676.35 Marks

Direct Damage	Marks
To Buildings and Houses of Factory	76,521.48
To Company Property at Railroad Station	3,055.09
By Anti-aircraft Fire	5,837.39
	85,413.96

Indirect Damage	
Loss of Production	?
Expenditure for Production	135,766.90
Bonuses Paid Employees	75,555.00
Paid in Insurance Premiums	30,354.45
	241,676.35

Results of Bombing on Railroad at Thionville
Number of Raids on Railroad: 61
Total Number of Hours Lost: 321 hrs. 5 min.
Total Damage: 1,552,150 Marks
Bonuses Paid: Over 1,000,000 Marks
Railroad Information

1. Based on numerous interviews with the various chiefs of the different departments, all of whom are Germans who were here for the past two to four years. The abstract referring to the number and duration of alerts was taken from the books of the machine department; the abstract regarding damage, values, etc., was taken from the day book of Herr Kienle, in charge of construction department. Conflicting stories were told by these officials but I have endeavored to check these up as much as possible, and the bulk of the information may be taken as correct, *regardless* whether it checks with our observers' report or not.

2. Every time an alert sounded, there was a total stoppage of traffic, until the "all clear" signal was given, this regardless of whether bombs dropped on Thionville or not. As there are a great number of tracks around this station,[b] traffic was delayed very little, once the "all clear" signal was sounded, as trains were switched from damaged tracks to others.

3. Due to very heavy traffic, a greatly increased personnel was used around the railroad station of this town, and this was further increased when the increasing number of raids began to lower the morale of the workers. In the summer and autumn of 1918, a total of 4,500 to 5,500 men were employed (including those working in the stations, shops, R.R. machine works, yards, etc.) In the summer of 1918, an agitation for an increase of wages was made, and in August, a so-called "flieger-zulage"[c] was given to the men, being an increase in wages of about 50 marks a month for the workers, and from 60 to 100 marks for the various officials. Up to the 11th of November, when this increase was stopped, well over one million marks were spent by the Imperial German Government as an inducement to work in the danger zone around Thionville. (Similar agitations were made in the various towns in the neighborhood, but with one or two exceptions, these were not successful). A number of Russian

prisoners were also used for repair work, and these were the men that generally repaired the damage inflicted by bombs.

4. Big damage was done on the 2nd and 3rd of May, 1918.[d] when a bomb dropped on the south end of the passenger station and smashed it, and another killed and seriously wounded about eight persons near the freight station. However, there seems to be no doubt that the damage done by a bomb dropped around 2 P.M. on July 16th, 1918, was enormous, in fact exceeding by far the combined damage of the hundreds of other bombs dropped here. This bomb dropped on a munition train of some 40 cars, causing shells to explode, setting fire to the freight station and other buildings in the vicinity, wrecking a string of horse cars and killing a number of horses (from 40 to 75, conflicting reports on number) as well as killing and seriously wounding about a dozen people.[e] About half of this munition train was finally cut off and pulled away by the cleverness of a

City ruins in Thionville.

Prussian officer, who yelled down in a dugout filled with workers, "Is anybody here heroic enough to attempt to cut this train," or words to that effect. He found a "goat" in a Lorrainian trainman who performed this risky undertaking, and was wounded for his pains. The Prussian officer was awarded the "Eisenes Kreuz." About an average of 1,500,000 marks is the estimate of the damage done by this one bomb. Traffic was held up for about a week, but this was overcome in part by routing trains along different routes. This was the only instance when military labor was used, to repair damage inflicted by bombs.

5. The morale of the railroad workers seems to have suffered considerable, especially after the above incident. Many were taken sick and it was only by the increase in wages given shortly after, that operations were carried on.

Detailed Report

Damage in Town and Factories

1. A very complete map gives us the location of nearly every bomb dropped on this town. The key of this map tells us the kind of bomb (dud, explosive, incendiary, etc.) as well as number of people killed, wounded, part of town hit, etc. The record of the alerts is the same as that kept by the railroad officials, and generally, it can be said that a complete stoppage of work resulted between the sounding of the alarm and the "all clear" signal.

2. Smelters and steel works are the main industries of Thionville, and although these figures are also approximate, about four thousand (4,000) men were employed in the above works. From interviews with a number of workers, it seems that their morale also dropped considerably in the summer of 1918, when our raids began to grow very numerous. Increased wages, approximately the same as those given to the railroad workers were necessary to carry on operations, and even then there was difficulty in getting men to work. Two big auto trucks were bought and fitted out as fire engines by these factories, for the purpose of combating fires caused by air raids.

3. Six batteries of anti-aircraft guns and a number of searchlights were used as aerial protection. Also towards the end a flight of planes was stationed, outside of Thionville for defense work, but it seems that during raids, their activities were confined to the ground, and that of the aviators in the dugouts.

4. In the city itself, the most important hit occurred on July 17, 1918, when the St. Hubert Hotel, opposite the Hotel de Ville, was demolished by a direct hit. Although in the official record only one person is marked as killed, I have reports from various sources stating that from 10 to 12 German officers who were

dining there were killed or wounded. Of course innumerable plates of glass were shattered by the repeated raids, but these values, also are not obtainable.

5. The morale of the people held up fairly well the greater part of the war, but towards the end, when the bombing became very heavy, it rapidly dropped, and the mental strain under which the people labored seemed to have been enormous. Various opinions were given as to the more effective, day or night bombing, but on the whole day bombing, especially when a number of raids were made in succession, seemed to be the most harmful, both in material damage and its effect on morale, although night bombing (in the winter time especially) played an important part in breaking down morale.

Summary of Damages Caused by Air Raids on the Carl Foundry, Thionville[9]

I. Direct Damages

a. By Air Raids on the Carl Foundry. The Carl Foundry was attacked 22 times by aviators. Altogether 186 bombs were thrown. 116 were thrown on the foundry area and 70 in the near vicinity. . . . The total involved damage is . . . M76,521.46. Killed, 7 persons, wounded about 50 persons. The damage resulting from the individual attacks were as follows:

Air Raid I. Four bombs thrown. The first bomb fell on the oil refiner built in masonry about 1 cbm. masonry disturbed. The second fell on the roof of the machine house 2 and exploded on an iron purlin without any great damage. Bomb 3 hit the gas connection of machine house 2; the damage was immediately repaired. Bomb 4 fell on the roof of casting house and destroyed a great number of roof tiles.

Air Raid II. Five bombs thrown; no damage.

Air Raid III. One bomb thrown; glass broken.

Air Raid IV. Four bombs thrown. The first bomb fell in the vicinity of the rope walk on the crushing machine. Damage to the light and power connections and to the towing-line of the rope walk; also damage to glass. Bombs 2 to 4, no damage.

Air Raid V. Three bombs thrown. The first bomb fell on the roof of the crushing machine 4. Little damage to the iron construction work. About 2,000 roof tile thrown down.

Air Raid VI. Fifteen bombs thrown, no glass damaged.

Air Raid VII. Two bombs thrown. Bomb one fell in the vicinity of Colonie Terwin. Damages to the glass. The second fell beside the track of the Carl Gallery railroad; a few signal connections were torn.

Air Raid VIII. Sixteen bombs thrown. The bombs 1 to 6 fell on distant ground and broke the window panes of some houses belonging to the officials. Bomb 7 fell on the foundry street and caused damage to the glass. Bomb 8 and 9 fell on the Russian Camp, destruction of the roof. Twenty-seven of the Russian prisoners were seriously wounded and 13 were slightly injured. Two of the former died from their injuries. Bombs ten and eleven broke many window panes in the vicinity of the office buildings and of the magazine. Bomb 11 also caved in a partition wall. Bomb 12 fell on the outer wall of the magazine, blew the roof off and penetrated the ceiling. Bomb 13 glass damages. Bomb 14 fell on an empty iron (50 t) self discharging vessel and greatly damaged it. Bombs 14 to 16 damaged the partition wall between the gallery railroad and the Diedenhofen-Hayingen [rail line].

Air Raid IX. Four bombs thrown. Glass damages; damage to the foundry fence.

Air Raid X and XI. No damage.

Air Raid XII. Seven bombs thrown in the vicinity of the Villa Rochling. Serious damage to the window panes and to the doors of the Villa.

Air Raid XIII. One bomb thrown. The bomb apparently bursted in front of a house in the foundry street on the telephone wires. Glass damage.

Air Raid XIV. Two bombs thrown. The first bomb fell on a wooden annex to the locksmith's workshop and burst on iron girder to which a transmission was attached. Damages to the surrounding wooden walls, to the sky-lights and to the windows of the workshop and of the locomotive shed.

Air Raid XV. Five bombs thrown. Bomb one fell on the cabin of the locomotive destroying it completely. The boiler remained intact. The scalemaster, who had fled under the oil container of oven four without obtaining the protection which was there hit on the head by the bomb splinters and immediately killed. Added to this many other persons were more or less seriously injured by the splinters. A seriously wounded Russian prisoner died in the course of the day. The corrugated sheet-iron roof of the coke loading space was penetrated seven times by the splinters so that it had to be entirely changed. One splinter struck a chief watermain. It was possible to close the leak in the meantime. Bomb two fell in the vicinity of the slag-crusher. The wire rope was destroyed. The work of crushing the slag was interrupted one day. The other bombs fell on the construction area of the steel workers.

Air Raid XVI. Eight bombs thrown on the construction area of the steel works. Small amount of damage. An Italian civilian laborer was very badly wounded on the head and died.

Air Raid XVII. Nine bombs thrown. Three bombs fell in the vicinity of the stone factory. One manager was fatally wounded on the head. Three other bombs fell on the oil container; damages to the iron carriers and to two water pipes. One bomb fell beside the oil container 4; one machinist killed. Two prisoners wounded. Another bomb fell on the gaspipe over the furnace house 2, penetrating the latter. The running of the gas machine was stopped for two days. One bomb hit the house No. 44 Colony Cassion, 2 penetrating the roof; burst in the hay stored there and blew off most of the roof. The other bombs caused no damage.

Air Raid XVIII. One bomb thrown to the working buildings. Demolition of damage of three state trains [?]. Destruction of the cast-iron windows of the workshop. Damage to the corrugated sheet-iron roof; great glass damage.

Air Raid XIX. No damage.

Air Raid XX. Seventeen bombs thrown. Eight bombs thrown on the construction area of the steel works. No damage. Four bombs fell in the vicinity of the gallery railroad. Damage to the high tension conduit. A bomb fell on a house in the vicinity of the former cement works, in which the guards of the Russians were lodged. The bomb tore off most of the roof and also damaged the buildings in the vicinity. The guards had opportunely taken shelter. The remaining bombs caused no great damage.

Air Raid XXI. Six bombs thrown in the vicinity of the foundries enclosure. Damage to the fence of the Villa Rochling.

Air Raid XXII. Seven bombs thrown. Damages to the electric connections of the gallery railroad.

b. By Air Raids on the Diedenhofen and Metz Railroad Stations. The baggage shed of the Diedenhofen station was set aflame by the air raid of July 16, 1918 occasioning the loss of our goods stored there. The damage to the Carl Foundry amounted to 2,577.21 Marks.

The wagon filled with cement for us was hit at the station Metz-Sablon in the air raid of May 30 to 31, 1918.[h] The damage to the Carl Foundry amounts to 477.98 Marks.

c. By the splinters of the anti-aircraft fire which fell from a great height the roofs of the houses and the workshops belonging to the Carl Foundry were damaged during the different attacks on the city of Diedenhofen. The reparation necessitated an expenditure altogether of 5,837.39 Marks.

II. Indirect Damage

a. In the Shortage of Production. It is difficult to make an estimate of the loss caused by the shortage of production. It is

to be noticed that not only through air raids on the Carl Foundry was the production hindered but also by the many alarms, even though no real direct attacks took place.

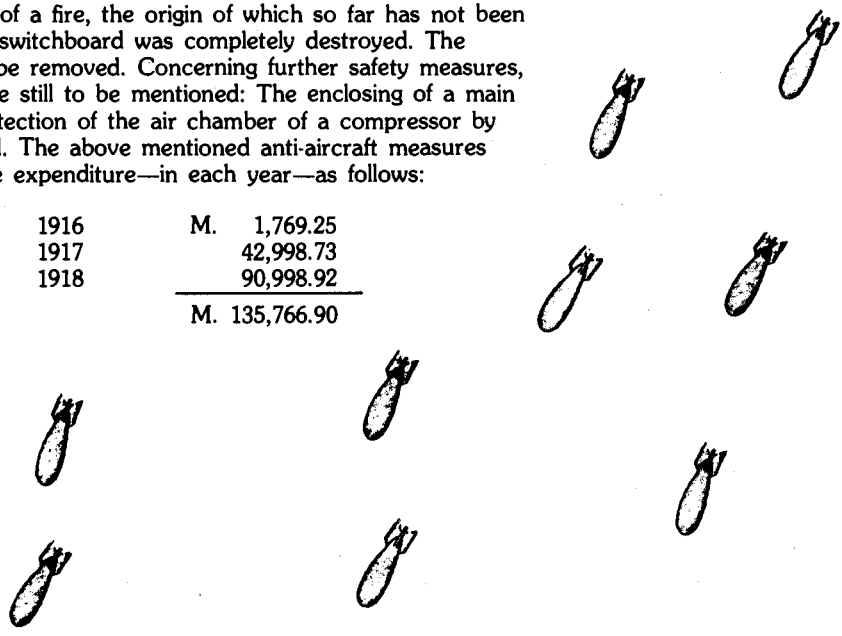
b. By expenditure in building retreats as protection for the workmen and machines against the effect of the bombs.

Protection of Workmen. Fifty dugouts were spread over the entire foundry grounds to afford protection to the workmen against the bombs. To assure this the existing buildings, which could be changed into dugouts were so completed. The existing fortifications of the Diedenhofen Fortress were also used for this purpose. Added to this new dugouts were built such as underground structures of masonry, cement or iron cement . . .

. . . . . .

Protection of Machines. Only important machines were protected. The steam turbine (2,000 KW) with generator in machine house 1 was surrounded by wall and covered so as to be bomb proof. Between the T-Girders a concrete roof 24 cm. thick was constructed over the switchboard in machine house No. 1. The switchboard in machine house 2 was also fully walled in and covered, a circumstance, which did not permit extinguishment of a fire, the origin of which so far has not been explained. The switchboard was completely destroyed. The dugout had to be removed. Concerning further safety measures, the following are still to be mentioned: The enclosing of a main water pipe, protection of the air chamber of a compressor by means of a wall. The above mentioned anti-aircraft measures necessitated the expenditure—in each year—as follows:

1916	M.	1,769.25
1917		42,998.73
1918		90,998.92
	M.	135,766.90



c. By payment of premiums to the workers. From January 1st to October 31st, 1918, the workmen were voted a monthly premium of 25 Marks, that is in altogether 250 Marks. This was only paid in a lump sum at the end of the year, but was short 1 Mark or 1.25 francs. The entire sum expended amounted to 95,693.75 francs.

d. By insurance premium paid to officials and workmen for accidents as well as for damages to the residences in the Carl Foundry and to the furniture of the officials and workmen. The entire sum paid out was 30,354.45 Marks.

Statement of Damages by Air Raids
on the
Carl Foundry, Diedenhofen

No. of Attack	Date	No. of Bombs on Foundry Grounds	No. of Bombs Outside Foundry Grounds	Total	Damage to Carl Foundry (Marks)
1	4/16/16	4		4	2,788.83
2	8/5/16	5	11	16	
3	8/5/16	1		1	34.41
4	8/6/16	4		4	118.15
5	10/11/16	3	9	12	488.07
6	12/27/16	15		15	102.17
7	3/2/17	1	1	2	86.65
8	7/27-28/17	16	11	27	5,934.07
9	9/3/17	4	4	8	1,912.68
10	9/4/17	4	1	5	
11	9/22/17	2	1	3	
12	10/1/17	7	11	16	5,087.27
13	1/21-22/18	1		1	1,117.12
14	5/3/18	2	1	3	4,293.13
15	5/15/18	5	4	9	18,376.76
16	5/29/18	8	1	9	353.41
17	6/6/18	9	1	10	(10,296.51 (2,134.53
18	6/6-7/18	1		1	17,482.91
19	6/27/18		2	2	
20	8/21-22/18	17	6	23	7,908.03
21	10/5-6/18		6	6	181.51
22	10/9-10/18	7		7	59.80
	Totals	116	70	186	M76,521.48

Thionville railroad station.

Abstract II[j]

Report of the Air Raids
Upon the Thionville Railroad Station

Date of Raid	Kind of Raid and Damage Caused.
3/23/18	From 10:00 to 2:00, air raid upon the railroad station. No damage.
3/24/18	From 10:00 to 2:00. No damage.
5/2/18	About 1:00 o'clock, air raid by about ten hostile

planes. One bomb dropped in the garden of the station master Fanssen, which damaged the fence, the latrine at the Turenne Barracks and the barracks itself. Damage about 50 marks. In the city of Thionville, seven killed.

5/3/18 About 11:15, air raid. The Stein building badly damaged by a bomb, the Lane dwelling completely destroyed. One conductor killed. In the Luxemburg section, track 82 badly damaged. In Elmingen, two soldiers killed. Near the Schwarzenweg, one bomb dropped in the Faeger garden and one train, in readiness, appreciable damaged. Damage 25,000 marks.

5/18/18 From 1:30 to 2:30, air raid. Two bombs dropped. Tracks 169, 64 and 65 damaged. Damage 400 marks.

5/20/18 From 11:10 to 4:00, air raid. No damage to station buildings. Several bombs dropped in the coal dumps of the garrison administration and several in the Moselle.

5/21/18 From 11:00 to 3:40, air raid. The station buildings were not damaged, but the Catholic Church and several houses in lower Yutz, were damaged.

5/29/18 About 9:00, air raid. About 100 meters from the Upper Moselle bridge, several bombs thrown. Telegraph and telephone lines damaged. Two killed in the castle garden. Damage to station buildings about 200 marks.

5/30/18 About 8:10, air raid. Two bombs dropped upon aviation landing place, several in the Luxemburg section, and in the east section, tracks 5, 7, and 8 were damaged as well as a large number of windows and doors broken in various buildings. Ten killed, one severely and four slightly wounded. Four-thousand marks damage. No interruption of traffic.

5/31/18 From 1:00 to 3:30, air raid. No bombs dropped.

6/1/18 From 7:00 to 8:10, air raid. No bombs dropped.

6/4/18 From 8:00 to 9:00, air raid alarm.

6/6/18 About 4:00 in the afternoon, air raid. The station received no bombs but in Karlshuette several were killed and wounded (9 bombs). At 6:00 in the afternoon, another raid. No bombs dropped.

6/7/18	About 11:30, air raid. The station buildings received no bombs but several fell upon the city and upon lower Yutz. From 1:00 to 2:00, air raid. No damage to the tracks.
6/13/18	From 7:00 to 8:00, air raid. No bombs dropped.
6/14/18	From 12:00 to 2:00, air raid. No bombs dropped.
6/16/18	About 4:40 air raid alarm but the aviators did not come to the station.
6/23/18	About 10:00, air raid. No bombs dropped.
6/29/18	About 12:00 o'clock, air raid alarm. The hostile aviators did not come to the station.
6/30/18	About 7:30, air raid alarm. The hostile aviators did not come to the station.
7/1/18	From 12:30 in the morning until 2:45, air raid. No bombs dropped.
7/2/18	From 12:30 until 3:00, air raid, No bombs dropped.
7/5/18	About 7:45, air raid alarm. The aviators did not come.
7/16/18	About 1:45, air raid upon the Thionville station between the signal tower and the night shelter building, one bomb; in the Witte district, several; in the east section, one bomb. In the Witte district a munitions train was hit and a part of it blown up. Several buildings for storing merchandise and for the collection of customs and several storehouses and 46 coaches were destroyed. Thirteen tracks and seven sidings were badly damaged. Siding No. 89 had to be completely restored. Forty meters of water pipes were also damaged. Damage one and one-half million marks. The traffic to Luxemburg, Sierck and Knuzig had to be stopped. About 11:00 o'clock in the afternoon, track 24 was put into condition for the traffic to Knuzig.
7/17/18	The tracks 64, 5b, 6b, 7, 8 and 9 were put into condition in the afternoon for the traffic which had been interrupted in consequence of the damage suffered during the air raid of the 16th. About 3:00 o'clock, air raid. Bombs dropped on the Schwarzenweg. No damage.
7/22/18	From 12:00 to 2:00, air raid. No bombs dropped.

8/8/18	From 1:30 to 2:00, air raid. No bombs dropped.
8/13/18	From 1:30 to 2:00, air raid alarm. The aviators did not come to Thionville. About 5:00 o'clock, air raid. In Knuzig, bombs were dropped near the station.
8/14/18	From 10:00 to 10:40, air raid alarm. The aviators did not come to Thionville. From 11:30 to 1:30, air raid. No bombs dropped.
8/18/18	From 12:00 to 2:00, air raid. No bombs dropped.
8/19/18	From 12:00 to 2:00, air raid. No bombs dropped.
8/20/18	From 11:00 to 4:00, air raid. Ten bombs dropped in the station yard: one bomb on track 135, one bomb on track 136, one bomb on track 137, as well as two bombs in front of the sleeping barracks in front of Schwarzenweg, one bomb on track 5a. The attack about 4:00 o'clock, damaged the east section, tracks 3 and 21, as well as the siding 284; four bombs dropped. Damage 6500 marks. Traffic was not disturbed.
8/21/18	From 11:00 to 3:50, air raid. About ten bombs were dropped upon the buildings of the railway detachment and upon siding 118. Tracks 1a and 107 were damaged. Several coaches damaged. Hotel Terminus caught fire. Two bombs dropped upon and two behind the new locomotive shed. Damage about 15,000 marks. No interruption of traffic. In the city, a large conflagration ensued which was finally overcome.
8/22/18	From 11:30 to 12:00, air raid alarm. The aviators did not come near.
8/23/18	From 2:00 to 2:30, air raid. No bombs dropped. From 11:30 to 1:00, air raid. No bombs dropped. At the same time there was a heavy thunder storm but little rain.
8/25/18	All day long several hostile planes were flying over the station but dropped no bombs.
8/30/18	At 9:30, 11:30, 1:00 and 10:30, air raid alarm. No aviators came.
9/3/18	About 11:00, air raid alarm. The aviators did not come.
9/13/18	About 2:00 and 7:00, air raid alarm. No bombs

	dropped. About 10:00 until 7:00, three new air raid alarms.
9/14/18	From 10:30 to 4:30, five air raids. No bombs dropped in Thionville but in Floerchingen. The number is not known here.
9/16/18	From 10:30 to 2:00, air raid. No bombs dropped.
9/18/18	During the night repeated air raid alarms. The aviators did not come to Thionville.
9/20/18	[Same as 9/18/18]
9/24/18	[Same as 9/18/18]
9/26/18	[Same as 9/18/18] From 9:30 to 2:35.
10/3/18	About 10:30, air raid alarm. The aviators did not come to Thionville.
10/5/18	About 9:50, air raid upon the Thionville station. Eight bombs dropped. No damage.
10/18/18	From 4:30 to 5:00, air raid alarm. The aviators did not come to Thionville.
10/21/18	About 1:30 in the afternoon, air raid. Both tracks from Thionville to Knuzig and the siding rails were damaged. Until 5:00 in the afternoon, traffic to Knuzig stopped. Damage about 1,000 marks. From 10:00 to 12:00 several air raid alarms. No aviators came to the city.
10/26/18	From 7:00 to 7:30, air raid alarms. The aviators did not come.
10/28/18	From 10:00 to 12:30, air raid. No bombs dropped. The anti-aircraft batteries displayed very energetic activity.
10/29/18	From 10:00 to 12:00, air raid. No bombs dropped.
10/31/18	From 2:00 to 2:40, air raid. A few bombs were dropped but caused no damage.
11/10/18	From 2:30 to 3:30, air raid. No bombs dropped. The fighting planes drove away the hostile aviators. This is the last air raid.

This is an abstract from the day book of the chief of the Thionville railroad district, G. Kienle. Below is his estimate of the number and value of the bomb proofs constructed by him as protection against air raids.

"Bomb proof shelters were built to the number of six and a cost of approximately of 15,000 marks. Besides these, six smaller ones were built as a protection against flying fragments at a cost of approximately 50,000 marks. These shelters, however, cannot be looked upon as bomb proof."

Damage to a railway station near Luxembourg.

—16—

Luxembourg

Occupied by the Germans at the beginning of the war, the Grand Duchy of Luxembourg was almost immediately subjected to aerial attack. The Americans who surveyed the effects of Allied bombing submitted reports on the capital city (including the neighboring commune of Hollerich) and several industrial towns in the southwest corner of the country, centering around Esch-sur-Alzette, the second largest place in the grand duchy (Reports 16-23). Dudelange (Dudelingen) is about five miles east of Esch and midway between Thionville and the city of Luxembourg; Remelingen (Rumelange) and Oettlingen (Ottange), about the same distance southeast of Esch, the former being in Luxembourg and the latter across the line in Lorraine; Differdange (Differdingen), about 3 miles northwest of Esch; Rodange, a little farther west, near the Belgian frontier; and Athus, just over the line in Belgium.

Number of Raids: 17
Total amount of damage: 26,845 Marks

Anti-aircraft shot, 4/15/15. 2 switches on Metz-Amanweiler tracks destroyed. Tracks out of commission 15/4 [April 15] 4

hours, 16/4 2 hours. Cost 25.00 marks. Excavation to determine whether shell exploded.

Bomb, 6/21/16. 2 houses in residence district. Roofs and window panes destroyed, 220.00 marks.

Bomb, 11/6/16. Residence in workshops damaged. Window panes, doors, roofs, 155.00 marks.

Bomb, 9/30/17. Telephone wires destroyed, 65.00 marks.

Bomb, 10/1/17. Line Sablon-Moselle bridge destroyed and supporting wall and telegraph connection destroyed. Tracks out commission 7 hours. Cost 575.00 marks.

Bomb, 10/29/17. Dud fell near tracks Metz-Amanweiler. Track out 6 hours. Cost 50.00 marks. Dud dug up.

Bomb, 2/26/18. Window panes in residence district, 180.00 marks.

Bomb, 3/24 and 25, 1918. Telegraph connections destroyed, 25.00 marks.

Bomb, 4-29/31-18 [?] Window panes in residence district. Tracks 7 and 8 in the Montigny district. Track out of commission 30 hours. 700.00 and 1,500.00 marks.

Bomb, 6/29/18. Window panes in residence district, 200.00 marks.

Fragments of anti-aircraft shells. April-June 1918. Roofs pierced by fragments. Cost 600.00 marks.

Bomb, 6/24/18. Residence damaged, 1,500.00 marks.

Bomb, 7/1/18. Line Sablon-Moselle bridge and supporting wall destroyed. Metz-Noveant, Metz-Amanweiler damaged. 1 track out 12 hours, 1 track 30 hours, 1 track 2 hours, 1 track 3 hours. 15,200.00 marks.

Long range guns, 9/13/18. Tracks Metz-Amanweiler, out 12 hours, 900.00 marks.

Long range guns, 9/15/18. Connecting tracks at Longville destroyed, 8 hours, 200.00 marks.

Bomb, 9/27/18. Switch Sablon and telegraph lines, 9 hours, 550.00 marks.

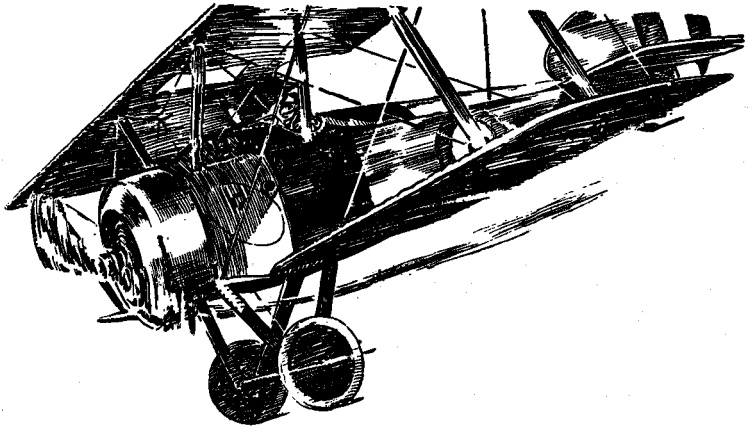
Bomb, 10/10/18. Line Metz-Noveant as well as street crossing. Track out 10 hours, 4,200.00 marks.

Total: 26,845.00 marks.[a]

Bombing at Hollerich[b]

Number of Raids: 19
Number of Bombs: 202
Total amount of damage: 699,942.03 francs
Expenditure for Protection: 300,000.00 francs

A special crew of 50 was kept busy during the last two years of the war to repair the damage done by bombs. They were paid ten francs per day.



—17—

Information as to Balloon Barrage in the Duchy of Luxembourg

The balloon barrages surrounding the town and works . . ., 39 balloons in all, each balloon containing 160 cubic meters of gas. With a new filling, each balloon could go as high as 3,000 meters and always were at an altitude of between 2,000 and 3,000 meters. One filling was sufficient for 10 days to 2 weeks. Balloons were let up electrically, 6 balloons on one main line. Balloons were let up at night and pulled down in the morning. The same territory was also protected by 32 anti-aircraft guns, 2 guns in a position. Each two guns had a personnel of 30 men. These guns were composed of 7.5, 8.8 and 10.5 calibre, the 10.5 being a marine gun. These guns were capable of 9 shots per minute and would shoot as high as 6,000 meters. It is, however, claimed that a great deal of damage was done to the roofs of factories and private dwellings in the enclosed country by the pieces of shrapnel and unexploded shells coming down from Anti-aircraft Guns.

A balloon barrage also surrounded the industrial region in the Saar Valley.

—18—

Esch

Number of Raids: 43
Total Material Damage: 1,348,709.21 [Marks]

	City	*Adolph Emil Factory*	*Burbach-Esch-Dudelage Factory*
Direct Damage	363,050.40	748,879.49	236,779.32
Loss of Production			9,871,690.00
Loss of Salaries			129,223.90
Protection		250,000.00	70,347.94
Bombs			76
Raids			14
Extra Consumption, raw materials			54,406.00

Foundry at Dudelange.

—19—

Dudelange

Expenses caused by the attacks of aviators:

		(Francs)
I.	Building department:	
	1. In 1916: Alarm dispositions	8,373.00
	2. During 1916-1917: The first shelters against attacks by avions were built in order to protect our workmen, the important buildings and engines.	110,005.00
	3. Damages caused by aerial attacks on the factory and on the buildings outside.	45,172.46
	4. Damage to roofs remaining to be repaired; these damages were caused by the fire of the defense guns; they will be repaired as soon as we obtain necessary materials.	6,600.00
II.	Blast-furnaces:	
	1. Damages caused by charging supplementary coke	27,000.00
	2. Supplementary wages	30,000.00
III.	Rolling Mills:	
	Supplementary wages: Plant I	8,428.00
	Plant II	6,566.00
	Adjusting Mill	7,188.00
	Coals	18,748.00
IV.	Steelwork, supplementary wages:	6,300.00
V.	Workshop and Foundry, suppl wages:	7,100.00
	Total	361,351.46

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Rumelingen and Oettlingen

Number of Raids: 9[a]
Total Amount of Damage: 1,230 Marks
Total Loss of Production: 3,386 Tons of Iron
Expenditure for Protection: 26,500 Marks

Date of Raid	Time	Bombs	Damage (Marks)
Sept. 15, 1916	1:00 A.M.	4	
Sept. 25, 1916	11:00 P.M.	4	980

Feb. 11, 1917	10:00 A.M.	35	
Feb. 13, 1917	10:00 P.M.	19	
Jan. 6, 1918	4:00 A.M.	12	
Jan. 25, 1918	10:45 P.M.	10	250
March 22, 1918	5:00 A.M.	10	
July 17, 1918	12:10 A.M.	4	
Sept. 22, 1918	3:00 A.M.	4	

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Differdange

Number of Raids: 39[a]
Number of Bombs: 395
Total Material Damage: 820,630 Marks
Loss of Production: 16,770 Tons
Expenditure for Protection of City: 51,883.37 francs
Expenditure for Protection of Steel Mills: 450,000 Marks

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Rodange

Number of Raids: 9
Total Damage to Town: 20,000 Marks
Expenditure for Protection: 15,000 Marks
Total Damage to the Ongres-Marihaye Factory: 10,919.90 Marks

March 18, 1918, 10:30 P.M. to 11:00 P.M. 5 bombs were dropped. 2 near RR station, 1 on tracks, and 2 in field. About 20 windows were broken and damage to tracks were repaired in 1½ hours. None killed or wounded.

March 15, 1918, 10:30 P.M. to 11:00 P.M. 5 bombs, 3 in field and 2 in city. Roof of one house was destroyed and another house was partly destroyed. 2 children wounded.

March 14, 1918, 10:30 A.M. to 11:00 A.M. 5 bombs, 4 in fields and 1 between RR tracks. Only damage, broken windows.

March 13, 1918, 11:00 P.M. to 11:30 P.M. 3 bombs in city. Broken windows.

Feb. 20, 1918, 11:00 P.M. to 11:30 P.M. 7 bombs, all near RR station. Destroyed telephone wires and windows.

Feb. 18, 1918, (no hour). 1 bomb in city. Windows destroyed.

Jan. 16, 1918, 10:00 P.M. to 11:00 P.M. 5 bombs in city. 1 house destroyed and windows broken.

Sept. 27, 1917, 9:00 P.M. to 9:30 P.M. 5 bombs, all in fields.

Sept. 25, 1916. Raid during night, lasting half an hour. 6 bombs in city. Windows broken.[a]

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Athus

Number of Raids: 8
Damage to Town: 19,000 francs
Damage to Athus-Grevegne Works: 400,000 francs

May 26, 1917. Night. Damage to Houses, 3,000 francs.

Jan. 25, 1918. 11:00 P.M. 3 bombs fell; no damage.

Feb 17, 1918. 12:00 P.M. 10 bombs dropped; damage to houses, 10,000 francs.

March 13, 1918. 11:00 P.M. 1 German soldier killed and 1 wounded; damage to houses, 10,000 francs.

March 21, 1918. 10:00 P.M. 4 bombs were dropped; damage to houses, 2,500 francs.

Dec 27, 1916. 11:00 P.M. 8 bombs dropped, 1 striking freight house at railroad station; damage to same, 500 francs; no damage railroad.

May 5, 1917. Midnight. 20 bombs dropped.

Oct 1, 1917. 9:00 P.M. 13 bombs dropped; no records were kept in this town as to exact dates and material damage or plans showing where bombs fell.

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Trier

Trier (Treves), situated on the Moselle River about 5 miles below the mouth of the Saar and not far from the Luxembourg border, had a population of about 50,000 people before the war. It had some factories, but it was chiefly a commercial city. Rail-

roads were important to its life, and the lines running through Trier were of strategic importance to Germany and the German army.

Up the river from Trier, rail lines paralleled the Moselle on both sides. At Trier there were two stations, one on each side of the river, the main station being on the east side in the main part of town. Below the city, the line on the east side crossed the river at Pfalzel, joining the other line in the yards at Ehrang. From Ehrang there was a line northeast to Koblenz and another north to Erdorf and Cologne. South of Trier the two lines were connected by a bridge over the Moselle at Conz (Konz), just below the confluence with the Saar. The line on the west side went westward to Luxembourg, the one on the east following the Moselle south to Thionville and Metz. From Conz there also was a rail line up the Saar River to Saarbrucken.

Railway targets in this area were sometimes assigned as objectives for Allied bombing raids. On other occasions, they were

Aerial view of Trier.

attacked by planes which, because of bad weather or for some other reason, were unable to bomb another target assigned for the mission. These raids are covered in three reports (#24-26) on Trier, Ehrang, and Conz and neighboring towns.

Resume of Results of Bombing

Number of Raids	20
Number of Alerts	120
Time Lost Through Raids and Alerts	75 hours, 1 minute
Number of Bombs Recorded	397
Material Damage Reported (does not include the damage to 864 people who were paid through Insurance Companies)	1,707,376.65 Marks
Indirect Damages	4,901,713.69 Marks
Total Damages[a]	6,609,090.34

Morale

The morale of the people was very much affected by air raids, causing sickness and nervous breakdown and causing dissatisfaction with the military authorities which one German interpreted into meaning that it was a desire of the German people in this area to cease hostilities.

Night bombing had the greatest effect on the morale of the people; day bombing also had a great effect.

Detailed Report of Allied Bombing

Sept. 13, 1915. Raid lasted from 8.30 A.M. to 9.00 A.M. 73 bombs were dropped, a good many of which were duds. Damage was done to 47 people, in addition to the damage done to Trier Walzwerk (Rolling Mill) on which damages were paid to the extent of 33,090.50 M.; of this amount 7,732.00 M. was paid by an insurance company. One man was killed and seven people injured, to 3 of whom 300 M. was paid as charity.

Oct. 17, 1915. Raid lasted from 10.35 A.M. to 11.00 A.M. 7 bombs were dropped, mostly in a field, wide of the city, 2 falling in the city but were duds. No damage was reported on this raid.

June 22, 1916. Raid lasted from 2.32 A.M. to 2.45 A.M. 13 bombs were dropped, 1 of which fell on the military treasury, setting it on fire. In all, damage was done to the property of 155 people, including damage done to Edward Raus & Company and to the People's Bank of Trier, on which damages were paid to the extent of 66,855.12. Of this amount, 38,864.52 was paid by the insurance company. This does not include all the damages, as 7 people did not report their damages. 7 soldiers were burned

to death in the fire at the military treasury, and 2 people were injured by bombs.

May 2, 1917. Raid lasted from 11.50 P.M. to 12.20 P.M. 38 bombs were dropped, one of which fell in a lumber yard, setting it on fire. The rest of the bombs fell around the town, again damaging the military treasury, the Dom church, People's Restaurant, Industrial Bank, and many houses. Damage was done to the property of 122 people, on which damages were paid to the extent of 219,280.03 M. of which amount 63,599 M. was paid by the insurance company. 47 people who suffered damage to their property on this raid and were insured did not report the amount of damage. One man was injured, to whom 75 M. was paid as charity.

June 4, 1917. Raid lasted from 12.30 A.M. to 1.30 A.M. 50 bombs were dropped in the center and south end of the city, damaging the Prov. Museum, Mothers' Home, and many buildings and houses, in all 164 places, on which claims to the extent of 83,983.47 M. were paid, of which 21,984.76 M. were paid by insurance companies. 4 people were injured on this raid.

July 7, 1917. Raid lasted from 11.30 P.M. to 2.45 A.M. 45 bombs were dropped in the middle and south end of the city, the greatest damage being done to a Nunnery, which was set on fire and very nearly destroyed. 100 places were damaged, on which claims to the extent of 89,673.08 M. were paid, of which amount 87,390.80 M. were paid by insurance companies. 51 people who carried insurance failed to report their damage.

July 25, 1917. Damage, 1,000 Marks. 21 wounded, from British report.

September 5, 1917. Raid lasted from 11.58 P.M. to 12.15 P.M. 14 bombs were dropped in the centre of the town, the greatest damage being done to a military barracks and Circuit Court building. 56 buildings were damaged, and claims made to the extent of 25,981.32 M., of which amount 20,432.78 M. was paid by insurance companies. 4 soldiers were killed in this raid. 24 people who carried insurance failed to report their damages.

October 1, 1917. Raid lasted from 9.10 P.M. to 10.27 P.M. 7 bombs were dropped, damaging 82 buildings and houses, on which claims to the extent of 1,405.80 M. were paid, of which amount of 1,164.93 M. was paid by insurance companies. 45 people who were insured failed to report their damages.

Jan. 24, 1918. Raid lasted from 7.35 P.M. to 8.35 P.M. 2 bombs fell in village of Seyen, just outside of Trier, damaging fourteen houses and buildings, on which claims of 406.55 M. were paid, of which amount 180 M. was paid by insurance companies. 1 man failed to report damage.

Jan. 27, 1918. There was no raid on Trier this day but anti-

Houses hit in aerial bombardment of Trier.

aircraft fire damaged property of 46 people, on which claims to the extent of 994.56 M. were paid, of which 917.35 M. was paid by insurance companies. 34 people who carried insurance failed to report damage.

Feb. 4, 1918. No raid but anti-aircraft shells damaged property of 18 people, on which claims to extent of 441.30 M. were paid, of which 115 M. was paid by insurance companies. 13 people failed to report their damage.

Feb. 18, 1918. Raids lasted from 12.01 P.M. to 12.30 P.M., and 8.20 P.M. to 9.40 P.M. In the first raid 12 bombs were dropped in the east end of the city, along west side of railroad, and the second raid 9 bombs were dropped in the middle of the town, damaging 248 buildings and houses, on which claims for 224,885.51 M. were paid, of which 42,572.84 M. was paid by insurance companies. 158 of the people who received damage on this raid have not reported the amount of their damage, which was all insured.

Feb. 19, 1918. Raid lasted from 12.10 P.M. to 1.00 P.M. 17 bombs fell in south and southwest part of city, damaging 231 homes and buildings, on which claims for 26,415.54 M. were paid, of which 12,773.05 M. was paid by insurance companies. 149 people failed to report their damage. 1 civilian and 1 soldier were killed.

March 12, 1918. No bombs were dropped but the property of 11 people was damaged by anti-aircraft fire, on which claims for

305.47 M. were paid, of which amount 209.92 M. was paid by insurance companies. 7 people who received damage have failed to report the amount.

March 24, 1919. 1,500 Marks. British report.

May 21, 1918. No bombs dropped on this day but 21 people received damages from anti-aircraft shells on which claims to extent of 709.24 M. were paid, of which amount of 603.24 M. was paid by insurance companies. 13 people failed to report amount of their damages.

June 1, 1918. No bombs dropped on this day, but 23 people received damages from anti-aircraft shells, on which claims to extent of 547.20 M. were paid, of which amount 357.50 M. was paid by insurance companies. 20 people have failed to report their damages.

June 4, 1918. Raid lasted from 9.03 A.M. to 9.48 A.M. 11 bombs were dropped in the south part of the city, damaging 121 buildings and houses, for which claims of 35,702.23 M. were paid, 15,367.96 M. by the insurance companies. 74 people who received damages on this raid failed to report it. 2 people were wounded.

June 13, 1918. Raid lasted from 8.20 A.M. to 9.02 A.M. 20 bombs were dropped in the northern part of the city, the greatest damage being done to a hospital and to the gas works. 57 buildings and houses were damaged, on which claims for 21,617.82 M. were paid, of which 7,964.43 M was paid by insurance companies. 26 people have failed to report amount of their damages. 5 people were killed and 4 injured. 1 person received 100 M. as charity.

July 1, 1918. Raid lasted from 7.45 A.M. to 8.55 A.M. 18 bombs were dropped in the center and eastern part of the city, damaging the property of 29 persons, on which claims to the extent of 2,028.36 M. were paid, 752.70 M. of which was paid by insurance companies. 13 people failed to report their damages.

July 2, 1918. Raid lasted from 9.50 A.M. to 10.50 A.M. 8 bombs were dropped on the northern part of the city, damaging buildings and houses of 45 people, on which claims of 2,421.05 M. were paid, of which amount 662.95 M. was paid by insurance companies. 10 people failed to report damages.

Aug. 1, 1918. Raid lasted from 8.30 A.M. to 9.30 A.M. 14 bombs were dropped in the center of town, damaging a church and several fine residences, as well as many smaller places, on which claims to extent of 189,824. M. were paid, of which amount 74,676.45 M. was paid by insurance companies. 69 people failed to report amount of damages. 5 people were wounded in this raid.

Aug. 23, 1918. No bombs were dropped on this day but their

anti-aircraft shells damaged property of 25 people, on which claims of 1,861.69 were paid, of which 1,847.83 M. was paid by insurance companies. 21 people failed to report amount of their damages.

Sept. 2, 1918. No bombs were dropped but their own anti-aircraft damaged property of 10 people, all of whom have failed to report amount of damages.

Sept. 14, 1918. Raid lasted from 1.45 P.M. to 2.25 P.M. 6 bombs were dropped on the city, damaging buildings and houses of 62 people, on which claims of 20,744.27 M. were paid, 11,936.73 M. by insurance companies. 32 people failed to report amount of damage. 1 man was killed and a child injured.

Sept. 16. 1918. Raid lasted from 10.40 P.M. to 11.05 P.M. 6 bombs were dropped on south end of R.R. yards and around southern part of town, setting one house on fire. Buildings and houses of 59 people were damaged, on which claims of 10,835.92 M. were paid, 9,933.71 M. by insurance companies. 38 people failed to report their damages. 1 man was killed, to whose relatives 100 M. was paid as charity.

Oct. 1, 1918. Raid lasted from 12.30 P.M. to 12.55 P.M. 5 bombs were dropped on Petrisberg, a hill on the edge of the city, damaging the property of 5 people, on which claims for 10,016 M. were paid. Two people failed to report amount of their damages.

All of the people that have failed to report amount of damage carried insurance and there [are] so many that it would take too long to interview each and every one, but when we get the total amount of damages paid by insurance companies, I will be able to determine their damage. I have not included in the damage reported by raids any damage on factories, R.R. etc., or places on which I have reported separately.

Expense City Was Put to on Account of Raids

57 bomb-proofs were built, costing 30,000 Marks.

Expense of making cellars in public buildings bomb-proof, 12,500 M.

Expense of making cellars of schools bomb-proof, 19,000 Marks.

An extra Fire Watch of 6 men and 2 horses were installed in the southern part of the city at an expense of 33,000 Marks, which is the amount it cost them to install and maintain it.

Protection of Monuments cost them 6,000 Marks.

Installing 10 sirens cost them 14,500 Marks.

Removing and replacing street lamps cost them 4,000 Marks.

Insurance on public buildings cost them 19,150 Marks.

Expense of cleaning streets of debris cost 1,000 Marks.

It was necessary to employ an extra clerk to look after damage by air raids, which cost 10,850 Marks, included in which is the expense of taking photographs.

The city was protected by eight searchlights, 1 machine gun, six 10-cm. guns, four 9-cm. guns, and seven 7.5-cm. guns, most of which were installed in the last year of the war. This information was secured from the adjutant of the German Commander of this post, and he was unable to give me the number of rounds of ammunition fired or the number of men that were kept here to man the guns, but he did say that men were used from the hospitals who were recuperating from wounds. They have written to headquarters in Berlin to try and get this information.

I called on the General Agent, Otto Plewka, of the Frankfort Allgemeine Versicherung Aktren Gesellschaft to get the amount of insurance premiums paid to him, also the amount of damage paid by his company, which information he could not give me but has written to the home office for it.

I also called on the Agent, A. Schmitt, and Sub-agent, F. Traub, of the Stuttgart-Berliner Insurance Company for the same information. They received in premiums 390,000 Marks but have written to the home office for amount paid in damages.

All of the information regarding the number of raids and claims, also material damage and expense the city was put to, was taken from the records in the (Hochbanamt) Building Department of Trier, by J. Alberts, City Building Director, Wm. Kroschel, Clerk in this department, and H. Dietrich, building police secretary.

Several times in the report I have mentioned small sums that were paid to dependents of people who were killed, and also to people who were injured; this was only done in the case of poor people. Damages are to be paid to the dependents of every one killed and to people injured, the amount of which has not been determined.

Railroad, West Trier

July 2, 1918. One bomb fell in coal supply on west side of railroad tracks, setting it on fire. 500 marks was the estimated amount of damage. One bomb fell on east side of railroad tracks, destroying two latrines, the value of which the railroad director claimed to be 4,000 marks. One latrine was rebuilt which I saw and I do not believe he overestimated the cost.

3 bombproofs were built, one costing 4,000 marks and the other two were built by soldiers, so that the only cost was material, about 1,500 marks.

Telegraph lines were also damaged on this raid but not to the

extent that traffic was delayed in the least.

Their own anti-aircraft did quite a lot of damage to roofs of buildings and windows and roofs of rolling stock, as the guns were located directly above the railroad yards. Estimated damage 12,000 M.

600 men employed in West Trier yards, all of whom received the bonus of 80 marks per month (last 6 months of the war).

All traffic stood still when an alarm was given and remained that way until alarm was called off or raid was over.

July 2, 1918, is the only time that the railroad in West Trier was bombed.

This line handled almost all of the soldiers going to the front and wounded were returned to hospital located in West Trier.

The above information was received from H. Irroste (Bahnhof Director) railroad director in West Trier.

Railroad, East Trier

Sept. 13, 1915. One bomb fell 90 feet from station on open ground and did very little damage. Damage was repaired in a very few hours at a cost of 252.71 marks. No damage at all was done to trucks or railroad system.

June 22, 1916. One bomb fell on east side of railroad tracks and only damaged windows in buildings nearby which was repaired at a cost of 45 Marks.

July 7, 1917. Three bombs fell in south end of railroad yards but did not damage rails, only damaging buildings which were repaired at a cost of 722.54 marks. Some damage was also done to buildings by anti-aircraft shells which was repaired at a cost of 231.64 marks.

Feb. 18, 1918. Two bombs fell on the station, setting it on fire and damaging the residence of the railroad director which is in the station; trains were not held up in the least and damage was repaired at a cost of 20,232.63 marks.

June 4, 1918. Three bombs fell in south end of railroad yards, destroying two tracks of a four track main line, delaying traffic entirely for two hours and then hindering traffic for eight hours after which time damage was entirely repaired at a cost of 7,692 marks.

June 7, 1918. One bomb fell on telegraph lines but caused no delay in moving trains, damage was repaired at cost of 100 marks.

August 23, 1918. One bomb fell in yard about 120 feet from turn-table, breaking a water main, but did not delay traffic. Damage was repaired at a cost of 312.55 marks.

Sept. 9, 1918. Two bombs fell in south end of yards, destroying one track on the main line and broke a water main,

traffic was not delayed but it caused quite a lot of inconvenience, damage was repaired at a cost of 2,143 marks.

Sept. 17, 1918. Two bombs fell in yards, destroying two main line tracks, one of which was repaired in two hours and the other in ten hours, traffic was not entirely delayed but although it did not move as fast for at least two hours after the damage was done. Cost to repair damage, 1,010 marks.

1,200 people are employed in the yards. Last six months of the war employees received a bonus of 80 marks per month.

Five bomb proofs were built at a cost of 13,477.80 marks.

The cellar in station was made bomb proof at a cost of 2,000 marks.

Anti-aircraft signal system was installed to Karthaus-Conz, West Trier and Ehrang, at a cost of 4,000 marks.

20 extra men were kept on hand at all times to repair damage by bombs at a cost of 300 marks per day.

All employees called out for extra duty received a 50% increase in pay.

During an alarm or raid all traffic was stopped.

The above information was received from Oberbahnhofmeister, Head Director Mols and (Bahnmeister) Director Wochgurtel, the most of which was taken from their records.

Railroad Shops, West Trier

No bombs fell on shops.

Employs 1,000 people.

Were closed 360 hours on account of raids and alarms.

Paid in wages for which they received no benefit, 360,000 marks.

Made 50 cm. grenades on and off for first nine months of the war.

Manufactured 1,200 grenades at a cost of 10,000 marks.

Repaired 80 locomotives less on account of air raids.

Damage to roofs and windows by anti-aircraft shells, 600 marks.

Installed an air raid alarm system at a cost of 500 marks.

Built two bomb proof roofs over two large cranes which, had either one been hit, would have closed the shops for at least three months, at an expense of 2,000 marks.

Built one bomb proof over a magazine at a cost of 7,600 marks.

Built one bomb proof at workmen's houses at a cost of 2,000 marks.

All workmen received a bonus of 80 marks for last six months of war.

The Manager, Chief Engineer and a couple of the shop

Damaged gas storage tank of the Trier Gas Works.

foremen were very much of the opinion that the efficiency of the employers was very much impaired by air raids.

The above information was received from the Manager, E. Spino, and Chief Engineer, F. Seibert.

Gas Works, Trier

June 22, 1916, 2.20 A.M. One bomb fell alongside of an 8,000 cubic meter gas holder, puncturing it in 72 places and setting it on fire but by transferring the gas in this holder to a larger holder which they had, they were able to lower it until the damaged part was under water, thereby putting out the fire and stopping the leakage of gas.

After all the gas in the holder has been used it was repaired, taking 4 days during which time it could not be used. Cost to repair damage was 1,200 Mks.

600 cubic meters estimated as amount of gas lost through burning and leakage, valued at 600 marks.

Damage to windows and office buildings, 2,200 marks.

Damage from their own anti-aircraft guns 200 marks.

Fixing cellars into bomb proofs cost them 2,000 marks.

No time was lost on account of raids or alarms as plant is automatically operated, boiler and gas furnace being fired by automatic stoker.

Above information received from Director Wahl.

H. Laeser & Company

Manufacturers of artificial wool and of which uniforms for German Army were made.

Employed 250 men and women.

Feb. 19, 1918. Two bombs fell on office building, setting it on fire and destroying it completely. Building was rebuilt in 9 months at a cost of 25,300 marks. Work in the factory was not delayed in the least.

Production for last 3 months of the war was 150,000 kilos of wool, valued at 500,000 marks.

Were closed 150 hours on account of raids and alarms and lost through wages for which they received no benefit, 3,000 marks. Production was decreased by 3,000 kilos valued at 10,000 marks.

Considerable damage was done here by anti-aircraft shells which [was] repaired at a cost of 1,000 marks.

Carried flying raid insurance for which they paid 2,192 marks.

Did not build any bomb proofs but used a wine cellar which was conveniently located near the factory.

H. Laeser, his son and foreman, all thought the efficiency of the employees was very much impaired on account of air raids,

especially during 1918 as a decrease in production was noticeable.

The above information was received from H. Laeser and his son.

Trier Eisengieserei and Machinenfabrick
(Trier Foundry and Machine Shops)

August Fenestein, Manager. Employs 115 people. Manufactured 15 cm. grenades and did work in 15 cm. Russtahl grenades, 7.6 cm. grenades and rifles, also made machines such as drill presses, lathes, etc.

During the war they made and worked on:

16,286 Grenades, 15 cm., value	378,175 Marks
34,387 Grenades Presstahl, labor, value	649,815 Marks
50,780 Rifles, labor, value	557,600 Marks
4,240 Grenades, 7.6 cm., labor, value	8,480 Marks
621 Ton of Machines, value	552,230 Marks

They were only able to give me their daily production in value, which was:

War Material,	1,250 Marks
Machines,	435 Marks

Were closed 86 hours on account of air raids, which they estimated and which I think was considerably under-estimated, at a loss in labor of 12,040 Mks.

The amount of production lost they could only give me in value, which was 14,491 marks.

No bombs fell on the factory but they received damage from bombs falling nearby and from anti-aircraft batteries which cost them 1,520 marks.

Carried flying raid insurance for which they paid 800 marks.

No bomb-proofs were built because they were also able to use the wine cellar used by H. Laeser & Co.

Above information received from August Fenestein and his secretary, Felix Hubner, both of whom were of the opinion that the efficiency of the employees was impaired by air raids.

Trier Walzwerk Action Geselschaft
(Trier Rolling Mills)

Employs 1,000 men. Manufacture band, strip and sheet iron. Manufactured bullets for the war. Production for the war was 29,047,478 kilos at a cost of 32,678,495 marks.

Lost 87 hours due to raids and alarms, in addition to the one time that a bomb hit factory. Loss in wages for which they received no benefit, 86,870 marks. Loss in production, 114,854 kilo, value 142,870 Marks.

Sept. 13, 1915. One bomb fell on transformer house of factory

No. 1, damaging it to such an extent that they were closed down for 4 full days at a loss in production of 114,854 kilos, valued at 137,458 marks. The closing of this factory did not bother the working of Factory No. 2. Damage was fully repaired in 4 days by 15 men at a cost of 3,256 marks.

Built 3 bomb-proofs at a cost of 8,291 marks.

Making roof of the machine house bomb-proof cost them 2,368.84.

An air raid signal was installed at a cost of 600 marks.

Installing a special fire alarm box cost 2,300 marks.

It was necessary to install additional lights and burn more electricity because lights were blinded so that they could not be seen from outside, cost of which was 16,300 marks.

Carried flying raid insurance which cost them for the 4 years of war, 17,283.05 marks.

In the opinion of the Assistant Manager, the efficiency of employees was very much impaired and went so far as to say that if a raid came early in the morning or early in the afternoon they practically lost a half day, he also said that on a clear day or moonlight night the nervousness among the employees was very noticeable, in fact he said he noticed it in himself.

Above information received from Hans Bauer, Assistant Manager.

Edward Laeis & Company

Employed 400 men.

Manufacturers of factory machinery.

Manufactured 100 mm. and 220 mm. grenades for the war.

Daily production was 14 tons valued at 14,300 marks.

Total production for the war was:

Machines,	11,464 tons,	value 4,301,200 marks
220 mm. Grenades,	2,258 tons,	value 2,600,000 marks
100 mm. Grenades	3,278 tons,	value 1,988,000 marks

Were closed 300 hours on account of air raids and alarms and lost through pay for which they received nothing, 60,000 marks, and lost in production, 210 tons of finished products, valued at 214,000 marks.

June 13, 1918. One large bomb fell in foundry, damaging it to such an extent that the whole factory was closed for a week and it took them until 5 months later to again reach their maximum production. Production lost during this time was 350 tons, valued at 360,000 marks.

Damage by bomb was repaired at a cost of 120,000 marks.

Built 3 bomb proofs at a cost of 5,000 marks.

Installed an air raid alarm system at a cost of 2,000 marks.

Built a bomb proof roof over Transformer house at a cost of

1,500 marks.

Carried flying raid insurance for which they paid in premiums 6,600 Marks.

The officers of the company were very much of the opinion that the efficiency of the employees was very much impaired by air raids.

Above information received from Otto Frik, Manager; William Greunit, Chief Engineer; and August Schaefer, Chief Accountant.

I interviewed every German whose name appears on report, along with other Germans with whom I have come in contact on what effect the raids had on the morale of the people and the opinion was held by everyone that it had a great effect, causing much sickness and nervous breakdowns.

Dissatisfaction was also found with the military authorities, claims being made that they were trying to save on ammunition. I verified these claims by going to the Post Commander where I found that during several raids batteries had run out of ammunition. One German interpreted the dissatisfaction with the military authorities into meaning that it was a desire of the Germans in this locality to cease hostilities.

In the opinion of these people, night bombing had the greatest effect on morale of the population, although day bombing also had a great effect.

Kurenz

Sept. 13, 1915. 3 bombs also fell in this small city, damaging property to the extent of 210.40 marks.

Nov. 24, 1916. 3 bombs were dropped in this city, damaging the property of 47 people on which claims to the extent of 8,436 marks were paid, of which amount 415.86 marks was paid by Insurance Companies.

August 23, 1918. 17 bombs fell in and around city, damaging property on which claims to the extent of 6,507.70 marks were paid (by Insurance Companies, 5,821.40).

Sept. 14, 1918. Several bombs fell in city, damaging property of 4 people on which claims for 992.50 marks were paid, of which amount 524 marks was paid by Insurance Companies.

This town is located just across the railroad from Trier and received their damage when Trier was being bombed.

Olewig[c]

Feb. 18, 1918. 1 bomb was dropped in this small town as well as Trier and damaged property of 4 people on which claims of 1,082.21 M. were paid, of which amount 366.71 was paid by Insurance Companies. 1 woman was killed.

July 7, 1917. Bombs were also dropped on this town as well

as Treves, damaging the property of 121 people on which claims of 14,732.32 Mks. were paid.

Kernschied[d]

Sept. 14, 1918. Bombs were dropped in this town, damaging property of 1 man on which claim for 77.85 marks was paid.

Irsch[e]

June 1, 1918. 1 bomb was dropped in this town, damaging property of one man on which claim for 1,206 marks was paid.

Fohren[f]

March 2, 1918. 1 bomb fell in this city, damaging the property of 5 people on which claims to the extent of 384.70 marks were paid.

Information on these small towns received from District Building Department (Kreis-bauamt) for the district of Trier, located at Trier.

—25—

Ehrang

Number of Raids: 9
Total Amount of Damage: 127,225 marks.
Expenditures for Protection: 62,200 marks.

.....

Information received from (Burgomeister) Mayor Arend of Ehrang, taken from the records of that city:

Sept. 13, 1915, Hour unknown. One bomb fell on a transformer house located between Ehrang and Biewer,[a] causing damage to the extent of about 300 marks but did not damage the lighting system.

Nov. 24, 1916. One bomb fell on house at Pfalzel, completely destroying it. Amount of damage, 3,000 marks.

July 7, 1917, 1:00 P.M. Several bombs fell in an open field about 300 yards from the railway station causing no damage other than breaking windows in the neighborhood. On this same raid, four bombs were dropped in an open field close to the water works but did no damage.

Jan. 27, 1918, 1:00 P.M. One bomb fell close to the Russian prison camp but did no damage.

July 2, 1918, 2:00 P.M. 6 bombs fell at Quint,[b] three were duds and landed on the railroad tracks about 90 feet from the station, one exploded 240 feet from a school house and the other two in a factory park, none of the bombs doing any damage, at least there were no claims filed for damage.

Aug 23, 1918, 11:00 P.M. Sixteen bombs fell in and around the R.R. yards at Ehrang, also about 30 feet from one of the ovens of the United Tile and Mantle works, causing damage to the extent of 1,328 marks.

Some bombs were direct hits on the line to Coblenz, putting it out of order for 24 hours although military trains were detoured by way of Quint. The cost to repair this damage, computed without records, was 40,000 marks. The rest of the bombs fell around the city causing damage in the city to the extent of 10,000 marks.

Three people died from fright on this raid and a great number were sick due to their being in the cellars so long as the air raid alarms were given at least five times during the night. This was far the worse raid they had.

Sept. 2, 1918, 11:30 P.M. Nine bombs fell 1,500 feet east of the railroad along a street between Ehrang and Pfalzel doing no material damage. For some reason the lights were out for 48 hours after this raid.

Sept 7, 1918, 2:30 P.M. One bomb fell on right hand side of railroad track damaging property to the extent of 1,269 marks and five bombs fell in a meadow on the left hand side of the railroad, doing no damage.

Sept 14, 1918, 1:45 P.M. Two bombs fell on a new line that was being built between Pfalzel and Biewer causing damage to the extent of 10,000 marks. Two bombs also fell north of Pfalzel in an open field causing no damage.

Some damage was done by anti-aircraft shells from Trier but on a whole did not amount to more than 100 marks.

Alarms were never given unless planes were sighted by some city in the immediate area, and when the alarm was given every business house and factory was closed for at least an hour.

They have no record of when an alarm was given and when called off or of the number of times that an alarm was given and there were no bombs dropped.

The only anti-aircraft that this town had was from machine guns, and then only for the last four weeks of the war but they were also protected by an anti-aircraft gun from Trier located on Green Hill.[c]

All cellar windows were sealed, in some cases with cement and others with steel doors, the expense of which was paid for by the individual having the work done.

Damage to the Railroad at Ehrang

Information received from Supt. N. Elsen and R. R. Director J. Silvornus:

Sept 2, 1918. 4 bombs fell on tracks running to Coblenz disabling the line completely for 24 hours, although all military trains were detoured by way of the 1 track line to Quint. The cost to repair this damage was 40,000 marks.

8 bombs also fell in the yards, destroying 12 switch tracks and 3 coal cars which were repaired in 48 hours, at a cost of 20,000 marks.

A crew of 100 men was kept on hand to repair damage from bombs at a cost of about 1,000 marks per day.

All men called out for extra duty received 50% increase in pay.

During an air raid, all traffic was stopped.

The R.R. yards were divided into 3 sections and a bomb-proof provided for each section that could hold 200 men at a cost of 20,000 marks each, making a total of 60,000 marks spent for this purpose.

Factories

United Tile & Mantle Works: (Vereinigte Serveis Geselschaft).

Did not make anything that could be used for war and did not make anything [?].

1 bomb on Aug 23, 1918 fell 30 feet from the factory, damaging an oven and roofs to the extent of 1,328 marks.

Did not carry insurance against damage by air raids

Quint Smelter and Foundry: (Gewerckschaft Quint).

No direct hits on factory, 8 bombs dropped in a field 200 yards from the factory but did no damage.

First year of the war, this factory made shells and narrow gauge rails for the war.

The manager of the factory claimed the factory was closed 7 hours on account of air raids at a loss in production of 7,000 marks and costing them 1,000 marks.

Built 1 dugout at a cost of 2,000 marks and had no other protection.

Carried air raid insurance during the last year of the war which cost them 5,242 marks on property valued at 2,140,000 marks.

Raids as stated by the Burgomeister of Ehrang and his staff had a very great effect on the people of this area, causing many nervous breakdowns and he believes that they increased the Germans' desire for a cessation of hostilities. There was a great amount of agitation in this area for the Allies and Germans to quit bombing towns.

The R.R. Director said he did not believe air raids impaired

the efficiency of the employees very much because they were too far apart, although during a raid there was practically no work done, the men not only being scared but anxious about their families.

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Karthaus, Merzlich, Conz, Wasserlich, and Oberemmel[a]

Number of Raids	7
Number of Bombs	29
Total Damage (including 500 marks—date not known)	61,216.58 marks
Expenditures for Protection	17,250.00 marks
Amount Paid in Bonuses	152,000.00 marks

Information received from Burgomeister Mayor Muller of Karthaus, partially taken from records of that city.

Aug. 9, 1914, Time unknown, One dud and one bomb fell on west side of railroad in a field. One bomb fell on east side of railroad—had no record or recollection of any damage being done.

May 10, 1918, 2:00 A.M. Number of bombs unknown. Fell in city of Wasserlieach damaging property of one man to the extent of 50 marks.

June 1, 1918, 8:00 A.M. Sixteen bombs fell in town along railroad damaging the property of 22 people on which claims for a 1,240 mark loss were filed and paid. One boy was killed.

June 4, 1918, 8:00 A.M. Number of bombs unknown. Several fell in the city of Conz damaging the property of ten people on which claims for 1,761.20 marks were filed and paid.

June 7, 1918, 8:00 A.M. Two bombs fell on railroad main line, four in the railroad shops and several in the town of Merzlich, damaging the property of 35 people to the extent of 14,949.46 Marks. Two women and three children were killed on this raid.

July 1, 1918, 10:00 A.M. Twelve bombs fell in the Moselle River, one bomb fell on switch line track to Ehrang and four bombs in the town of Conz, damaging the property of 101 people, claims being filed to the amount of 11,333.38 marks and paid.

Oct. 11, 1918, Time unknown. Two bombs fell in the town of

Oberemmel and eighteen bombs around the town, damaging the property of four people to the extent of 9,339.54 Marks. One boy was killed.

The town of Karthaus and Conz paid one-third of the cost of installing a siren at railroad station which was 500 marks.

Five anti-aircraft guns, German 77s, were stationed around the town and there were fifty men to man the guns.

The town carried insurance against damage by air raids on public buildings:

1915-16	294.65
1916-17	350.40
1917-18	1,650.00
	2,295.05

A great number of the people also insured their lives and property.

Closing all of the cellar windows in public buildings cost 200 marks.

Cellar windows in business houses and private dwellings were also closed at the expense of the owner.

Damage to Railroads at Karthaus and Conz

June 7, 1918, 8:00 A.M. Two bombs fell on main line damaging through tracks so that they could not be used for 48 hours, although the traffic was detoured around the damage, a great deal of delay ensued. This cost to repair damage was 2,043 marks. Some bombs fell in the round house but missed the turntable by about 40 feet so that they could continue the work. This damage was repaired at a cost of 20,000 M. One man was also killed.

During the last year of the war, 50 to 75 men were kept on hand to repair damage at a cost of about 9 marks per day per man.

Employees called out for extra duty received 50% increase in pay.

One siren was built at a cost of 1,500 marks of which 500 marks was paid by the city of Conz.

Five bomb proofs were built, costing 5,250 marks.

During a raid all traffic was stopped, in all 119 hours.

On one raid the date of which they could not tell me, the telegraph system was put out of order for 6 hours during which time trains had to be held back to some extent. Cost to repair damage 500 marks.

Railroad Shops, Karthaus

Employed 1,200 people.

Repair Engines and Tenders only.

Were closed 324 hours due to Air Raids.

*Loss in Production. Repaired 1,500 Locomotives less, at a loss of labor costing 200,000 marks.

Built eleven bomb proofs for workmen costing 10,000 marks.

In talking with the Burgomeister of Conz and Karthaus, also the directors of the Railroad, the same opinion was held as in Ehrang that the air raids increased the desire of the people for a quick cessation of hostilities.

The Railroad Director and Director of the Railroad Shops were both of the same opinion that efficiency of the employees was not impaired because of air raids.

There are no factories in the area other than the Railroad Shops.

For the last six months of the war, all railroad and railroad shop employees received a bonus of eighty marks per months, which amounted to approximately 152,000 marks.

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Saarbrucken

Some of the most important targets for Allied bombers in World War I were in the Saar Valley, one of the great industrial areas of Western Europe. Here was produced much of Germany's iron and steel, using coal mined locally in the Saar and ore or pig iron shipped in from Lorraine. Blast furnaces in the area were concentrated around Saarbrucken, at Burbach (a western suburb incorporated into the city in 1909), Brebach (just east of the city), Volklingen (down the Saar about 6 or 7 miles), and Dillingen (another 7 or 8 miles down the river). The report on the bombing of Saarbrucken, printed below in its entirety, should be read in conjunction with those for Burbach and Brebach, which follow.

Number of Raids: 24
Total Damage: 2,987,650 Marks

Dates of Raids	Damage (Marks)	Killed	Wounded
9 Aug. '15	140,000	13	43
6 Sept. '16	700,000	5	10
16 Sept. '16			8
9/10 Feb '17	40,000	12	3
16 March '17	19,500	1	
16/17 June '17	148,000		4
24 Oct. '17	101,000	6	7
17 Oct. '17	53,000		
5 Dec. '17	153,000	6	9
6 Dec '17	25,000	1	4
5 Feb '18	201,000		17
16 May '18	57,000	11	49
21 May '18	3,500		
24 June '18	19,000	1	1
25 June '18	80,000	3	7
26 June '18	16,000		
1 July '18	930,000		
5 July '18	12,000		
17 July '18	181,000		
30 July '18	3,500		
14/15 Sept '18	2,500		
23/24 Oct. '18	1,100		
28/29 Oct. '18			
29/30 Oct. '18	1,450		
Totals	2,887,650	59	162

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Burbach

Number of Raids: 13
Number of Bombs on Factory [Steel Works]: 93
Total Amount of Damage: 488,100 marks
Cost of Protection: 100,000 marks

A total of 93 bombs were dropped on the Foundry grounds during the 13 different aerial attacks that took place. In addition, 5 other bombs were dropped in the gardens around the Foundry and in front of one of the officials' buildings. . . .

. . . . . .

The damage caused by the bombs in each individual case is as follows:

Raid No.	Date	No. of Bombs	Place and Kind of Damage
1	9/8/15	1	Fell behind the furnaces on the Coke grounds, but caused no damage.
2	6/9/15	4	Fell on the Railroad dam, in the field and in a store of bar-iron, but no damage was done.
3	15/9/16	8	Were dropped on the shipping yard and on the roofs over the Dolomite furnaces, on the Block street, on the Generators and Universal rolling mill and caused damage to the roofs, window panes and tracks. 5,800.00 Marks.
4	10/11/16	24	Hit the Coke grounds-West, the smelting room, the blast engine house and the steel works-Pumphaus. The roofs of one Valve room on the Coke grounds, of the smelting hall, and of blast engine buildings were destroyed. In addition to that one steam conductor and one steam kettle. 21,200.00 Marks.
5	23/11/16	4	Were dropped on the steel works and in front of a mortar battery, partially destroying roofs and conductors. 4,000.00 Marks.
6	23/1/17	9	Fell near smelting furnace #3, in the steel works, near the foundry, in the Modelling shed and on the port on the Saar, damaging a large water reservoir, different roofs and sheds and also the tracks. 6,600.00 Marks.
7	17/10/17	3	Fell on a siding in rear of coke grounds-West, a near a cooling tower, and in front of the Foundry club-house thus destroying some rails which were torn up from the tracks just behind the cooling tower and damaging badly the club-house building and the neighboring foundry officials' residences. 17,500.00 Marks.
8	5/2/18	19	Fell entirely on foundry property, except the 4 bombs already mentioned, which fell in the gardens. Hits were obtained mainly on the smelting furnace grounds, slightly damaging some conductors and dust collectors, also causing some slight damage on shipping grounds. To this must be added the damage caused to grass, flowers, etc. in the gardens. 9,300 Marks.
9	24/6/18	7	Hits obtained in railroad yards, destroying some tracks and damaging the office building and a neighboring adjusting (regulating) shop. 4,500.00 Marks.
10	2/9/18	8	Fell in the rolling mill, in the main shop, in the locomotive shop and on the docks on the Saar River. Seven of these bombs caused slight damage to the roofs, glass and railroad tracks. Bomb #79[a] hit the roof of the main work shop, destroying by fire the whole roof and ceilings. The machinery remained intact but had to be repaired. Main damage, however, was caused by the burning of several models. It is impossible to look up the prices of the damaged objects at present, all books being

Raid No.	Date	No. of Bombs	Place and Kind of Damage
			burned, but we estimate it to be 400,000 Marks.
11	16/9/18	5	Hit the pump-house and the neighboring rolling mill halls. The roof of the former and different conductors were completely destroyed; as to the latter, the damage caused to the glass was not altogether insignificant, and as in most of the other attacks, some damage was caused to the railroad tracks. 17,000.00 Marks.
12	5/10/18	5	Fell on and near the mixing building and only caused little damage. 700.00 Marks.
13	6/11/18	1	Dropped in front of a foundry official's residence, damaging the roof of the house and also the nearby greenhouse. 1,500.00 Marks.
	Total	98	488,100.00 Marks

Protection: Concrete shelters were built for the employees amounting to 100,000 marks but no false roofing of any kind was built over the factory.

Moral Effect: The workmen maintained a fairly good working standard in the factory and many were glad when an alert was signalled because it meant a loaf for a while. Night raiding was more disastrous on the morale than day raiding as many men had families which required more care and anxiety. On one occasion, however, when four men were killed by a bomb, the women working in an adjacent plant, became hysterical and threatened to give up work but were calmed in the course of a day or two.

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Brebach
(Halburgerhutte Iron & Steel Works)

Number of Raids: 5
Total Amount of Damage: 89,256 marks
Cost of Protection: 250,000 marks
Number killed: 10

Date of Raid		Marks
Aug. 9, 1916	Small buildings destroyed	446
Feb. 10, 1917	Benzol cooler hit	9,000
Feb. 22, 1917	1 shelter destroyed	1,150
May 22, 1918	Coal cleansers	8,970
Unknown[a]		69,690
		89,256

Protection. Dugouts and shelters were built to the cost of 250,000 marks.

Moral Effect. No bonuses were paid to employees and no strikes ever occurred here. The nervous strain of alerts and raids cut down their efficiency. Night bombing was more telling on their nerves than day bombing.

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Volklingen

Number of Raids: 8[a]
Number of Alerts: 328
Number of Bombs Recorded: 213
Total Material Damage: 1,261,500.46 Marks
Total Loss of Production in Tons: 31,101.962
Total Expenditure for Protection: 457,719.98 Marks

Damage at Volklingen.

Monthly Total of Direct Damage Caused by Bombs and Anti-Aircraft on Roechlingen Bros. Steel Works

Date	Number Bombs	By Bombs (Marks)	By Anti-Aircraft (Marks)
Sept., 1916	13		
Oct., 1916			
Nov., 1916	33	42,171.53	
Dec., 1916	5	5,575.90	
Jan., 1917		93.00	
Feb., 1917			
March, 1917	22	1,015,174.97	
April, 1917			
May, 1917	51	77,737.96	
June, 1917			868.90
July, 1917			
August, 1917			
Sept. 1917			
Oct., 1917	86	71,865.32	
Nov., 1917			
Dec., 1917			
Jan., 1918			
Feb., 1918			1,068.26
March, 1918			
April, 1918			
May, 1918	3	22,519.97	
June, 1918			
July, 1918			
Aug., 1918			713.21
Sept., 1918	10	23,711.44	
Oct., 1918			
Nov., 1918			
Total	213	1,258,850.09	2,650.37

Monthly Totals of Indirect Damages Due to Stopping of Work, Caused by Alerts on Roechlingen Bros. Steel Works

Month and Year	Number of Alerts	Loss in Salaries (Marks)	Other Losses thru Faulty Products (Marks)	Quantity in Tons
Sept., 1916	7	2556.96	8798.86	1016.013
Nov., 1916	14	9700.63	6762.55	1713.898
Dec., 1916	4	3378.31	70.60	559.870
Jan., 1917	4	1671.38	904.00	326.600
Feb., 1917	9	7066.01	615.97	1522.200
March, 1917	7	4105.45	43063.13	1310.400
April, 1917	1	169.96	58422.50	82.350
May, 1917	1	4814.34	4547.80	2952.738
June, 1917	2	2577.62	3957.60	739.250
July, 1917	3	1990.10	2517.50	450.300
Aug., 1917	2	233.00	458.00	40.1000
Sept., 1917	7	1012.08	204.00	351.000
Oct., 1917	17	20020.84	5588.20	4068.150
Dec., 1917	5	1620.17	150.00	160.300
Jan., 1918	11	9397.46	1020.80	978.200
Feb., 1918	11	7828.32	2091.80	958.500
March, 1918	8	4364.07	401.50	389.900
April, 1918	1	No interference in work whatsoever.		
May, 1918	13	13734.41	1517.55	1651.395
June, 1918	33	18421.14	2643.92	2050.410
July, 1918	47	17447.36	3509.83	2106.025
Aug., 1918	50	28091.29	1889.92	2881.883
Sept., 1918	44	22541.79	3797.60	2622.960
Oct., 1918	23	14427.83	932.75	1768.875
Nov., 1918	4	3769.21	78.00	400.645
Total	328	200899.73	153844.38	31101.962

Amounts Expended for Protective Purposes

	Marks
False roofing placed over factories	178,151.97
Bomb proofs for employees of the foundry	91,602.20
Bomb proofs for employees outside of foundry	37,587.13
Signal and communication arrangement for alerts	5,466.11
Balloons, anti-aircraft guns, etc.	112,115.32
Expenses of 30 French officers held as hostages at the plant for one year, to reduce the number of raids	*32,797.25
Total	457,719.98

*The factory was reimbursed for this expense by the 10th Landsturm J.E.Bn.,[b] from Magdeburg.

Measures for Protection

Attached is a blueprint drawing[c] showing a cross-section of a cement-screen set up between pieces of machinery (dynamos, motors, etc.) in the various sections of the plant. A bomb that exploded on the head of a motor would cause no damage to any of the adjacent machinery.

All the roofing at this plant which covered machinery of any value was covered by a second roofing, raised up about 3 feet over it. The material used in the "False Roofing" was on concrete, about 6 inches in thickness. A bomb scoring a direct hit on the "False Roofing" exploded there but did not penetrate below.

No bonuses were paid but the Company was obliged to increase the workmen's food supply owing to these raids. During the years of 1917 and 1918, each day, at various hours, hot soup, rice, etc., were served to the workmen as a compensation, and to stimulate those who suffered more consequences from these alerts and actual raids.

Moral Effect

The morale of the workmen was affected to the extent that when they "went on" again on their next shift, their physical strength was somewhat reduced and were incapable of working at their normal capacity, and would try to find some place to steal a rest.

Night bombing had greater effect upon the morale of the workmen. During the several raids that took place, some of the women employees became hysterical and their lack of control had its effect upon the workmen in the same building.

Night bombing at this plant scored all the effective hits and the consequent damages.

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Dillingen

Number of Raids: 62[a]
Number of Alerts: 89
Total Number of Hours Lost: 90 hrs. 27 min.
Total Amount of Damage: 296,881.61 marks
Expenditure for Protection: 150,000 marks

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Bous

Bous and Wadgassen (Report 33) are on the Saar, about halfway between Volklingen and Dillingen, while Merzig (Report 34) is farther down the Saar, about midway between Saarbrucken and Conz.

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The loss of production [at the Mannesmann Steel Works] owing to total stoppage of 454 hours [during 301 alerts] amounted to 9,437.5 tons, or, as stated approximately by the director of the factory, 7½ million marks. The actual damage resulting from bombs amounted to 8,621 marks.

Protection: In addition to being protected by the Saar Valley Balloon Barrage, it had several anti-aircraft batteries and searchlights.

Moral Effect: The men at this factory were not greatly disturbed but nevertheless found night raids more disquieting than day raids.

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Wadgassen

No material damage from bombs was recorded at this place.

The loss of production from alerts, however, was estimated at 48,000 marks for the glass factory of Villeroy & Boch, which was closed down for a total of 10 hours.

Anti-aircraft dropping on the office of the factory caused damage to the extent of 3,000 marks.

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Merzig

Number of Raids: 1
Number of Bombs: 4
Total Damage to Town: 22,600 marks

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Kreuzwald

The towns covered in this and the following eight reports are all situated within a radius of less than 40 miles west and south from Saarbrucken, Kreuzwald (Creutzwald-la-Croix) being about 14 miles west.

Note: The following information was derived simply from the memory of some of the office force of the Ste. des Mines de la Houve, records, etc., not being available.

Number of Raids: 7
Total Damage to Town: 80,000 Marks
Value of Loss of Production at Electric Plant: 10,000 Marks
Expenditures for Protection: 10,000 Marks

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Bouzonville

Bouzonville (Busendorf) is about 10 miles northwest of Kreuzwald.

No direct hits were obtained on the factory at this place but about 1/4 of the daily production was lost every time an alert was sounded. It was stated that alerts, lasting on an average of two hours, sounded about once daily from January 1, 1918, to November 11, 1918. The total tonnage lost in this way was 900 tons, representing a value of 360,000 Marks. One re-inforced concrete shelter was built at a cost of 12,000 Marks.

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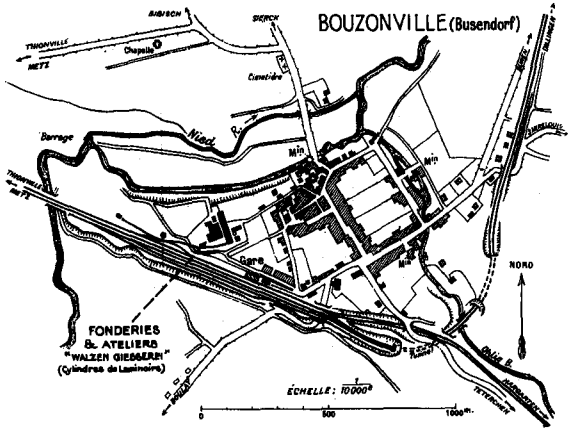
St. Avold

St. Avold, about seven miles south of Kreuzwald, is on the rail line between Metz (via Remilly) and Saarbrucken.

Station
June 15/16, 1917, 9:00 PM–10 PM, 16 bombs.
June 18/19, 1918, 11:30 PM, locomotive destroyed.
July 21/22, 1918, 11:40 PM, 4 bombs.
Aerodrome.[a]
No bombs ever dropped on the aerodrome.



Sketch of Bouzonville, taken from Intelligence files of AEF, GHQ.

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Bensdorf

Bensdorf (Benestroff) is east of Morhange, on the rail line between Metz and Saarburg.

Date	Time	Bombs	Damage
June 1, 1915	9.00 P.M.	6	No damage
June 2, 1915	12.00 Noon		
June 3, 1915		12	No damage
Sept 21, 1915	10.30 A.M.	77	Switch damage
Oct. 10, 1915	2.00 P.M.	4	No damage
Mar 3, 1916	1.30 P.M.	40	2 meters of double track destroyed
Apr 26, 1916	11.00 P.M.	9	No damage
Dec 27, 1916	10.20 P.M.	9	No damage
Feb 9, 1917	12.00	30	No damage
Jan 24, 1918	9.00 P.M.	2	
Feb 20, 1918	7.00 P.M.	6	No damage
May 27, 1918		8	
May 28, 1918	9.30 A.M.	23	
July 20, 1918	4.00 A.M.	4	
Aug 17, 1918	10.15	6	No damage

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Dieuze

At Dieuze, a town south of Bensdorf, on a branch rail line between Bensdorf and Avricourt, the chief industry was a salt works.

Dec. 23, 1914	Salt factory damaged, 300 francs. 1 bomb.
Feb. 13, 1916	No damage, 2 bombs.
Feb. 21, 1916	Few telegraph wires broken. 1 bomb dropped.
Apr. 9, 1916	No damage, 7 bombs dropped.
July 23, 1916	25 bombs in vicinity of barracks. Several soldiers killed
Sep. 3, 1916	3 bombs on factory. Damage, 1600 francs.
Feb. 16, 1917	3 bombs, no damage.
Mar. 16, 1917	16 bombs dropped on airdrome killing 13 horses and wounding 2 men.
Mar. 27, 1917	17 bombs, damage to buildings, 1,500 francs
Jul 6, 1918	Several bombs dropped, damage 7,000 francs
Jul 16, 1918	2 bombs near station, no damage.
Aug. 12, 1918	17 bombs, no damage
Sep. 14, 1918	3 bombs, vicinity of station.
Nov. 5, 1918	12 bombs near hospital, 1 killed. Morale not badly affected due to inaccuracy of bombing.

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Rechicourt

Rechicourt is between Avricourt and Heming, on the rail line from Nancy to Saarburg.

Date	Time	Bombs	Damage
Aug. 18-19, 1918	1:30 A.M.	13	No damage
Sept. 15-16, 1918	10:45 P.M.	12	No damage
Sept. 21-22, 1918	2:00 A.M.	13	No damage
Nov. 9, 1918	11:00 A.M.	4	No damage

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Heming

Heming is on the rail line from Nancy to Saarburg, about five miles southwest of the latter place.

Sept. 6, 1918, 12:30 A.M. to 2:30. 13 cars ammunition destroyed, 50,000 rounds 77.[a] 200 meters of double track torn up. Lothringen Cement Factory stopped work 2 days. Loss of production: 19,000 francs' worth of cement.

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Saarburg-Rieding

Rail lines from Strassburg, Nancy, Metz, and Saarbrucken meet in the Saarburg (Sarrebourg)-Rieding (Reding) area, about 35 miles south of Saarbrucken.

Resume of results of bombing:

Date	Time	Bombs	Damage
Saarburg			
Dec. 18-19, 1914	12 M	10	No Damage
Sept. 10, 1916	2 pm	15	No Damage
Aug 13, 1918	11:45 pm	16	Double track destroyed; 17 hours to repair
Sept. 15-16, 1918			Destroyed a train; 60,000 marks
Nov. 3, 1918	1:30 pm	16	Damage to station; 5,000 marks
Rieding			
July 12, 1918		15	No Damage
Sept. 2-3, 1918	11:00 pm		8,000 marks
Aug. 16-17, 1918	2:00 am	16	30 meters of

			double track destroyed
Sept. 21-22, 1918	2:00 am	10	50 meters of two double tracks destroyed

Rieding. No. 147[a] July 12, 1918

Today at noon (12 o'clock) an attempted aerial attack on the station at Rieding; about ten bombs of unknown calibre which fell at a distance of about 150 and 500 m from the railroad area. The number of aviators could not be ascertained because of the heavy clouds. [No ?] Damage to the railroad yards. No loss of personnel.

Reidel

Rieding. August 17, 1918

Tonight at 2 o'clock an aerial attack on the station at Rieding. Eight bombs of unknown calibre thrown. Two of them blinds. The tracks 20 and 21 were damaged by one bomb for a distance of about 30 m. The rest of the bombs fell in the vicinity of Signal 6 about 150 m south of the area. The number of aviators

Office of the Solvay Chemical Factory at Sarralbe, following the air raid of 22 August 1918.

could not be ascertained. No interruption of traffic. No damage to trains. No losses in personnel.

Tribschler

Rieding. No. 36. Sept. 3, 1918

Tonight from 10:50 P.M. to 3:15 A.M. uninterrupted attacks of enemy aerial squadrons on the station and anti-aircraft batteries. North of the area Sbg-Rd, on the other side of Signal L. About ten bombs—of unknown calibre—were dropped. Tracks not damaged. Because of the bombardment with incendiary bombs the shed was partly burned. Further the house situated south of the area Ho-Rd belonging to the railroad guard Bontre was completely reduced to ashes. The wagon 23758 SS at Saarbrucken also caught fire; 2 bottom boards burned. Coal loader Mupel slightly injured by bomb splinters.

Tribschler

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Sarralbe

Sarralbe (Saaralben) is about halfway between Saarburg and Saarbrucken.

Number of Raids: 1
Total Damage: 8,800 Francs
Expenditure for Protection: 0

The only damage ever done here was to the Chemical Factory of Solvay & Company on the night of the 22nd of August when one bomb fell on the roof of the office building, which amounted to 8,800 francs.

No special forms of defense were set up here with the exception of one mobile anti-aircraft gun. Employees found refuge from attacks in natural pits and quarries near at hand.

The workmen never complained over having to work under exceptional conditions and seemed to go on with their work as usual. No bonuses were ever paid. Alerts never lasted over fifteen minutes.

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St. Ingbert

St. Ingbert, about 8 miles east of Saarbrucken, on the Rohrback, a tributary of the Saar River, was an industrial town of some 20,000 people. At the center of an extensive coal-mining area, it was the site of large iron and steel works.

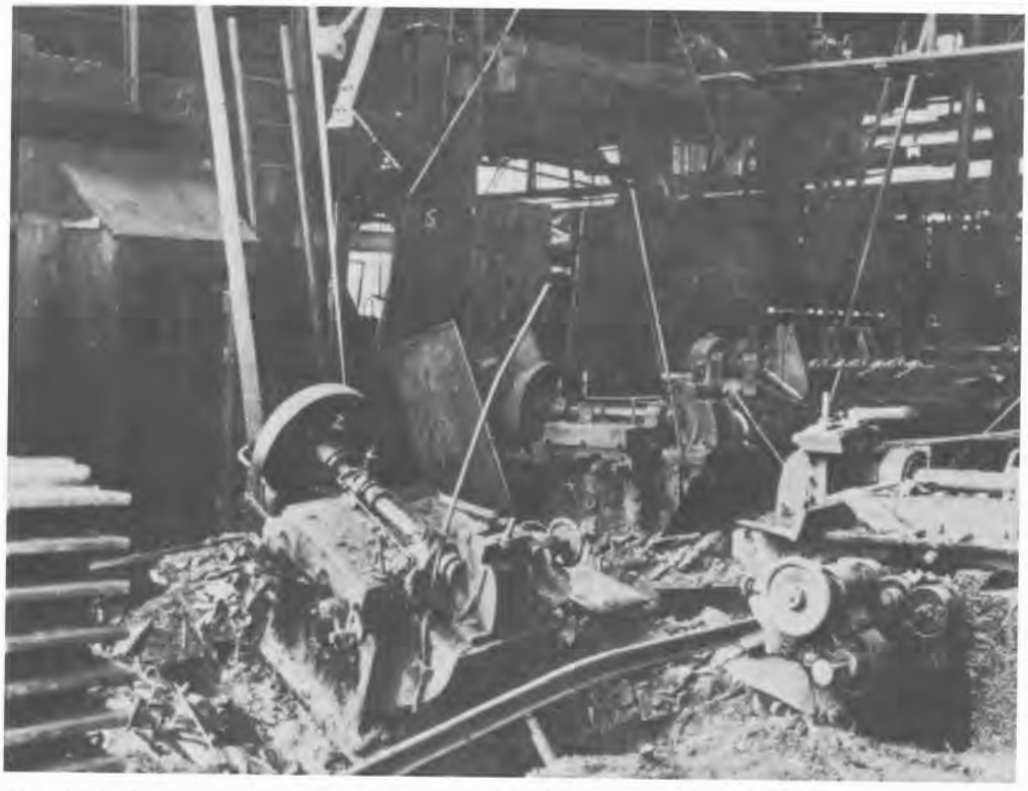
Number of Raids: 2
Number of Bombs: 7
Total loss due to both Raids and Alerts: 400,000 marks
Total loss of production due to both Raids and Alerts:
200,000 tons gun material
600 tons plain steel
600 tons bond steel
Total cost of protection: 20,000 marks

Only two raids were recorded at this place on the factory of Rumelinger and St. Ingbert Steel Works, at which 2,000 men are employed, one on August 9, 1915, when 6 bombs were dropped, again on November 11, 1917, when 1 bomb was dropped.

Officials of the factory stated that at each alert, during which as a rule 2 hours were lost, the loss in production represented 2,000 marks or, expressed in terms of the product, 600 tons of plain steel, 600 tons of bond steel, and 200,000 tons of gun material.

Cement shelters were constructed for the employees at a cost of 20,000 marks. No netting or false roofing was placed over the factories.

The efficiency of the employees was lowered only to a limited extent by the raids.



View of the Stumm Bros. factory at Neunkirchen, following the air raid of 17 July 1918.

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Neunkirchen
Stumm Bros. Factory

Neunkirchen, on the Blies, about 14 miles northeast of Saarbrucken, was an industrial city of iron and steel works, which, along with coal pits in the area, had been owned by the Stumm family since early in the 19th century.

No. off Raids: 3
No. of Bombs: 16
No. of labor hours lost through raids and alerts: 250
Amount paid for unproductive labor: 320,000 marks
Total loss of production: 8,550 tons of steel
Value of loss of production: 2,137,500 marks
Total damage to buildings: 300,000 marks
Expenditure for protection: 150,000 marks

Moral Effect: The workmen seemed to be glad to have a chance for a rest during the alerts. Night bombing had more severe effect on the morale because of the workmen not being able to take care of their families properly.

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Zweibrucken

Zweibrucken, southeast of Neunkircken and about 17 or 18 miles east of Saarbrucken, was an industrial town of some 15,000 people.

Number of Raids: 5
Total Bombs Dropped: 96
Total time lost through alerts and raids: 124 hrs. 18 mins
Total amount of damage: 86,041 marks
Expenditure for Protection: 15,514 marks
Loss in salaries due to alerts: 80,262 marks

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The city of Zweibrucken was affected with five air raids as follows:

Aug. 9, 1915. Raid announced at 8.00 A.M. All clear signal given at 8.10 A.M. Time, 10 min. Total number of bombs dropped, 38; Cost of damages, 28,468 Marks.

June 4/5, 1917. Raid announced at 11.45 P.M. All clear signal given at 2.35 A.M. Time, 2½ hours; Total number of bombs dropped, 27; Cost of damages, 16,209 marks.

Dec. 5, 1917. Raid announced at 2.05 P.M. All clear signal given at 2.43 P.M. Time, 38 minutes. Total number of bombs dropped, 9; Cost of damages, 13,743 marks.

Feb. 19, 1918. Raid announced at 10.05 A.M. All clear signal given at 11.00 A.M. Time, 55 minutes. Total number of bombs dropped, 8; No damages. All bombs dropped on the hills outside of town.

March 16, 1918. Raid announced at 12.00 M. All clear signal given at 1.00 P.M. Time, 1 hr. Total number of bombs dropped, 14. Cost of damages, 27,621 marks.

The city had no protection of any kind during the first raid. Later two batteries of anti-aircraft guns were furnished by the military authorities, cost of same not known. Search lights, fire clock and signal bombs and shelters were all bought or built at an expense of 13,514 marks to the city. Signal bombs and factory sirens were used announcing air raids. Nearly all business and shops were closed during air raid announcements.

The railroads were not bombed in this town.

Information pertaining to the production of war material in the two factories [in] Zweibrucken shown as follows:

Peschee Factory. 15c shells were produced at the rate of 250 daily, money value of same being 24,000 marks.

All operations ceased during air raids—hours of work lost during announcements should be taken from the city report as no record of air raids were kept at the factory.

260 persons were employed, total cost of daily wages being 2,040 Marks.

No means of defense for the protection of employees. A cell was built by the factory for the protection of its employees at an expense of 2,000 Mks.

No bonus was paid employees, but full pay was received by them during the time they were under shelter due to air raid announcements.

No part of this factory was ever bombed during the war.

Dingler Sche Machinfabrik. 15c shells were produced at the rate of 1,100 daily, money value of same being 53,000 Marks.

All operations ceased during air raids. Hours of work lost during these raids should be taken from the city report as no record of air raids were kept at the factory.

620 persons were employed, total cost of daily wages being 15,000 marks.

No means of defense for the protection of employees. Cellars only were used for protection against air raids which were constructed before the war.

No bonus was paid employees, full pay was received by them during the time they were under shelter due to air raid announcements.

No part of this factory was ever bombed during the war.

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Pirmasens

Ten miles east of Zweibrucken is Pirmasens, an industrial city with a population at that time of about 40,000 people.

Number of Raids: 4
Total amount of damage: 465,000 mks.

Date of Raid	Announced	Number of Bombs	Material Damage Marks	Killed
Oct. 30, 1917	12.00 noon	9	120,000	1
Feb. 20, 1918	12.45 P.M.	7	80,000	2
Feb. 8, 1918	12.18 P.M.	6	90,000	2
Oct. 30, 1918	9.40 P.M.	6	175,000	5
Totals		28	465,000	10

The above figure for material damage represents a total of 791 claims submitted for damage but does not include an almost equal number of claims which were paid through insurance companies.

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Kaiserslautern

Kaiserslautern, which then had more than 50,000 people, is situated between Saarbrucken and Mannheim. Its industries included large iron and steel works.

Number of Raids: 7
Total Time Lost: 54 hours[a]
Total Material Damage: 1,850,000 Marks
Total Loss of Production: 387,990 Marks

. . . . . .

1. The city of Kaiserslautern was affected with seven air raids, as follows:

Nov. 1st, 1917. Raid announced at 3.05 P.M. All clear signal given at 3.45 P.M. Time, 40 min. Total number of bombs dropped, 3. Nobody killed nor injured. Cost of damages, 100 marks.

March 17th, 1918. Raid announced at 12.15 P.M. All clear signal given at 1.20 P.M. Time, 65 min. Total number of bombs dropped, 21. Persons killed, 6; injured, 10. Cost of damages, 350,000 marks.

July 2nd, 1918. Raid announced at 12.47 A.M. All clear signal given at 1.57 A.M. Time, 1 hr. 10 min. Total number of bombs dropped, 8; nobody killed nor injured.
Cost of damages, 500 marks.

July 7th, 1918. Raid announced at 4.13 P.M. All clear signal

given at 5.15 P.M. Time, 1 hr. 2 min. Total number of bombs dropped, 15; persons killed, 1; injured, 3. Cost of damages, 600,000 marks.

Sept. 14, 1918. Raid announced at 10.10 P.M. All clear signal given at 11.47 A.M. Time, 1 hr. 37 min. Total number of bombs dropped, 10. Persons killed, 4; injured, 2. Cost of damages, 150,000 marks.

Sept. 25, 1918. Raid announced at 10.06 A.M. All clear signal given at 10.45 A.M. Time, 39 min. Total number of bombs dropped, 11. Persons killed, 0; injured, 2. Cost of damages, 150,000 marks.

Oct. 21st, 1918. Raid announced at 8.12 P.M. All clear signal given at 10.54 P.M. Time, 2 hrs. 42 min. Total number of bombs dropped, 4; persons killed, 1; injured, 5. Cost of damages, 600,000 marks.

2. The military authorities furnished the city with 16 anti-aircraft guns, several searchlights and signal bombs, cost of these not known by the civilian authorities . . . . The factory sirens, telephones and signal bombs were used announcing air raids. No shelter of any kind was built for the population, therefore there was no expense to the city in that respect. All business in the city was practically at a standstill from the time of each air raid announcement until the signal of "all clear" was given.

3. During the raid of Sept. 14th, one bomb was dropped on the railroad near the main railroad station damaging 2 box cars to the extent of 2,000 marks; there was no suspension of traffic or other damages to the railroad during this raid or any other.

4. Information pertaining to the production of war material by the 4 factories in Kaiserslautern are as follows:[b]

Greist-Werke Factory. Cartridge clips were produced at the rate of 20,000 daily, money value of same being 600 marks.

All operations ceased during air raids. Hours of work lost during announcements should be taken from the city report as no record of air raids were kept at the factory.

30 girls were employed at this work, total cost of daily wages being 200 marks. Working hours were from 7.00 A.M. to 6.00 P.M., night and Sunday work excluded.

No means of defence for the protection of employees. Cellars only were used for protection against raids which were constructed before the war.

No bonus was given employees but full time was paid them during the time they were under shelter due to air raid announcements.

On the night raid of Oct. 21st, 1918, one bomb fell directly upon the factory putting it entirely out of commission, damaging it to the extent of 350,000 marks.

The explosion of a 112-lb. British bomb collapsed the wall of the building in the photo.

Gutz Armaturwerk Factory. War material was produced in this factory as follows:

(Kind of shells)	(daily production, 24 hours).
15 c	600
21 c	200
7.6 c	800
10.4 c	200
Hand grenades	4000 to 5000.
Small arm shells	not known.

Daily money value of this production estimates at 75,000 marks.

All operations ceased during raids. Hours of work lost during announcements to be taken from the city report as no records of raids were kept at the factory.

1,400 persons were employed, total average of daily wages being 14,000 Mk. 12 hour work day, day and night shift, Sundays included.

No means of defence for the protection of employees. Cellars and shelters were built by the factory for the protection of its employees at an expense of 40,000 marks.

No bonus was paid employees. No wages were paid them while they were under "shelter." Everybody was paid on a "piece work" proposition.

No part of this factory was ever bombed during the war.

G. M. Pfaff Werke Factory. Locks for machine guns were produced at a rate of 200 sets daily, money value of same being 40,000 marks.

All operations ceased during air raids. Hours of work lost during announcements should be taken from the city report as no record of raids were kept at the factory.

About 800 persons were employed. Total cost of daily wages being about 9,000 marks. Hours of work from 7.00 A.M. to 6.00 P.M. No night work.

No means of defence for the protection of employees. Dugouts were built for the protection of employees at an expense to the factory of about 10,000 Mks.

No bonus was paid employees but full time was paid them during the time they were under shelter due to air raid announcements.

No part of this factory was ever bombed during the war.

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Landau

The targets of the raids mentioned in the following report were barracks and the railway station at Landau, a town of some 14,000 people, about 25 miles southeast of Kaiserslautern and about the same distance southwest of Mannheim.

Number of Raids: 3
Number of Bombs: 29
Total Amount of Damage: 310,809.88 marks

Date of Raid	Time	Duration Hr—Min	Killed	Bombs Dropped
1918				
May 20	11.30 A.M. to 12.30 P.M.	1	3	17
June 30	8.36 A.M. to 9.05 A.M.	29	0	6
June 30	1.12 A.M. to 2.27 A.M.	1 15	0	6
Totals		2 44	3	29

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Karlsruhe

Allied planes flew many bombing missions to cities on the Rhine River and caused many more alerts in the area. Karlsruhe, being east of the river and outside the zone of occupation, was beyond the reach of Americans investigating the effects of Allied bombing. Consequently, the Americans could not obtain detailed information about the raid the French made on 15 June 1915 in reprisal for the Germans' shelling of Verdun and Nancy. Nor could they report anything except casualty figures for the French raid of 22 June 1916, which caused the Germans to reorganize and strengthen the home defense against aircraft.

Note: It being impossible to go directly to Karlsruhe, the following is all the information procurable.

Date of Raid	Killed	Wounded
June 15, 1915	30	55
June 22, 1916	117	152
Feb. 9, 1917	1	2
May 31, 1918	5	100
June 25, 1918	1	
April 11, 1918		6
Aug. 22, 1918	10	5
Sept. 15, 1918		2
Sept. 20/21, 1918		4
Total	164	326

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Speyer

About 20 miles north of Karlsruhe, on the left side of the Rhine, is Speyer, a historic city with a famous 11th-century cathedral. The only bombing there apparently was by the British on the night of 21/22 July 1918, when the assigned target for Handley Pages of Squadron 216 of the Independent Air Force was at Mannheim.[a]

Number of Raids: 1

Number of Bombs: 5
Total Damage to City: 23,329.22 marks
Total Damage to Railroad: 5,952.11 marks

July 22, 1918. Raid lasted from 1:36 A.M to ? Five bombs were dropped around the station damaging property of 42 people to the extent of 23,329.22 marks. This was the only raid on this town. No protection whatsoever was built against air raids.

R. R. Speier. One bomb destroyed a switch track which was repaired by 15 men in about 6 days at a cost of 2,950 marks. Traffic was not delayed in the least.

Windows in buildings and several small buildings were damaged which was repaired at a cost of 3,002.11 marks.

Information obtained from Burgomeister.

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Ludwigshafen

The Badische Anilin- und Sodafabrik was regarded by the British as one of the most important targets for their strategic bombers. Founded in 1865, the company made aniline dyes and nitrogen. Its main plant, one of the largest chemical factories in the world, occupied the northern part of Ludwigshafen, a city of some 90,000 people, on the left bank of the Rhine, opposite Mannheim.[a] A branch plant was situated nearby, at Oppau, just north of Ludwigshafen.

Resume of Result of Bombing

Number of raids: 22.
Total damage to city and private property: 1,565,230.50 M
Damage to military stores: 210,000.00 M
Expenditures for protection: 168,000.00 M
Total expenditures paid to dependents of killed and wounded, including funeral expenses: 1,607,000.00 M
Damage to Railroad:
Direct damage by bombs: 44,012.91 M
By anti-aircraft: 395.90 M
Expenditure for protection: 25,000.00 M

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Factories. Although there are numerous factories in this town, all bombing raids seem to have been concentrated on but one plant; viz., The Badische Anilin & Soda Fabrick (See below). A

few of the other plants received only isolated bombs and the majority of the material damage was caused by anti-aircraft guns. However, all suffered indirect damage from loss in production, insurance premiums, cost of bomb proofs, etc. Below are statements on six of the largest plants in this town and it is safe to assume that the remainder of the factories—about 18 in number—also suffered in proportion, but as these are all small plants employing between 20 and 100 people, it was impossible to get detailed information. The following covers all the important plants in town:

1. The Badische Anilin & Soda Fabrick. This plant manufactured poison-gas-chemicals during the war, and was the objective for all Allied bombing in this section . . . .The total grand [of damages], about 6,700,000 marks, shows that considerable damage was inflicted but the moral effect seems to have been enormous also. From various conversations with the chief director, it was this moral effect which also considerably curtailed production. A total of 13 workmen and 1 soldier were killed in all raids, and others suffered injuries, but these were all covered by insurance. However, these deaths also helped to lower the morale of the workers, which seems to have suffered considerably.

2. Gebruder Guilene. Also a chemical plant, located in Mundenheim[b] (near Ludwigshafen). Only 4 bombs in all dropped on this plant, and no great material damage was caused. No records were kept regarding production, loss, etc....The morale of the workers employed here seems to have suffered considerably also, although not to the extent of the "Badische" plant.

3. Ludwigshafener Walzmuhle. No bombs fell on this plant, but as this plant was run on a 24 hour a day working schedule, a considerable production loss was caused by the various alarms. . . . As this plant is concentrated in one five-story building, a bomb-proof was constructed by simply blocking up a few of the basement windows, and this, as well as the fact that the plant was never hit, served to keep up the morale of the workers.

4. Gebruder Sulzer.
   H. Hessenmuller.
   Dr. F. Raschig.

A statement from each of these firms regarding bombing damage shows that very little material damage was caused by bombs, and the majority of loss was occasioned by anti-aircraft fire, insurance premiums, and production loss. . . . The effect on morale does not seem to have been very marked, as bombs were not dropped often enough on these plants.

Badische Anilin & Soda Factory
General Summary of Damages

1. Direct damages on Buildings	284,109.00M.	
Machinery, etc.	142,414.00	
Material	92,787.19	
		519,310.10
2. Insurance Premiums		
Buildings, material, etc.	393,205.80M.	
Personnel Insurance	60,519.75	
	453,725.55	
Deduct amount paid by insurance companies	134,622.73	
Loss		319,062.82
3. Cost of Bomb-proofs, etc.		
A. Bomb-proofs, building protections, & window barricade	1,529,751.72	
B. Light-proofing windows	150,720.88	
C. Camouflaging Gasmeters (?)	27,719.11	
D. Camouflaged factory (for deceiving nightbombers)	95,619.79	
		1,803,811.50
4. Indirect Damage.		
Production loss caused by work stoppage & interruptions.	3,299,198.00	
Amount paid and unproductive as wages and salaries	740,972.00	
		4,040,170.00
Grand Total		6,682,354.51

Ludwigshafen. Air Raids

May 27, 1915	Raid lasted from 7.00 A.M. to 7.45 A.M. 40 bombs were dropped in north part of city. 19 people killed and 8 wounded.
Sept. 22, 1916	Raid lasted from 12.00 midnight until 12.40 A.M. No bombs fell in Ludwigshafen; all fell in Mannheim.
Jan. 3/4, 1917	Raids lasted from 9.00 P.M. to 9.40 P.M., 11.07 P.M. to 11.27 P.M., 3.25 A.M. to 4.00 A.M. Five bombs were dropped in this city, the rest in Mannheim.
July 27, 1917	Raid lasted from 1.15 A.M. to 1.40 A.M. 40 bombs were dropped.
Dec. 24, 1917	Raid lasted from 12.50 A.M. to 1.20 A.M. 2 bombs were dropped in this city, the balance in Mannheim.
Jan. 24, 1918	Raid lasted from 9.00 P.M. to 9.45 P.M. 3 bombs were dropped.

Feb. 18, 1918	Raid lasted from 11.25 P.M. to 11.50 P.M. 2 bombs fell on wood storage of chemical factory.
Mar. 18, 1918	Raid lasted from 12.20 P.M. to 2.00 P.M. 14 bombs were dropped, 6 people killed and 18 wounded.
Mar. 24, 1918	Raid lasted from 12.20 A.M. to 2.25 A.M. 13 bombs were dropped, killing 4 people and wounding 13.
Mar. 24, 1918	Raid lasted from 12.45 P.M. to 1.40 P.M. 14 bombs were dropped, wounding 9 people.
May 22, 1918	Raid lasted from 1.00 A.M. to 1.30 A.M. 26 bombs were dropped.
May 23, 1918	Raid lasted from 12.00 midnight to 12.45 A.M. 20 bombs were dropped on chemical factory and around factory.
May 28, 1918	Raids lasted from 12.55 A.M. to 1.45 A.M., 2.25 A.M. to 2.40 A.M. 6 bombs were dropped in open field between Freisenheim[c] and Ludwigshafen.
June 27, 1918	Raid lasted from 1.20 A.M. to 1.45 A.M. 9 bombs were dropped, the most of which fell in chemical factory.
June 30, 1918	Raid lasted from 1.20 P.M. to 1.50 P.M. 10 bombs were dropped on city and chemical factory, killing 4 people and wounding 4
July 20, 1918	Raid lasted from 12.20 P.M. to 12.50 P.M. 17 bombs were dropped on the city.
Aug. 15, 1918	2 raids lasted from 11.15 P.M. to 11.30 P.M., 12.45 A.M. to 1.00 A.M. 10 bombs fell in Mundenheim.
Aug. 26, 1918	Raid lasted from 10.50 P.M. to 11.50 P.M. 18 bombs were dropped on city and chemical factory.
Sept. 7, 1918	Raid lasted from 1.50 A.M. to 2.35 A.M. 21 bombs were dropped, injuring 1 person.
Sept. 16, 1918	Raids lasted from 2.15 P.M. to 2.45 P.M., 3.05 P.M. to 3.35 P.M. Only 1 bomb fell in this city, the rest in Mannheim.
Oct. 24, 1918	Raid lasted from 8.40 P.M. to 10.20 P.M. 4 bombs fell on chemical factory.
Oct. 30, 1918	Raid lasted from 10.00 P.M. to 12.15 A.M. 11 bombs fell in north part of Mundenheim and in open fields.

Alarms

July 30, 1915	11.00 A.M. to 11.40 A.M.
Jan. 6, 1918	4.30 A.M. to 5.05 A.M. Raid on Mannheim.
Feb. 20, 1918	11.40 P.M. to 12.10 A.M. Raid on Mannheim.
Mar. 17, 1918	12.30 P.M. to 1.10 P.M. Raid on Kaiserslautern.
May 20, 1918	11.15 A.M. to 11.45 A.M.
June 29, 1918	8.40 A.M. to 9.05 A.M.
June 30, 1918	8.40 A.M. to 9.10 A.M.
July 7, 1918	4.30 P.M. to 4.55 P.M.
July 19, 1918	12.40 A.M. to 1.20 A.M.

July 31, 1918	9.55 A.M. to 10.10 A.M.
Aug. 16, 1918	8.30 A.M. to 8.52 A.M.
Aug. 21, 1918	1.10 P.M. to 1.50 P.M.
Aug. 22, 1918	11.20 A.M. to 12.00 Noon.
Aug. 22, 1918	12.35 P.M. to 1.10 P.M.
Aug. 22, 1918	9.00 P.M. to 9.20 P.M.
Aug. 23, 1918	11.05 P.M. to 11.40 P.M.
Sept. 14, 1918	10.30 P.M. to 11.30 P.M.
Sept. 15, 1918	1.05 P.M. to 1.40 P.M.
Sept. 15, 1918	11.00 P.M. to 11.20 P.M.
Sept. 21, 1918	9.20 P.M. to 10.20 P.M.
Sept. 25, 1918	11.45 P.M. to 12.08 A.M.
Sept. 25, 1918	12.30 A.M. to 1.05 A.M.
Oct. 21, 1918	4.05 P.M. to 4.15 P.M.
Oct. 21, 1918	8.25 P.M. to 8.50 P.M.
Oct. 21, 1918	9.30 P.M. to 10.15 P.M.

Damage to private parties and to the city amounted to 1,565,230.50 M.

Expenses for funerals, hospital bills, etc. for people killed and wounded was 10,000 M.

Erecting special tombstones at graves of people killed in air raids, 5,000 Marks.

Money advanced to dependents of those killed and hospital bills for wounded, 32,000 M.

Money that state will have to pay to dependents of people killed and those totally disabled, 1,560,000 Marks.

Expense of making cellars in public buildings bomb proof, 78,000 M.

Installing signal alarm system, 10,000 M.

Preparing quarters in school buildings for people whose homes were destroyed by bombs, 40,000 Marks.

Maintaining a flying raid bureau to May 16, 1919; has cost 30,000 M., and before its work is completed, will cost another 10,000 Marks.

On the raid of Mar. 24, 1918, 13 full military gasoline tank cars were punctured and quite a quantity of gasoline was lost; loss estimated at 210,000 Marks.

All business houses were closed during a raid or alarm.

In the opinion of a number of people interviewed, the raids had a great effect on the population in this area, causing nervous breakdowns and generally impairing their efficiency.

Night raids had the greatest effect both on the morale of the people and in amount of damage caused.

Damage to R.R., Ludwigshafen

July 27, 1917	One bomb fell alongside of switch tracks, damaging one R.R. car traffic was not delayed and damage was repaired at a cost of 1,434.74 Marks.
Jan. 3, 1918	3 bombs fell in R.R. yards damaging one locomotive and 4 passenger cars, traffic was not delayed and damage was repaired at a cost of 1,593.42 Marks.
Jan. 6. 1918	1 bomb was dropped in R.R. yards, destroying one main line track which could not be used for six hours, traffic was not delayed but switched around damaged. Damage was repaired at a cost of 805.81 Marks.
Jan. 24, 1918	One bomb fell between Ludwigshafen and Mannheim, damaging the telephone line which was repaired at a cost of 42.84 Marks.
March 18, 1918	3 bombs fell in R.R. yards at station, damaging one main line and several pasenger cars; also the telegraph lines. One main line could not be used for one hour but traffic was not delayed. Damage was repaired at a cost of 7,201.35 M.
March 24, 1918	4 bombs fell on main line between Ludwigshafen and Mannheim delaying traffic for 3 hours and hindering work at the R.R. Rhine harbor for several days, 13 gasoline tank cars and 10 freight cars were also damaged. Damage was repaired at a cost of 28,000 Marks.
May 21-22-23-27-28, 1918	Quite a lot of damage was done to R.R. buildings and rolling stock which was repaired at a cost of 4,484.75 M.
June 27, 1918	Damage by anti-aircraft guns, 139.90 Marks.
July 20, 1918	One line over Rhine bridge was not used for 3 weeks because of changing a girder which had been damaged by a bomb on a previous raid. Cost to repair damage 450 Marks.
Oct. 23, 1918	Damage by anti-aircraft to building repaired at a cost of 256 Marks.
	Expense of shading lights in R.R. yards and buildings, 6,700 Marks.
	Installing alarm system in R.R. yards, 2,900 Marks.
	Building bomb proofs and making station cellar bomb-proof, 15,400 Marks.

No special crews were kept on hand to repair damage by bombs.

No bonus of any kind was paid to employees.

During the first year of the war, bombing had no great effect on the morale of the employees but as the raids became more frequent and the sizes of the bombs larger, the efficiency of the employees was very much impaired.

During a raid and alarm, all traffic was stopped and in the opinion of R.R. officials the greatest damage sustained at this point was from idleness during a raid or alarm.

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Worms

Worms, a commercial and manufacturing city of some 40,000 people, had no great war plants and was not a primary target for Allied bombers. The three attacks reported by the American survey team, the first by the French, and the other two by the British, were made by planes which had been sent to nearby targets at Mannheim or Ludwigshafen.

Number of Raids: 3
Total Amount of Damage: 120,300 Marks

The city of Worms was protected against air raids by anti-aircraft batteries and searchlights. All information on these is in the hands of the military authorities.

There were 3 raids on the city. . . . First: 6/7 July, 1917, 20 bombs were dropped in the outskirts of the city in the neighborhood of the prisoner of war camp, damage amounted to about 300 M. Second 15/16 August, 1918, 2 bombs fell in the Rhine. Third: 28/29 October, 1918, 1 bomb fell between the junction of two railway tracks, and damaged several cars on a siding but did not injure the tracks or hold up traffic, material damage amounted to about 120,000 M.

Railroads. There were 3 different warnings: (1) Danger from the air (Luftgefahr); (2) Danger of flyers (Fliegergefahr); (3) Flyer alarm (Flieger-alarm). No. 1 & 2 were merely preparatory, at 3 all trains were stopped by the dispatcher and from a central switch all electric lights in the station were extinguished. The passengers in trains went into the tunnels under the platform and those in stations to the cellar.

The only bomb which fell near the railroad destroyed 4 freight cars partially and slightly damaged the track. There was no congestion for neighboring track was used. Usual yard crew repaired damage.

Herr Rohmann stated that schedules were badly disrupted due to these delays. Trains from Ludwigshafen 21 K. distant were frequently two hours late.

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Mainz

Mainz (Mayence), on the Rhine just below the influx of the Main, was a commercial and manufacturing city of some 100,000 people. Furniture, shoes, and sparkling wine were its chief products. There was some war industry in the city but no great establishment comparable to the chemical works at Ludwigshafen that could be singled out as major industrial targets for Allied bombers. The two raids reported by the American survey team were flown by the Independent Air Force, the target for the first being factories, barracks, and railways, and for the second, the railway station.

Number of raids: 2
Total time lost: 18 hours, 30 minutes[a]

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Results of Allied Bombing

The protections of Mainz against air raids, as in the case of most German cities, were entirely in the hands of the military authorities and definite information on all points could not be gotten. It appears that there were sixteen anti-aircraft batteries around the city, and many searchlights. Further information was not available. The city government took no special precautionary measures other than publishing how alarms would be given from the "Militarische Polizeicentral Telephone" and marking good cellars to be used as refuges.

There appear to have been only two raids on Mainz, March 9, 1918 and Sept. 15, 1918 . . . . The raid reported to have taken place on Oct. 23-24, 1918, is absolutely denied. (. . . [In] the first raid . . . eleven persons were killed and many wounded.) The second raid took place during the night and it is asserted that none were seriously injured nor were buildings damaged; the greatest injury was done on the Johannes Kirche. No fires resulted from bombing. Except for splinter marks on walls no traces of bombing can now be observed.

As far as could be gathered from direct questioning the morale of the population was not affected by alarms, but from slips in the conversation and one or two confidential sources it appears that they were quite worried. The people and authorities were surprised at the few times the city was bombed, since planes were almost continually over Mannheim and Frankfurt-a-M. They

attribute the sparing of the city either to the fact that it was known that many Allied officer prisoners were kept in Mainz, or to the fact that the Allies wished to get possession of the town intact.

There were not enough raids to compare results of day and night except that more people were caught in the street during the day. During alarms all street car traffic and business stopped in town.

Insurance

Frankfurter Allgemeine Versicherungs Akt.-Ges. This was undoubtedly the largest company dealing in air-raid insurance in Germany; it is estimated that it had perhaps one-fourth to one-third of all that type of business in Mainz. Rates:

1/2 M per 1000 M on real estate; 1/3 M extra if offices in house.

2/3 M per 1000 M on certain retail stores.

1-1/4 M per 1000 M on munition factories.

Herr Harburger estimated that he had collected premiums of between 50 and 60,000 M for all air raid insurance, during last year of war (real and personal) in Mainz and surroundings.

Providentia Ins. Co. Estimated that they had 1/10-1/15 of the air raid insurance policies of Mainz. Premiums on policies amounted to from 5 to 6,000 M per year.

The remainder of the air-raid insurance business was scattered among many companies having agents in Mainz, but no one of these was of great size.

Railroads

On three occasions only were trains held up. July 2, 1918, 4 trains lost a total of 2 hrs. 10 min. Aug 20, 1918, 5 trains lost a total of 3 hrs. 19 min. Sept. 16, 1918, 13 trains lost a total of 7 hrs. 50 min.

This is the total of trains actually stopped and causing congestion. No bombs made direct hits on tracks, but from those which fell near tracks, damage to railway property—glass, wires, etc.—amounted to 1871.80 M. No tie-up in traffic resulted from these bombs, nor were special preparations in the way of crews made in case bombs should strike the tracks.

Factories of Mayence

All the factories of the City of Mayence were connected with the central military telephone office so that all had the same warnings and alarms. The signal Tuftgefahr was preparatory warning and only on the further notice of Fliegeralarm did work in the factories stop. The approximate time lost for each factory

was twenty hours. Other manufacturers had no exact records of time lost and estimated it from ten hours to sixty. I believe the higher estimates are due to the increase in alarms toward the end of the war.

Gasapparat & Gusswerk, Akt.-Ges., Mainz.
Personnel: 1,000 men; 2,800 women.
Daily production: 12,000-15,000 fuses; value 200,000 M.
Production lost about 10,000-13,000 fuses; 17,164 M wages, production 148,100 M.
Factory insured, premium cost 12,000 M per year.
For protection, 5,000 M was spent in reinforcing and building 14 cellars.

Firma Werner & Merz
Personnel: 700 men and women.
Product per day:
10,000 field cookers (same purpose as solidified alcohol, but paraffine used); value 35,000 M.
5,000 trench lamps (burned paraffine with wooden wick; known as Hindenburg Lampe); value 7,500 M.
5 tons paraffine, also shoe and metal polish, 10,000 M.
Loss, including labor:
10,000 cookers, 40,000 M
5,000 lamps, 7,8000 M
5 tons paraffine, 10,500 M.
Insurance: 10 million M premium cost 13,000 M per year.
Protection: used ordinary factory cellars. Warning siren installed; cost 250 M.

Gasmesserfabrik
Personnel: 1400, 1000 of these worked on fuses.
Product: 5000 fuses for 150 MM howitzer and field artillery; value 60-75,000 M. Loss equalled approximately one day's production; all labor on piecework basis, so no wages lost.
Insurance: 1 M per thousand on fire insurance, amounted to 2,000 M every 3 months.
No special protection. This factory is in the central part of town and was the nearest of any in Mainz (approximately 500 yards) to a spot where a bomb fell.

Julius Komheld
Employees: 300 men and women.
Product daily: 350 shells cast and turned; value 10,000 M
Also foundry: Loss including wages: 350 shells, 16,000 M.
No insurance or special protection.

Sichel u Cie G. m. b. H.

This is merely a warehouse handling plates, bars and other rolling mill products. Employees, exclusive office force, 8 to 10 men who handled 4-5 tons a day, valued at from 4-5,000 M. Loss due to alerts inconsiderable.

Johann Schmahl, Mainz-Mombach

Personnel: 150, chiefly men.

Product: 32 tons per month of light gauge locomotive bodies without driving mechanism; wheels for same, 100,000 M per mo.

Loss about 1-2 tons, 8-15,000 M, including wages.

Insurance: 1 million M premium 1300 per year. No special protection.

Verein fur Chem. Industrie. Chemische Fabrik, Mainz

Personnel: 25 men and women, including 50 prisoners of war.

Product per day: 500 kg. of "dope" for airplane linen, value 10,000 M.

Loss, including wages: 50 kg., value 14,000 M.

Factory was insured but amount not known as policy kept at main office of the "Verein" in Germany. No special protection, but the City of Mainz installed the siren used for warning the suburb of Mombach, in this factory. It was stated that employees considered alarms a joke.

Munitionsanstalt, Mainz

Personnel: 1,000 women, 50 men.

Product: (this was a government arsenal, so no prices for cartridges can be given) 300,000 small arms cartridges assembled only in 24 hours.

Pay of employees, basis of 9 hour day:

500 women 5.95

50 men 7.02

400 women 5.95 & bonus of 10 pf hr. extra for night work.

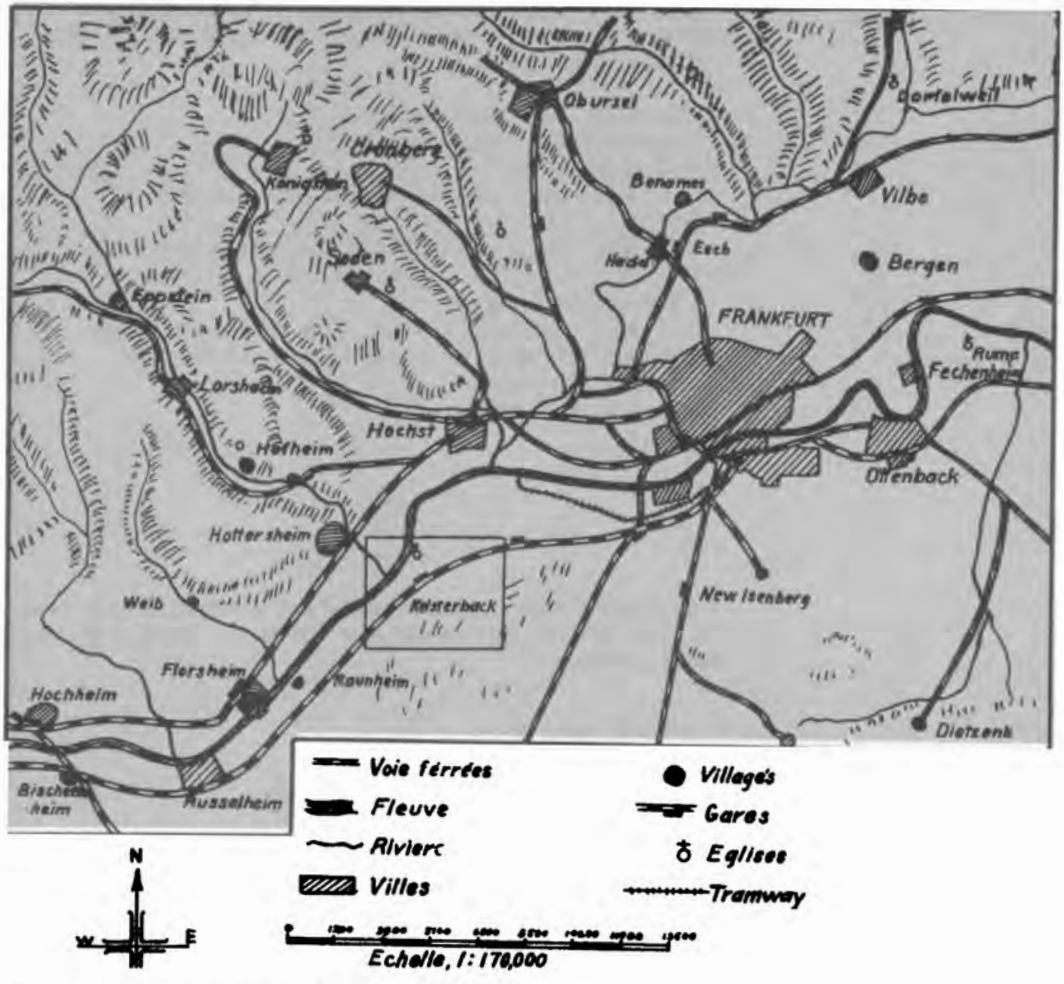
Loss due to alerts: about 6,500 M in wages, 300,000 cartridges.

Herr Hasselmann stated that the plant had about 100 women on the sick list, due to poor food, nervousness over air alerts, and other causes.

During alerts the employees went to one of the neighboring forts. A bomb struck this but appears to have been a "dud", for I was assured that the hole made in the ground was barely noticeable.

No insurance or protection.

Map sketch of Frankfurt, taken from Intelligence files of the AEF, GHQ.



Chemische Fabrik Ludwig Meyer
Personnel: 100 men and women
Product per month:
21,000 batteries for electric lights, value 25,000 M.
48,000 Kg of poison to protect seeds against birds, mice, etc.; substitute soap, etc., 25,000 M.
Loss, including pay: 700 batteries: 1100 M; 1600 Kg misc. 1300 M.

Insurance premium of 308.10 M was paid for the period from Sept. 1918, to July 1919, and the manager is still wondering whether he can recover from Nov. 1918. A loss of 100 M is estimated due to skylights broken by anti-aircraft shell splinters.

No special protection.

Waggonfabrik Gabr. Gastell G. m b. H.

Personnel: 1000, mostly men.

Product per month:

100 light railway cars with double trucks (8 wheels), 500,000 M.

100 light railway cars with single trucks (4 wheels), 170,000 M.

Also ordinary wagons.

Lost about: 3 of each type cars, value 30,000 incl. wages.

Insurance: 600,000 M at rate of 1-1/3 M per thousand premium; 800 M per year.

No special protection.

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Frankfurt

Frankfurt-am-Main, a commercial and industrial city of more than 400,000 people, presented a number of good targets for Allied bombers.

Number of Raids: 9
Number of Bombs: 108
Total Amount of Damage: 1,750,000 Marks
Expenditures for Protection: 75,000 Marks

The city of Frankfurt A.M. at the time investigated was not occupied by any Allied troops and for that reason there was nothing to compel the authorities morally or physically to give any information concerning air raids, so that a report is necessarily limited to that information given freely in response to questions.

The city was protected by anti-aircraft guns and searchlights, but all this information is in the hands of German military authorities . . . .

There were nine actual raids, the number of alerts must have been at least equal to those of the suburb of Hochst which totaled almost 100.

Frankfurt spent approximately 75,000 Marks building and reinforcing cellars for the protection of the people; these municipal refuges could accommodate between 15 and 20,000 people. If the war had continued, it was planned (in fact the plans were completely drawn up at the time of the armistice) to build shelters for the workers in the Osthaven at an expense of 1,000,000 Marks.

. . . . . .

Resume of the Results of Bombing on the Chemical Factory of Meister, Lucius & Bruning, Hochst[a]

Number of Alerts: 98
Total Time Lost: 19 Hrs. 27 Min.
Expenditure for Protection: 435,145 Marks
Insurance Premiums: 223,722 Marks
Bonuses Paid 2,290 Marks
Value of Loss of Production: 5,858,173 Marks.

Interviewed Herr Dr. Jonka, Oberburgermeister, of Hochst in regard to official information on air raids. He stated that the town had anti-aircraft and searchlight protection but that exact information concerning this was in the hands of the military authorities in Germany. All this equipment was maintained by the Army at no expense to the city.

Although there were numerous alarms, no bomb was dropped within the limits of the city. Dr. Jonka said it was not clear to anybody why this town was spared on account of the large chemical factory. The popular opinion was that English capital was in the plant, but he said that the more intelligent knew that this at least was not the reason.

The Rathaus was insured but I did not learn to what extent.

The French in the city told me that the Germans were much alarmed by the alerts, but, now that it is all over, the Germans themselves as usual will not admit any anxiety at the time.

. . . . . .

Both Dr. Jonka and Herr Blank absolutely deny . . . that the workmen at Hochst were on strike and preferred the machine guns of the troops to exposure to air raids. Herr Blank stated that the factory had been unusually free from strikes during the war and that the workers were most loyal, putting their best efforts into their work at all times.

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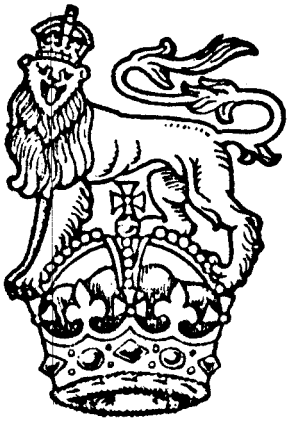

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Wiesbaden

Wiesbaden, then a city of 100,000 people, had long been famous as a watering place. The attack reported by the American survey team was made by a Handley-Page bomber of the Independent Air Force. Squadron 97 dispatched six planes that night to targets at Mannheim, Essen, Cologne, Saarbrucken, and Kaiserslautern. Because of poor visibility, five planes returned early. The other dropped its bomb, a 1,650-pounder, in the center of Wiesbaden.

Number of Raids: 1
Total Amount of Damage: 1,250,000 Marks
Number Killed: 14

The city of Wiesbaden is purely a residential place and no Allied air raids were expected on it, however, as a measure of safety and for the popular morale one anti-aircraft battery was located near the city under the direction of the military authorities at Mainz. Also cellars were marked for protection but no money was paid by the city for reinforcing them.

During alerts all business in the town stopped but I was unable to get a list of these alerts or the total length of time they lasted. From the position of the city with regard to Mainz and Frankfurt a.m. I think there were probably between 25 and 35 alerts, but it was said that the people were little affected by planes overhead for they did not expect any bombs to be dropped.

The one raid took place on October 23, 1918. Serious damage was caused by only one which fell in Riehlstrasse . . . . The damage done to certain houses totaled 693,900 M, added to which was other damage caused by splinters, etc. totaling 556,000 M., the entire damage amounted to about 1,250,000 M. In this raid, 14 people were killed and 20 more or less seriously wounded.

As stated above Wiesbaden is not a manufacturing city, there are no factories nearer than the cement mills at Biebrich and the factories of Mainz.

Railroads. Trains did not stop running during alarms. It was planned that if an attack actually took place on the station all trains should stop running, but this never occurred.

When an alarm was given all electric lights were extinguished and passengers in the station went to the cellars. All those

whose train was in got aboard and pulled out so it was affirmed practically on time.

No special crews were kept on hand in case rails should be damaged.

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Coblenz

Targets for Allied raids on Coblenz (Coblence), a city of more than 50,000 people, situated at the influx of the Moselle into the Rhine River, were railroads, barracks, and factories.

Number of Raids: 7
Number of Alerts: 37
Time Lost through Raids and Alerts: 36 hrs. 42 min.
Number of bombs recorded: 110

Results of a raid on the residential area of Coblenz.

Material damage reported (does not include damage to 122 people who were paid through insurance companies: 398,513.16 Marks)
Total Expenditure for Protection: 319,872.65 Marks

. . . . . .

[*City*]

Oct. 1, 1917. Raid lasted from 10.00 P.M. to (?). Three bombs fell around and in city damaging the property of 28 people to the extent of 4045.41 M.

Mar. 12, 1918. Raid lasted from 11:40 A.M. to 12:30 P.M. Twenty three bombs fell in the middle and west part of the city, damaging R.R. station and R.R. Post Office. Damage was done to the property of 122 people amounting to 54116.80 M. Twenty three people have failed to report damage. In addition, the Post Office received material damage amounting to 625 M. One Post Office employee was killed whose wife will receive 2,859 M. a year until the high cost of living drops after which time she receives 1,839 M. a year until her death. She is now 52 years old and can take 33,000 M. in a lump sum instead of the 2,859 M. a year. Three post office employees were wounded, costing the government 1,353.70 M. In all 12 people were killed, 7 badly wounded and 7 not badly wounded.

May 21, 1918. Raid lasted from 12:38 A.M. to 2:15 A.M. Twenty six bombs were dropped, of which number five were duds. Bombs fell on military barracks, Coblenz-Trier R.R. line, hospital and in the city. Property of fifty one people was damaged, amounting to 33,628.92 M. Eleven people have failed to report damage.

June 6, 1918. Raid lasted from 7:53 A.M. to 8:50 A.M. Seventeen bombs were dropped falling on Telegraph Battalion Barracks, in the Moselle River and next to a R.R. Water Tank. Forty one people received damage to their property amounting to 12,452.40 M. Fourteen people have failed to report amount of damage.

July 2, 1918. Raid lasted from 10:40 A.M. to 11:50 A.M. Twenty bombs were dropped on ship yards, in the Rhine River and town. Two ships in ship yards were damaged, one being sunk; the damage to one ship was repaired at a cost of 3,871 M. and the one which was sunk at a cost of 28,000 M. Neither of these ships were used for military purposes, one being a private passenger boat and the other a barge for hauling coal, etc. Damage was done to the property of 55 people amounting to 13,505.41 M. Fourteen people failed to report damage. One woman was killed.

July 5, 1918. Raid lasted from 7:43 A.M. to 8:50 A.M. Six bombs were dropped on R.R. ship docks, hospital, ship Moselle, and on the city. Damage to the ship Moselle was considerable and was repaired at a cost of 15,000 M. This ship was a passenger ship and of no military value. The damage at the R.R. ship docks was of no military damage, although it cost the city quite a little to repair the damage. Damage was done to the property of 163 people amounting to 158,000 M. Twenty people have failed to report amount of damage.

Aug.22/23, 1918. Raid lasted from 11:49 P.M. to 12:51 A.M. and 12:59 A.M. to 2:11 A.M., and 8:41 A.M. to 9:22 A.M. Fifteen bombs fell in and around city of Coblenz damaging a ladies seminary and the Fest Hall. Damage was done to the property of 114 people amounting to 23,367.94 M. Forty people failed to report amount of damage. Two people killed and four injured.

Oct. 21, 1918. No bombs were dropped on this day but the property of 29 people was damaged by anti-aircraft guns amounting to 871.45 M.

City was protected by 12 anti-aircraft guns of 7.5 cm. and 9 cm. calibre and eighteen machine guns. Two officers and 200 men were here at all times to take care of and man the guns. Did not have balloon barrage, aircraft or searchlights. This information received from Wm. Benzich, Police Assistant, who was in the home defence during the war.

City built two bomb proofs at cemetery costing 4554.65 M. for both.

Closed all windows in the cellars of school houses at a cost of 3,996.50 M.

Installed and built an alarm system of 13 sirens at a cost of 38,536.50 M.

One man was retained to handle air raid claims and take care of work in connection with raids, which cost the city 15,000 M.

This information received from F. Neumann, City Building Director, and F. Behan, Post Office Director.

In connection with the people that were killed and wounded in raids, the city paid 117 M. for funeral expenses to the relatives of each.

Three wives of men killed are receiving 110 M. each a month. How long this will last, they were not able to tell me.

Amputations were necessary in the case of four wounded which cost the city 2,267 M.

This information was received from Miss Loenartz, Director of city Welfare work.

R.R. Coblenz

Oct. 1, 1917. One bomb fell just south of railroad station

damaging main track to Mainz, a switch track, 18 passenger cars standing on switch tracks and building. Passenger cars were sent first to Nippes and then to Lingen where they were repaired at a cost of 4,550 M. Damage to the line was repaired in a half a day by sixteen men at a cost of 100 M. Traffic was not delayed but switched around the damage.

March 12, 1918. One bomb fell in front of R.R. station damaging the post office and station. Two bombs fell north of the station but did no damage to rails. Damage to R.R. station was repaired at a cost of 5,139.60 M. and damage from bombs north of station repaired at a cost of 12.60 M. Ten men repaired damage at R.R. station in three weeks.

May 21, 1918. No bombs fell on R.R. line at Coblenz, but damage was done to buildings by their own anti-aircraft guns which was repaired at a cost of 1,629.34 M.

Three bombs fell on two track line to Trier at Moselweiss which damaged one track so that it could not be used for 4 hours. Traffic was not delayed as they used the other track. It did handicap them though. Damage was repaired by ten men at a cost of 100 M.

June 6, 1918. One bomb fell near office buildings damaging them and a water tower. No damage was done to the system, or were trains delayed in the least. Damage was repaired at a cost of 2,755 M.

July 5, 1918. No bombs were dropped on R.R. lines but damage was received from their anti-aircraft guns which was repaired at a cost of 188 M.

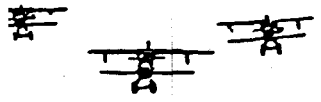
Aug. 22/23, 1918. One bomb fell in round house at Moselweiss, damaging the building but did not damage rolling stock or hinder traffic in anyway. Damage was repaired at a cost of 1,763 M.

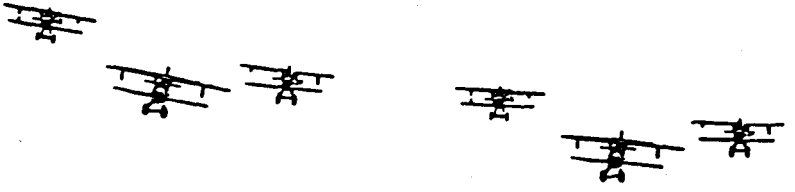
Oct. 21, 1918. No damage from bombs but anti-aircraft did some damage which was repaired at a cost of 490 M.

During an alarm or raid all traffic was stopped.

Employees did not receive a bonus but received 50% increase in pay for overtime although not a 100 M. was paid for overtime in connection with air raids.

Five bomb proofs were built at a cost of 34,094 M.





Personnel tunnels at R.R. station were all made bomb proof at a cost of 6,651 M.

No men were kept on hand to repair damage by air raids.

No special alarm system was installed on R.R. system.

Efficiency of employees was impaired according to the statement of the Chief Engineer.

This information received from Chief Engineer 1st class Gries., J. Fenerlich, Round House Foreman, and R. Adam, R.R. director at Winnigen.

Damage to Military Buildings

March 12, 1918. Bombs fell on Military Barracks and Wagon Sheds of Pioneer Infantry. Damage was repaired at a cost of 610 M. One officer and three men were killed on this raid and one more wounded.

May 21, 1918. Bombs were dropped on wagon sheds, garrison of Pontoon Company, Fort at Ober Ehrenbreitstein, new Artillery Barracks, Clothing Office, Gymnasiums 2 and 3, Tradesman's Building 3 and working parties' barracks. Part of damage was repaired at a cost of 3,819 M., the balance to be repaired at an estimated cost of 1400 M.

June 6, 1918. Bombs were dropped on Telegraph Battalion Barracks and Barracks at Ehrenbreitstein Fort, damaging roofs, windows and one trench mortar, damage was repaired at a cost of 5,740 M.

July 5, 1918. Bombs fell on Lazerett Barracks, new field barracks and train barracks, damaging roofs and windows. Part of damage was repaired at a cost of 2400 M., balance to be repaired at an estimated cost of 1700 M.

Aug. 23, 1918. Bombs fell on Barracks and old train depot at Ehrenbreitstein, damaging roofs and windows which were repaired at a cost of 507 M. One officer was wounded.

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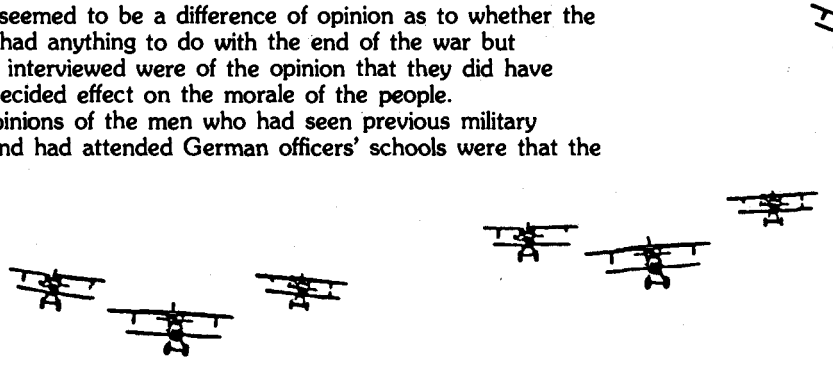
There seemed to be a difference of opinion as to whether the air raids had anything to do with the end of the war but everyone interviewed were of the opinion that they did have quite a decided effect on the morale of the people.

The opinions of the men who had seen previous military service and had attended German officers' schools were that the



raids on the Rhine provinces did help bring the war to and end, not directly, but it was the means of carrying the war to the people in power.

. . . . . .

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Bonn

The only attack on Bonn was made by six D.H.4's of the Independent Air Force which, because of bad weather, were diverted from their assigned target at Cologne.

A report on the results on production of war material in Bonn of Allied bombing is not very extensive, for the reason that there are very few factories in town. About ten years or more ago, an ordinance was passed prohibiting further building of factories within some five kilometers of the city limits and when asked as to the factories of Bonn the universal answer is that the principal factories are at Siegburg and Troisdorf[a] . . . .

The only raid on the city took place at 3.25 p.m. on October 31, 1918 when 10 bombs were dropped. . . . 25 people were killed or died of injuries and 37 were injured. No bombs fell in the neighborhood of any factory.

In the early part of the war there had been anti-aircraft batteries and searchlights for the protection of the city, but at the time of the raid there were merely sirens and signal bombs to warn the population.

The warning was given from Siegburg and Troisdorf and the sirens sounded from a central switchboard in police headquarters.

All business and street car traffic was suspended during alerts. A list of the alerts for the town is given on the attached list.

The morale of the population does not appear to have been affected until after the first raid which was only eleven days before the Armistice. As may be noted from one of the red posters, the people would not take shelter during alerts and an example of what resulted from this lack of caution in Cologne is given.

Railroads. One bomb on Oct. 31, 1918 fell on the railroad but buried itself in the ground between two ties without exploding. Trains were able to run without interruption and the slight damage was repaired by the regular yard crew at odd times. No crews were kept specially to repair damage by bombs.

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Troisdorf

Resume of results of Bombing on the Rheinish Westfalische Sprengstoff Act.-Ges.
Number of Raids: 0
Number of Alerts: 25
Total time lost: 19 hrs. 15 min.
Expenditures for Protection: 174,000 Marks.
Value of Loss of Production: 974,800 Marks.

Resume of Results of Bombing on the Falconeisen-Walzwerk L. Mannstaed Co.
Number of Raids: 0
Number of Alerts: 11
Total time lost: 16 hrs. 30 min.
Loss of Production: 600 Tons.
Value of Loss of Production: 300,000 Marks.
Expenditures for Protection: 21,000 Marks.

General information as regards town of Troisdorf. When an alarm was given all the inhabitants of the town went to the cellars, all business stopped, and street cars ceased running for the duration. The town had had an anti-aircraft battery in the early part of the war, but this was removed before the first actual alert. There was one searchlight in the center of town maintained by the military; other than this, the town had no protection. There was never a bombardment of the town and the morale of the people was not appreciably lowered.

Railroads. In all, there were thirty alerts given the railway authorities. During 4 out of the first 5, trains stopped running a total length of 3 hours and 53 minutes. During the 4th, lasting 30 minutes, schedules were partly suspended. Troisdorf is not a railway center and this suspension of traffic was said to have had little effect on other trains.

. . . . . .

The town of Troisdorf has only two factories of any importance, the "Rheinish-Westfalische Sprengstoff Akt-Ges." composed of three branches: the powder factory, fuse factory, and metal factory; and the "Faconeisen-Walzwerk L. Mannstaed & Cie. Akt-Ges." . . .

. . . . . .

Bomb damage in Cologne.

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Cologne

The ancient city of Cologne (Koln), famous for its magnificent cathedral, had been bombed by a pilot of the Royal Naval Air Service on 8 October 1914. Flying from Antwerp, Squadron Commander Spenser Grey• had been unable to locate his target, the airship sheds, in a thick mist, so he dropped his bombs in the middle of town, aiming at the main railroad station. British planes did not return to Cologne until a Handley Page of the Independent Air Force attacked on the night of 24-25 March 1918, the first mission mentioned in the following report. The heavy casualties of the next raid, by D.H.4's of the Independent Air Force on 18 May 1918, were the consequence of a breakdown of the German warning system.

Number of Raids: 4
Number of Bombs: 38
Total Amount of Damage: 872,000 marks
Loss of Production: 138,500 marks
Cost of Protection: 10,200 marks

.....

There were four actual air raids on Cologne; during the 4th, only one bomb was dropped and the damage was insignificant. . . . The 10 bombs dropped during the first raid fell in Deutz, on the east bank of the river, and a lumber pile was burned. . . . This was March 25, 1918.

In the second raid, May 18, 1918, carried out in broad daylight, 43 people were killed and 55 wounded; 38 buildings damaged. The estimated loss was about 340,000 Mks . . . .

In the third raid, Aug. 22, 1918, 6 people were killed and 10 wounded, 22 buildings damaged; loss 477,000 Mks.

Sept. 16, 1918. None killed or injured, damage to the extent of 55,000 Mks., chiefly windows broken by concussion.

Cologne was protected by anti-aircraft guns, home defence flight (apparently demanded by the people after the raid on May 18), and searchlights. Concerning these military questions, information has been asked from Frankfurt and will be forwarded later. The raid on May 18 was entirely a surprise and after it the commandant of the defences was dismissed for not being prepared.

Insurance rates were not raised by bombing, but a special policy was offered as follows:

2 Mks. per 1,000 Mks. for Life.
1 Mk. per 1,000 Mks. for Real Estate.
1/2 Mk. per 1,000 Mks. for Personal Property.

It appears that after the first raid, however, more insurance than usual was taken out.

The moral effect on the people was rather insignificant. I am informed that even before May 18, the better classes were against bombing of the cities of the Allies; after that date the feeling became more widespread. It seems, however, that the people were in general quite stoical, the feeling being that Cologne was a fortified city and the Allies had a right to bomb it. After the first raid, the people became quite resigned.

The one day raid on Cologne did not do most damage though more people were killed on account of being in the streets. There were not enough attacks to warrant a generalization as to whether day or night raids did most damage. Moral effects, no difference.

. . . . All work and trade stopped during entire alert. It seems that Allied Commissions are covering or have covered the entire subject of the amounts of business done in Cologne and surroundings; if a part equal to the length of time air alerts were taken, a fair estimate of the loss in production and business could be gotten.

Notes on factories making war material shut down during alerts.[b] In the first place it may be noted that no bombs were

dropped on any factories. All factories were warned by telephone or buzzer from Police Headquarters each alert; all shut down work for period of alert. . . .

. . . . . .

Railroads. No bombs ever dropped on the railway tracks in Cologne (I have this on good authority, besides all German officials with whom I have talked, in spite of flyers' reports). Tram schedules were not interrupted during alerts nor were special crews kept on hand to repair damage should railway be struck.

. . . . . .

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Duren

Finding their targets at Cologne obscured by clouds on 1 August 1918, D.H.4's of the Independent Air Force dropped their bombs at Duren, a manufacturing city on the Roer River, about 20 miles west-southwest of Cologne.

There was only one actual bombardment of Duren by Allied flyers, that of August 1, 1918. The Germans report the dropping of 30 bombs while the Allied flyers report 35. Possibly the other five were duds and location not noticed, or they fell at some distance from the city and were not reported.

. . . . 16 people were killed or died of injuries and 18 injured seriously. The majority of places where bombs fell have been investigated but all damage other than splinter scars have been repaired except at the Susschule where a latrine is pretty badly knocked about.

Conveniently forgetting whatever they may have done along that line, the German population consider the attack on the unfortified town of Duren an outrage and there is no doubt but that the morale of the people was greatly lowered and later alerts nearly caused panics.[a]

It appears that before August 1, the town had no protection or warning other than the fire and church bells, after that time sirens were installed and the cellars of the town hall and post-office cleared out and reinforced for shelters for people caught in the center of town by an alert.

When the authorities were advised of "Luftgefahr," the news was telephoned to the factories[b] to be prepared for an alarm but

the sirens were not sounded, work did not stop, and the population in general was not warned. At the Alarm signal, all work stopped, the street cars stopped running and the people took shelter.

. . . . . .

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Morhange

German airdromes frequently were designated targets for Allied bombing missions. The one at Morhange, about 25 miles northeast of Nancy, was attacked many times, especially during the latter part of the war. The Americans surveying the effects of the bombing were able to obtain some information, although not nearly as much as they would have liked, concerning the raids on Morhange. They found very little information about attacks on the German air base at Buhl, near Saarburg (Report #63), and had even less success some other places (Reports #64-65). Further, the survey includes no reports on many other important German airdromes, such as the one at Frescaty, near Metz.[8]

Resume of Results of Bombing at Morhange

Number of raids on towns: 5
Total amount of damage to town: 107,500 marks
Bonus paid to railroad employees per month: 60 marks
Number of raids on airdrome: Almost daily after July 1, 1918
Total number of airplanes destroyed: 40
Total number of hangars destroyed: 5
Note: Full information on the damage done to airplanes and hangars is not available, due to the fact that it was taken away or destroyed by the retreating Germans.

Detailed Report on Effects of Allied Bombing

Morhange Station. Oct. 28, 1918. At 4:30 P.M., the alert was given, lasting 15 minutes. Four bombs were dropped near station. One direct hit was obtained on a passenger train standing at the station at the time. One fourgon (last car of passenger train) was completely destroyed, and one passenger car badly damaged. Eight meters of the track under the fourgon was torn up. Two bombs hit the railway depot, full of supplies at the time, destroying it completely. . . . Seven or eight meters of one track in front of depot was also torn up, thus killing three

men and wounding slightly about six. Repair of tracks lasted until next morning. Two trains were delayed about 1¼ hours. These trains and all the others which arrived later on were switched around to another track until 8:00 A.M., when tracks were repaired and trains took up the direct route once more. No congestion occurred however. Soldiers were employed for the repair of the tracks. The total damage to the station amounted to about 90,000 francs, including fourgon and damage to car. This bombing also lowered the morale of the employees considerably. Employees living in vicinity of station abandoned their homes soon after. The morale was quite low after July, thus resulting in an average bonus of 60 marks per month to each employee for the months of July and August. There are 65 employees at the station. There is one dugout at the station which was built in 1915.

On Nov. 10, 1918, at 1:30 P.M. and 4:45 P.M., several bombs were dropped near the railway but no damage was done.

Morhange (City). In 1915, 14 bombs hit the military barracks, damaging one of them very badly and in 1917, about the month of August, several bombs fell behind the military hospital, just in front of the munitions depot, but no damage was done.

On the night of Sept. 3–4, 1918, at 11:30 P.M., the alarm was given, which was followed immediately by a raid, lasting ten minutes. Four bombs of large calibre were dropped on the Rue de la Gare and one direct hit was obtained on a house in the same street, destroying it completely. Damage amounted to about 15,000 francs. . . .

Morhange Airdrome. Beginning with the month of July, 1918, the airdrome has been bombed almost every day and night, and sometimes twice per day. Most of the bombs fell on the airdrome (making numerous bomb holes), in vicinity of airdrome, near the Tuileries (100 meters from airdrome), in the woods, etc., and a few direct hits were obtained on hangars and machines. The total number of airplanes destroyed and injured during the period of the war was 40, about 12 of them being damaged while landing on account of bomb holes on the airdrome. These machines were replaced in from one to two weeks. A total of 5 hangars damaged and one burnt down. Hangars were repaired at once with the exception of three which were repaired a few days later by a special crew of Prussian civilians employed for that purpose. These civilians would go from one airdrome to another making repairs. Also one anti-aircraft gun and one machine gun were destroyed.

The morale of the aviators and personnel was affected to a great extent and hindered considerably the progress of their

work. Several dugouts, having an average capacity of 40 men, were constructed on the airdrome near the hangars. Three anti-aircraft guns and about 20 machine guns were employed against the raiding parties.

The photographs referred to in the British Official Report of 4/9/18 has shown the disappearance of about 10 hangars but this is explained as follows: The hangars were at first built close together, but when the danger increased with the continuous bombardments, several hangars (every other one) were torn down, so as to derive the advantage of extended order.

In the month of July, 1918, 10 cows were killed near airdrome by bombing. The cows were being watered at Lake Mutch, near airdrome.

On Sept. 3, 1918, at 10:30 A.M., and on the night of Sept. 3-4, 1918, at 6:30 P.M., several bombs were dropped near and on the house of Seebach am Pflugplatz, across the railway from the airdrome, damaging it and the house in rear of it, very badly. Damage 2,500 francs.

The small calibre bombs were more effective from the standpoint of damage, but large calibre bombs affected the morale much more, none having had confidence in any protection against them. The incendiary bombs did not cause any damage whatsoever.

During the war, about 50 soldiers were killed in town of Morhange and its vicinity by bombs, which gave it a bad reputation as a rest area for which purpose it was used. The soldiers coming from the front, feared the bombing most.

Haboudange.[b] Night of Nov. 10-11, 1918, some incendiary bombs and 10 bombs of large calibre were dropped here at 7:00 P.M.; some direct hits were obtained on buildings, thus burning 11 houses, including the Chateau. . . . No damage was done to the troops stationed in the village. The morale of the population was affected to a great extent.

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Buhl Aerodrome

4 large dugouts, 12 hangars. Employed 200-300 civilians owing to shortage of squadron personnel. Damage to village and fields estimated at 85,000 marks.

1918			
July 8	4:00 pm—4:10	10 min.	40-50 bombs dropped.
Aug. 7	4:00 pm—4:10	10 min.	1 hangar hit; 2 planes damaged; 1 bomb hit concrete hangar, destroyed 2 planes . . . . Planes replaced next day.[a]
Aug. 14	10:00 pm—2:00 am	4 hrs.	100 bombs dropped. Large hangar slightly damaged; 4 killed.
Aug. 23	7:30 am—7:38	8 min.	14 planes participated; no damage.[b]
Sept. 2	10:00 am—12:00	2 hrs.	32 " " " " " "
	5:00 pm—5:30	30 min.	3 hangars completely destroyed; 1 killed; 1 wounded.
Sept. 5	9:30 am—9:45	15 min.	12 planes participated; bombs dropped in field.
Sept. 30	12:30 am—1:30	1 hr.	4 houses in village destroyed by fire. . . . 1 hangar set on fire.

Houses of Buhl village, destroyed by aerial bombardment.

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Airdrome at Boulay

Destruction of Gasoline Depot: 1,000,000 marks
Damage to Town: 250,000 marks

Note: Full information on the damage resulting to airplanes and hangars is unavailable, due to the fact that it was taken away or destroyed by the retreating Germans.

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Airdrome at Folpersweiler

Thirteen machines were found destroyed, still on the airdrome. Six of these appeared to have been destroyed by the Germans since the Armistice.

Note: Full information on the damage to airplanes and hangars was not available, due to the fact that it was taken away or destroyed by the retreating Germans.

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Airdrome at Friesdorf

Number of Airplanes Destroyed or Damaged: 13
Number of Hangars Damaged: 3

Note: Full information on the damage resulting to airplanes and hangars is unavailable, due to the fact that it was taken away or destroyed by the retreating Germans.

STATISTICAL SUMMARY OF RAIDS

City	No. of Raids	No. of Alerts	Material Damage Marks	Cost of Protection Marks	Bonuses Paid Marks	Loss of Production Marks	Extra Expenses Marks	Working Hours Lost	Killed	Wounded	Remarks
Athus	8	?	419,000	?	0	?	0	0	1	1	
Bensdorf	15	?	?	?	0	0	0	?	?	?	Very little damage. Hit railway tracks twice.
Bonn	1	16	?	?	0	0	0	10-1/2	30	55	
Boulay	?	?	1,250,000	?	0	0	0	?	?	?	One of most important German airdromes. Aerial photos shows considerable damage not included in damage given. Records destroyed.
Bous	?	301	8,621	?	?	7,500,000	0	454	?	?	Loss of production, 9437 tons of iron.
Bouzonville	?	?	0	12,000	0	360,000	0	?	0	0	Loss of production, 900 tons of iron.
Breback	5	?	69,256	250,000	0	?	0	?	10	0	
Buhl	7	?	205,000	100,000	0	0	0	?	5	1	
Burbach	13	?	486,100	100,000	0	?	0	?	?	?	
Coblenz	7	37	473,946	319,872	0	0	0	36-1/2	18	87	
Cologne	4	20	872,000	10,200	0	138,500	0	18	49	65	
Conflans	?	?	?	?	?	?	0	?	?	?	Considerable damage done by U.S. Sqs. Co. of 250 men and 100 civilians kept on hand to repair damage. All records taken by Germans. Town later under artillery fire.
Corny	?	?	71,501	0	0	0	0	?	?	?	
Orny	?	?	2,960	0	0	0	0	?	?	?	
Ars	?	?	33,333	1,600		0	0	?	?	?	
Gorze	?	?	24,000	0	0	0	0	?	?	?	
Noveant	?	?	56,000	0	0	0	0	?	?	?	
Remilly	?	?	28,800	4,800	0	0	0	?	?	?	
Bayonville	?	?	28,000	0	0	0	0	?	?	?	
Arnaville	?	?	46,400	0	0	0	0	?	?	?	
Courcelles	?	?	59,445	184,000	0	0	0	?	?	?	
Dieuze	14	?	18,270	?	0	0	0	?	3	2	
Differdange	39	309	820,630	501,883	0	8,350,000	0	?	?	?	Loss in production, 16,770 tons of iron.
Dillingen	62	89	296,881	150,000	0	?	0	90-1/2	?	?	
Dommary-Baroncourt	?	?	310,000	?	0	0	0	?	?	?	
Dudelange	?	?	41,418	158,599	52,466	?	36,596	?	?	?	Extra cost, charging furnaces with supplementary coke.
Duren	1	34	539	453,500	0	114,095	0	33	16	18	
Ehrang	9	?	127,225	62,200	0	7,000	410,000	?	3	0	Ry. had crew of 100 men at cost of 1000 marks per day. All others called out during raids received 50% increase in pay.
Esch	43	263	1,348,709	320,347	0	9,871,690	54,406	282	?	?	Extra cost, extra consumption of raw material.

City	No. of Raids	No. of Alerts	Material Damage Marks	Cost of Protection Marks	Bonuses Paid Marks	Loss of Production Marks	Extra Expenses Marks	Working Hours Lost	Killed	Wounded	Remarks
Friesdorf	?	?	526,000	?	0	0	0	?	?	?	
Frankfort	9	89	1,752,000	75,000	0	?	0	84	22	56	Information on Frankfort not complete.
Hochst[2]	0	98	0	435,145	2,290	5,848,173	0	84	0	0	
Hagondange	33	266	?	?	?	?	?	416-1/2	?	?	Considerable damage done. See detailed report.
Hayange	?	?	92,200	202,794	369,233	1,283,900	856,625	?	?	?	Extra cost, extra heating and maintenance of furnaces due to neglect.
Homecourt	?	?	12,000	?	0	0	0	?	?	?	
Jouef	?	?	96,000	0	0	0	0	?	?	?	
Auboue	?	?	333,333	0	0	?	0	?	?	?	
Heming	1	?	614,800	?	?	15,360	0	48	?	?	
Kaiserslautern	7	65	1,850,600	10,000	0	387,990	0	45	12	22	
Karlsruhe	?	?	?	?	?	?	?	?	164	326	No other data available.
Karthaus											
Conz											
Wasserlich	7	?	61,216	17,250	152,000	?	0	?	7	0	
Merzlich											
Oberemmel											
Kreuzwald	7	?	80,000	10,000	0	10,000	0	?	?	?	
Landau	3	?	310,809	0	0	0	0	?	3	0	
Longuyon	18	?	?	?	?	?	?	?	?	?	See report on Longuyon.
Ludwigshafen	22	25	2,338,947	2,450,536	0	3,299,198	1,607,000	34	33	53	Extra expense, amount paid to wounded and dependents of those killed.
Luxembourg	17	?	26,845	?	0	0	0	?	?	?	
Hollerich[3]	19	?	699,942	300,000	0	0	91,250	?	?	?	Extra cost, Ry. had crew of 50 men who repaired damage in Hollerich and Luxembourg.
Maizieres	17	?	62,009	0	0	0	0	?	?	?	
Mars-la-Tour	?	?	534,000	?	0	0	0	?	?	?	
Mayence	2	?	1,871	40,998	0	365,300	0	18-1/2	0	0	
Merzig	1	?	22,600	0	0	0	0	0	0	0	
Metz	92	?	1,400,718	?	2,880	?	1,620,000	98	82	290	Extra cost, Ry. had 450 men to repair damage. Material damage includes only that done to Ry. See map of Metz for bombs dropped in city. Number of hours lost includes raids only.
Montmedy	?	?	800,000	?	0	0	720,000	?	?	?	Extra cost, Ry. had 400 men to repair damage. Damage does not include Ry. or city.
Morhange	?	?	1,659,400	?	1,450	0	0	?	50	?	
Neunkirchen	3	?	300,000	150,000	0	2,137,500	0	250	?	?	
Pirmasens											

STATISTICAL SUMMARY OF RAIDS (Cont'd)

City	No. of Raids	No. of Alerts	Material Damage Marks	Cost of Protection Marks	Bonuses Paid Marks	Loss of Production Marks	Extra Expenses Marks	Working Hours Lost	Killed	Wounded	Remarks
Rodange											
Rombas	33	?	368,837	391,509	1,162,497	5,495,316	0	?	0	0	
Rumeliwgen and Oettlingen	9	186	1,230	26,500	0	1,693,000	0	?	?	?	
Saarbrucken	24	?	2,987,650	?	0	?	0	?	59	162	
Sarralbe	1	?	7,040	0	0	?	0	?	0	0	
Saarburg	5	?	70,000	?	?	?	0	?	?	?	
Rieding	4	?	27,000	?	?	?	0	?	?	?	
St. Avold	3	?	4,800	?	?	0	0	?	?	?	
St. Ingbert	2	6	See remarks	20,000	0	See remarks	0	?	0	0	With exception of protection, information not considered reliable.
Speyer	1	?	29,281	?	0	?	0	?	0	0	
Thionville	61	?	5,810,029	1,388,120	1,076,555	7,000,000 See remarks	135,766	321	29	55	Extra expense, consumption of raw material (extra). No data on loss of production but 7,000,000 is a low estimate.
Treves	20	120	1,707,376	253,311	1,344,000	1,113,401	2,191,000	76	21	47	Extra expense, special crews. Damage does not include amount paid by insurance cost to 864 people.
Troisdorf	0	25	0	174,000	0	974,800	0	19-1/4	0	0	
Uckange	6	23	78,611	79,650	50,000	?	0	415-1/2	0	0	
Voelklingen	8	328	1,261,500	457,719	?	15,550,500	153,844	?	?	?	Extra, faulty products.
Wadgassen	?	?	3,000	?	0	48,000	0	10	0	0	
Wiesbaden	1	30	1,250,000	0	0	0	0	?	14	20	
Worms	3	?	120,300	?	0	0	0	?	?	?	
Zweibrucken	5	201	86,041	15,514	0	?	80,262	109-1/4	?	?	Extra cost, loss in salaries due to raids and alerts.
Total	685	2,570	35,449,190	9,141,049	4,213,371	71,563,723	7,956,751	2,952-1/2	641	1,262	
80 cities[4]				53,000,000	home defense flights.						
				23,425,480	balloon barrages.						
				85,566,529	Total						

Note: The value of a mark has been taken as pre-war exchange.

Narrative Summary[1]

Material Damage

The material damage, as recorded in 66 of the 140 cities, amounted to 35,449,190 marks but this should not be taken as all of the damage done in the 66 cities because in some cases records had been kept of only a part of the damage. For example, the damage done in Boulay includes only that done to the city and to the gasoline depot, while aerial photographs show that considerable damage was done to the airdrome which was one of the most important German airdromes on that front. A fair opinion may be formed of the damage done in cities where it was impossible to obtain an estimate in money by reading the detailed reports on Longuyon and Hagondange because the records in these two cities did show the kind of damage done in each raid.

Then, there are cities such as Karlsruhe, Freibourg, Offenburg, Stuttgart, and Mannheim on the eastern side of the Rhine which could not be covered because the German authorities refused to give the American officers permission to enter them. One of the American officers was taken to Karlsruhe by a French officer to obtain permission from the German authorities to carry the investigation into that city, and although permission was refused, succeeded in seeing the city mayor who stated that 164 people had been killed and 326 wounded by bombs.

Cost of Protection

The cost of protection as recorded in 36 cities amounted to 9,141,049 marks, which includes the expense of railroads, cities, and industrial concerns. To this should be added the amounts expended by individuals, by the military authorities, and the amounts that will be spent in tearing down shelters and other protection for which there will be no further use. Many individuals walled in their windows and built small shelters in their basements and small retail stores furnished some protection for their employees. The military authorities probably expended the largest amount of money for protection. Almost every city of any importance was protected by anti-aircraft artillery, and some were protected by balloon barrages and home defence flights. The Germans had 11 home defence flights of 10 machines each along the Rhine Valley prior to June 1, 1918, and during the first part of June increased the number of flights to 17 and the strength of a flight to 14 machines. The original cost plus the expense of maintaining these air units amounted to 53,000,000

marks at least. The military authorities also maintained a barrage of 63 balloons at Cologne, one of 39 at Esch, one of about 45 at Hayange and Knutange, and one of about 100 in the Saar Valley. The original cost plus the expense of maintaining these barrages amounted to 23,425,480 marks at least.

In addition to the balloon barrages and the home defence flights, the military authorities furnished anti-aircraft artillery, machine guns, and searchlights for almost every city of any importance. Coblenz, a city which was not important from an industrial standpoint, was protected by 12 anti-aircraft guns of 7.5 cm and 9.0 cm calibre, and 18 machine guns with a total personnel of 2 officers and 200 men. An attempt was made to obtain the approximate number of anti-aircraft guns used to defend cities in the interior but it was found that the information was unreliable and resulted in duplications wherever the guns protected more than one city.

The cost of protection against air raids was not limited to those cities actually bombed. Troisdorf and Hoechst were never bombed but 174,000 marks were expended for protection in the former and 435,145 marks in the latter. Undoubtedly every city of any importance in the Saar, Rhine, and Moselle Valleys made some expenditure for protection.

Bonuses

As a general rule bonuses were not paid as a means of getting the employees to work during a raid or alert or in factories which were frequently bombed. The general opinion of the employers in the factory was that during a raid or an alert they would be held responsible for the casualties while if the employees went to the shelters the employers would be relieved of responsibility. Consequently, in most cases the employees sought shelter as soon as the alert was sounded and no deduction was made from their pay for the time lost. In a few cases four or five men were paid a bonus to remain at work during the alert to carry on the necessary work. Out of a total of 80 cities, 60 were found in which no bonuses were paid, 10 in which bonuses were paid which amounted to 4,213,371 marks, and 10 in which the information was not available.

Loss of Production

Out of 80 cities, 20 were found where the information on the loss of production was not available, 22 in which there had been a loss of production which amounted to 71,563,723 marks, and 38 in which there had been no loss of production. This by no means covers the entire loss of production in the area investigated. Hoechst and Troisdorf were not bombed but there

was a loss of production, 5,848,173 marks in the former and 974,800 marks in the latter. The loss of 71,563,723 marks includes only the loss in 20 cities which were bombed and 2 which were not. All cities in the vicinity of those raided sounded the alert and production stopped. The 38 cities in which there was no loss of production were usually railway centers, depots, airdromes, or cities in which there were no factories. With a very few exceptions every factory manager admitted that there had been a loss of production and the manager of the Burback-Esch-Dudelange Iron Works at Esch stated that it took about 30 minutes after a raid or alert before the entire personnel was at work.

While the loss of production is not an entire loss, the raw material appears to be the only part that was saved.

Extra Expenses

In addition to the above listed damages there were a few expenses incurred which could not be placed under those headings which amounted to 7,956,751 marks.

Killed and Wounded

The information available shows that 641 people were killed and 1262 wounded in 22 cities. While the number of killed and wounded may not be considered very important, inasmuch as most of these were civilians, it did have a direct effect on the morale of the people and may have entailed an additional expense to the government. In Ludwigshafen a total of 1,607,000 marks was paid to the 53 wounded and to the dependents of the 33 killed. This was the only case found where such an expenditure was made and it is doubtful whether it was made in other cities but if this same principle had been applied in other cities an expenditure of approximately 35,000,000 marks would have been necessary.

Raids, Alerts, and Working Hours Lost

In 15 cities where the information on the number of alerts, raids, and working hours lost was available, it was found that 220 raids and 1647 alerts resulted in a loss of 2187 working hours or a loss of one hour and ten minutes for each raid and alert.

In 20 cities, where the number of raids and alerts were known, there were 291 raids and 2447 alerts for every raid. Troisdorf and Hoechst were never raided but the former had 25 alerts and the latter 98.

The system of alerts varied in different parts of Germany. In the Saar Valley all industries controlled by the government were

notified as soon as the bombing planes crossed the lines and again when it appeared likely that some city in the area would be raided. In some cases the alerts were sounded along the entire route which airplanes usually took in reaching certain objectives so that an alert has been sounded in Cologne when Ludwigshafen was raided, simply because the airplanes had previously taken that route to Cologne. In other cases the alert was sounded over a certain area such as the Thionville area when it was known that the airplanes were proceeding in that direction. However, the system of alerts was undergoing a change during the last part of the war which would have reduced the number of alerts and the number of working hours lost because of alerts. A system was used in the vicinity of Kaiserslautern through which a city never sounded the alert until it was known that the airplanes had passed over the nearest large city between there and the front line. This system would probably have been used more extensively had the war continued and would have resulted in a smaller number of alerts and a smaller number of working hours lost because of alerts.

Moral Effect

It is certain that air raids had a tremendous effect on the morale of the entire people. Americans who had been in this area during the war claimed that an alert always resulted in confusion and factory managers admitted that the morale of their employees had been affected, the manager of the Burback-Esch-Dudelange Iron Works in Esch claiming that it took 30 minutes after an alert to get everyone at work. In the raid of August 23, 1918, on Ehrange, three people died of fright. Prominent citizens in Treves held a meeting at which it was suggested that all bombing be stopped. Railroad officials at Thionville claimed that it was necessary to increase the number of workmen around the station because the morale of the workmen had been lowered by bombing making them unable to perform the work which they were expected to perform. Boulay had the reputation of being a poor rest area for troops because it was bombed frequently and because about 50 soldiers had been killed during one raid.

Judging by the information received, night bombing appears to have had the greatest moral effect, probably because the largest percentage of people lost sleep because of night raids and because they would not see the airplanes which were dropping the bombs while, in the event of a day raid, they merely stayed in a shelter instead of in the home or factory and knew just where the planes were.

In addition to the above named damages done by bombing, there are some effects which cannot be expressed in terms of

money. Among these the delay of railroad traffic is probably the most important. In Luxembourg the average time which one or more tracks were out of commission in eight raids was 12 hours. It is impossible to state just how much inconvenience to the German Army resulted from these delays and the many others that occurred in other railroad yards because this depended entirely upon the nature of the traffic passing through at that time and whether a main track or a switch track was hit.

While an estimate of the loss of production has been given in money, this shows only the selling price of the articles and not what the buyers would have paid for the products had it been possible to manufacture them. Most of the factories were running 24 hours a day and a loss in production meant that the loss could not be made up by working over time. Most of the iron and steel turned out was used in the manufacture of war material. The question comes up as to just how much the government and business concerns would have paid to obtain this extra product. The enormous expense of maintaining balloon barrages, home defence flights, and anti-aircraft artillery must be an indication that the material was needed as well as that the popular clamor for protection was great.

Too much emphasis cannot be given to the importance of hindering the enemy's military organization. The importance of the material damage as shown in this report may be discounted because it includes a large amount of damage done to private property which was of no military importance except insofar as it affected the morale of the people. This also applies to a less extent to the other forms of expenditures made by and the damage done to the enemy's army and its manufacturing and transportation agencies is of direct military importance, the material damage hindering the work of the army and its agencies and the expenditures necessitating an increase in loans which would not have been necessary if the money had not been expended for protection, etc.

It has been shown that the morale of the fighting forces as well as that of the civilian population was affected by bombing, that the employees of organizations controlled by the government were not able to perform their work because of bombing, that the transportation of the enemy's troops and war supplies was hindered by bombing, and that the manufacture of war material was hindered. It would be folly to attempt to estimate these effects of bombing in terms of money, and it appears that questioning whether these effects plus the effects which can be estimated in money justified the expenditures made for bombing is like asking "Did it pay to win the war?"

Conclusion

The following points should be considered:

First: that the following amount of damage was caused by bombing:

Direct:

Killed 641
Wounded 1262

	marks
Material damage	35,449,190
Cost of Protection	85,566,529
Bonuses Paid	4,213,371
Extra costs	7,956,751
Total	133,185,841
Indirect	
Loss of Production	71,563,723
Total direct and indirect as far as has been ascertained	204,749,564

Second: that the material damage as shown above includes only a large part of that done in 66 out of 140 cities which is probably not more than 50% of what was actually done.

Third: that the cost of protection as shown above includes only the expenditures made in 36 out of 127 cities, that it includes only the expenditures made in two of the cities in the vicinity of those that were bombed, that it does not include the expenditures made by individuals or by the army for anti-aircraft artillery, machine guns, and searchlights, and that it probably does not include more than 50% or 60% of the actual amounts expended for this purpose.

Fourth: that the bonuses paid as shown above include a large part of those actually paid and that it was not a general policy to pay bonuses.

Fifth: that there was a loss of production in almost every factory city that was bombed or that is in the vicinity of a city which was bombed, that the loss of production as shown above includes the loss in only 22 out of 102 cities, that it includes the loss in only two cities in the vicinity of those that were bombed, and that it probably does not include more than 50% of the production lost in this area.

Sixth: that the morale of the fighting forces as well as that of the civilian population was lowered by air raids.

Seventh: that a great deal of inconvenience was caused to the enemy such as the congestion of railroad traffic which cannot be expressed in terms of money.

After having taken the above points into consideration, it appears that the total direct damage of 133,185,841 marks and the loss in production of 71,563,723 marks may be doubled and still keep the estimate of the damage done by bombing below the amount which actually was done, and that the expenditures made by the Allies for bombing were justified.

Criticisms of Bombing in the Present War

The greatest criticism to be brought against aerial bombardment (British—American did not have enough bombing aviation to warrant its employment other than with our ground forces—France did not approve of this use of its bombing aviation) as carried out in the war of 1914-1918 is the lack of a predetermined program carefully calculated to destroy by successive raids those industries most vital in maintaining Germany's fighting forces. The evidence of this, is seen in the wide area over which the bombing took place as well as the failure of crippling, beyond a limited extent, any one factory or industry. (It might be well to add that in many conversations with officers of the British Independent Air Force there was a growing feeling of dissatisfaction against their bombing policy. It was the statement of these officers that they did not believe they were getting the best results possible and that while the wish and later the decision to "bomb something up there" might have appealed to one's sporting blood, it did not work with greatest efficiency against the German fighting machine. It was on the return of an American officer from a three day visit with the British that it was learned of the disgust held by a British bombing expert—who had achieved very good results in bombing submarines—of the inaccuracy of bombing by the British Independent Air Force and the unintelligent choice of targets.)

The criticism is also directed against the bombing of a town rather than some definite objective of military value in the town. This is shown in the bombing of Treves, Ludwigshafen, and several of the steel industry towns where the legitimate targets, which are respectively the railroad, Badische, Anlin and Soda Factory, and steel works, are all easily capable of being hit and the action should have been concentrated on them alone.

This investigation has decidedly shown that the enemy's morale was not sufficiently affected to handicap the enemy's fighting forces in the field. The policy as followed out by the British and French in the present war of bombing a target once or twice and then skipping to another target is erroneous. Greater results would have been achieved by bombing a single target three or four days in succession. By this method the effects of cumulative results are obtained. It may be said, however, that the occasional

bombing of a town of general manufacturing importance is productive of good results for it tends to force factories to close every time an alert is sounded. . . .

Bombing for moral effect alone such as took place over Cologne, Frankfort, Bonn, and Wiesbaden, and which was probably the excuse for the wide spread of bombs over a town rather than their concentration on a factory, is not a productive means of bombing. The effect is legitimate and just as considerable when attained indirectly through the bombing of a factory.

The bombing of railroads presents a particular plan of bombardment, which either through lack of machines or disbelief in the theory, which is outlined in the following chapter, was never practiced in the area investigated.

Suggestions for Future Bombing Campaigns

The operations of a bombardment aviation must be an integral part of the mission of the entire air force and consequently of the ground forces and the army as a whole. There can exist no such force as a separate or independent bombing force.

The three kinds of bombing that are of most importance are, first, that directed against war industries; second, that against railroad lines; and third, that against an enemy's troops in the field. In considering the first a careful study should be made of the different kinds of industries and the different factories of each. This study should ascertain how one industry is dependent on another and what the most important factories of each are. A decision should be reached as to just what factories if destroyed would do the greatest damage to the enemy's military organization as a whole. On these factories the entire available bombing force should be concentrated until it is satisfied that the factory is sufficiently crippled. Once the plan of bombardment is chosen it should be held to religiously and a choice of immediate targets affected only by weather conditions and airplanes available. Factories should be bombed night and day successively as far as the weather will permit until the desired results are thought to have been accomplished. However, there is a limit to this, inasmuch as the enemy will concentrate its protective organizations to a prohibitive degree if one target is bombed entirely to the neglect of others.

The bombing of railroads presents a different proposition. The object in view is to hinder troops and supplies from arriving at the front. This is done by not only bombing two or three of the larger yards and stations but at the same time bombing smaller stations through which traffic could be diverted. The instance when all traffic was stopped in Thionville for one week may be

well used as an illustration. This traffic was immediately routed via other stations which were not bombed and the good results obtained in Thionville were lost because traffic was probably not held up more than five or six hours.

A map of the entire network of railroads showing single and double track lines should be studied with reference to each sector of the front and with reference to the least number of stations chosen which if successfully bombed would cut railroad communications to the front. Under railroad conditions as existing in northern France and western Germany five to eight stations would usually control about 100 kilometers of the front.

The bombing of railroad stations for the purpose of severing communications to the front should be carried out only immediately preceding and during a major operation, and at this time the entire bombing force should be concentrated on this work, bombing night and day the various stations forming the cordon. Only in this way can results be expected from bombing railroads. The occasional attempt to cut a track is useless as the resulting delay is negligible. . . .

The fact is brought out very forcibly in the reports on the several railroad stations bombed namely, Luxembourg, Thionville, Treves, Ehrange, Metz, Conflans, and Dommary-Baroncourt, that unless the main tracks are cut the delay in traffic is negligible because the obstruction is easily overcome by switching in the yards. It follows then that in order to obtain the greatest delays the main tracks entering or leaving the station must be destroyed. This is not impossible as can be seen from the detailed report on Dommary-Baroncourt.

Night bombing whenever possible has usually been found to be more accurate than day bombing. This statement on the respective value of night and day bombing is based on statements which factory managers and city officials made on this subject.

Concerning the third phase of bombing, viz.: the bombing of troops in the field, the value of this to affect the morale of the fighting forces has been seen and is easily understood in all armies.

Conclusion

The post-World War I survey served its purpose in that it helped to shape bombing policies and operations of the U.S. Army Air Corps and the U.S. Army Air Forces (USAAF). It indicated, for instance, that the best results from a bombing campaign could be obtained by identifying and destroying critical components of the enemy's industrial complex, a targeting system which previously had been advocated by Gorrell in his plan for strategic bombing and which would be used by the USAAF in the bomber offensive against Germany in World War II. The survey also indicated, to cite but one other example, that more could be accomplished by bombing a definite military objective in a town than by bombing the town itself, this being the policy that would be adopted by American airmen who opted for precision rather than area bombing of Germany in the Second World War.[1]

The link between the bombing survey in 1919 and USAAF bombing policies and operations in the 1940's was the Air Corps Tactical School. The school's library, which contained many World War I documents, including Gorrell's plan for strategic bombing and other important items from "Gorrell's History," had a copy of the narrative summary containing the conclusions, criticisms, and suggestions resulting from the survey.[2] The bombardment manual used as a text at the school during the 1930's cited and quoted the survey.[3] Laurence S. Kuter, Haywood S. Hansell, Jr., Ira C. Eaker, Curtis E. LeMay, Emmett O'Donnell, Jr., and others who would occupy key positions in the USAAF in World War II were thus exposed, and had access, to the survey while attending the Tactical School at Maxwell Field in the 1930's.

Despite citation in the text, notes, and bibliography of the Tactical School's bombardment manual, the survey seems to have escaped the notice of persons writing on the early history of U.S. military aviation and air doctrine.[4] One reason is that the copy of the summary report that was in the library of the Tactical School when the manual was written in 1930 has been "lost." If it has survived, it should be with other documents of the Tactical School in the Albert F. Simpson Historical Research Center at Maxwell Air Force Base. Researchers do not find it, however, in the Center's catalog (at least not under any logical heading), and it has not been located among the Center's documents.[5] Furthermore, the two copies that were incorporated into "Gorrell's History" were added after the basic history had been assembled at Tours in February 1919. Those copies became the last two volumes of the massive 280-volume compilation and,

like some other late additions, were not entered into the index. Consequently, there was nothing to call the researcher's attention to the presence of the survey as part of "Gorrell's History," which over the years has been the principal source of documentary information about the Air Service, AEF, in World War I.

Appendix A: Tables of Organization

Organizational planning in the AEF in the summer of 1917 resulted in a series of tables of organization approved for Air Service units by Headquarters, AEF on 15 September. There were some changes when a new series appeared in January 1918, but more substantial changes were made when new tables were issued on 8 September 1918.

One of the most important changes in the tables was that pertaining to the rank of officers authorized for service squadrons. World War I documentation, including reports of lessons learned, contain many complaints about low rank and lack of opportunities for promotion for pilots in the AEF. The tables of organization of September 1917 provided for captains as squadron commanders, first lieutenants as flight commanders, and second lieutenants as pilots. This was not changed until September 1918, when new tables authorized the rank of major for squadron commander, captain for flight commander, and first lieutenant for about one third of the pilots.

Another important change, to cite but one more example, was in the number of aircraft authorized for service squadrons. Eighteen per squadron were authorized in September 1917 in tables that provided 15 pilots and 3 flight commanders for observation and pursuit squadrons and 16 pilots, plus 3 flight commanders, for bombardment. The aircraft authorization was not increased until September 1918, when 24 were provided for observation squadrons and 25 for pursuit and day bombardment. Since there was not a proportionate increase in the number of pilots, the additional aircraft provided a badly-needed reserve for use in place of planes undergoing repair.

All three series of tables may be found in "Gorrell's History."[1] The representative tables reproduced below are from the September 1918 series, which was in use at the end of the war.

ARMY AIR SERVICES (s)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
									Attached					
1	UNITS	Headquarters	2 Air Parks	2 Army Observation Wings	1 Balloon Wing	1 Monoplace Pursuit	1 Day Bombardment	Total	Med. Dept. and Chaplains	Ordnance Department	Artillery	Intelligence	Aggregate	REMARKS
2	Brigadier General	*1						1					1	(a) 1 Adjutant and 1 Operations Officer.
3	Colonels			2	1	1		4					4	
4	Lieutenant Colonels	*1[t]		6	1	3	1	12					12	(b) Aides.
5	Majors	1p*1n2[a]	2	20	3	10	3	40	1	*1[k]		*1[k]	43	(c) 1 Assistant to Adjutant and 1 Assistant to Operations Officer.
6	Captains		2	92	20	37	11	162	1	6		*1[k]	170	
7	1st Lieutenants	*2[bp]	6	482	46	84	54	674	18	22	6	6	726	(d) Regimental Sergeant Major.
8	2nd Lieutenants	*2[cn]	2	224	60	166	82	536		12			548	
9	Chaplains								6				6	(f) 2 Clerks, 1 telephonist, 2 motorcycle riders.
10	Total Commissioned	8	12	826	131	301	151	1429	26	41	6	8	1510	(g) 1 telephonist and 4 general utility.
11	Field Clerks	3						3					3	(h) Maintained by one of the squadrons.
12	Postal Agents	1						1					1	(k) For Brigade Headquarters.
13	Master Electricians	*1[d]	4	98	36	49	15	203					203	(m) Clerks.
14	Ordnance Sergeants									30[1k]			30	(n) Non-flyers. Whenever possible these positions will be filled by former pilots or observers who are unfit by reason of disability for service flying but who possess the necessary technical qualifications.
15	Sergeants 1st Class	$1[m]	10	422	175	207	67	882	28				910	
16	Mess Sergeant		2	20	15	10	3	50					50	
17	Sergeants	$1[m]	18	246	144	102	33	544	28	150		8[2k]	730	
18	Corporals	$1[m]	24	494	245	211	65	1040		80	6	166[9k]	1042	
19	Chauffeurs, 1st Class	$2	22	212	140	90	26	492					492	
20	Chauffeurs	$3	44	334	251	147	42	821					821	
21	Cooks	*2	8	126	51	63	19	269					269	
22	Buglers	*2	4	56	30	28	8	128					128	
23	Privates, 1st Class	$5[f]	68	760	527	311	91	1762	61				1823	(p) Must be a pilot and active flyer.
24	Privates	$5[g]	108	1018	1057	491	141	2850	54	270		6	3160	
25	Total Enlisted	23	312	3786	2681	1709	510	9021	171	530	6	30	9758	(s) Size varies with type and quantity of ground troops in the Army.
26	Aggregate	31	324	4612	2812	2010	661	10450	197	571	12	38	11268	(t) Balloon Officer.

*) Armed with pistol.
$) Armed with rifle.

27	Ambulances, Motor.....								10				10
28	Cars, Motor.....	3	8	96	19	27	8	161				6	167
29	Cars, Motor, Light.....			18		9	3	30					30
30	Motorcycles with side-cars....	2	20	232	53	81	23	411				12	423
31	Motorcycles.....			18		9	3	30				6	36
32	Trucks, Motor, 3 ton.....	1	36	172		82	21	312				6	318
33	Trucks, Motor, 3 ton, F. W. D. Standard.....				90			90					90
34	Trucks, Motor, Repair.....		4	40		20	6	68					68
35	Trucks, Motor, 1 1/2 ton.....	1	24	184	49	96	28	382					382
36	Trucks, Motor, Lighting.....			6			1	7					7
37	Trucks, Motor, Photo.....			8				8					8
38	Trucks, Motor, Radio.....			6		3	1	10					10
39	Trucks, Motor, Winch.....				15			15					15
40	Trucks, Motor, Tender.....				15			15					15
41	Trailers, 3 ton.....		6	78		39	12	135					135
42	Trailers, 1 1/2 ton.....	2	34	104		48	10	198				6	204
43	Trailers, 1 ton.....		20	182		91	27	220					220
44	Trailers, Kitchen, Rolling....		2	20	15	10	3	30					30
45	Trailers, Photo.....			8				8					8
46	Trailers, Radio.....			6		3	1	10					10
47	Trailers, Water, Tank.....				15			15					15
48	Airplanes.....	4[b]		440		229	76	749					749
49	Balloons.....				15			15					15
50	Pistols.....	13	30	1372	248	454	197	2314		571	12	32	2929
51	Rifles.....	18	294	3240	2564	1556	464	8136					8136
52	Rifles, Automatic.....				15			15					15
53	Guns, Machine, anti-aircraft-mounts.....				90			90					90
54	Guns, Machine, Synchronized....	8[b]	8	924		480	158	1578					1578
55	Guns, Machine, Flexible.....	8	8	924		4	158	1102					1102

CORPS AIR SERVICES (a)

	1	2	3	4	5	6	7	8	9	10	11	12
						Attached						
1	UNITS	Headquarters	1 Observation Group	1 Balloon Group	Total	Medical Dept. and Chaplains	Ordnance Dept.	Artillery	Infantry	Intelligence	Aggregate	REMARKS
2	Colonel	*1			1						3	(a) 1 adjutant (non-flyer), 1 operations Officer (pilot), 1 for pay-rolls (non-flyer). (b) Assistant to operations Officer. (c) 1 as regimental sergeant major and 1 for pay-rolls. (d) 2 for pay-rolls and 1 clerk. (f) 1 clerk and 1 for pay-rolls. (g) 2 clerks and 2 motor-cycle riders. (h) Maintained by one of the squadrons in the wing. (n) Non-flyers. Whenever possible these positions should be filled by former pilots or observers who are unfit, by reason of disability, for service flying
3	Lieutenant Colonel		1		1						0	
4	Majors		3	1	4				1		0	
5	Captains	1p=3*2n	14	6	23						25	
6	1st Lieutenants	*1[bp]	79	15	95	2	1	1		1	101	
7	2nd Lieutenants		37	20	57		3				61	
8	Chaplains[c]					2					2	
9	Total Commissioned	5	134	42	181	4	4	1	1	1	192	
10	Master Electricians	*2[e]	15	12	29						29	
11	Ordnance Sergeants						3				3	
12	Sergeants, 1st Class	$1	68	48	127	7					183	
13	Mess Sergeants		3	5	8						4	
14	Sergeants	$3[d]	36	48	87	3	6			1	98	
15	Corporals	$2[f]	74	81	157			1		2	167	
16	Chauffeurs, 1st Class	$1	31	46	78						70	
17	Chauffeurs	$3	47	83	133						138	
18	Cooks	*2	19	17	38						33	
19	Buglers	*2	8	10	20						20	
20	Privates, 1st Class	$4[g]	109	175	288	15					303	
21	Privates	$4	150	355	509	10				1	520	
22	Total Enlisted	24	560	890	1474	35	9	1		4	1523	
23	Aggregate	29	694	932	1665	39	13	2	1	5	1715	

24	Ambulances, Motor.....					1					1	
25	Cars, Motor.....	2	14	6	22					1	23	
26	Cars, Motor, Light.....		3		3						3	
27	Motorcycles, with side-cars.....	2	34	17	53					2	55	
28	Motorcycles.....		3		3					1	4	
29	Trucks, Motor, 3 ton.....	1	22		23					1	24	
30	Trucks, Motor 3 ton, F.W.D. Standard.....			30	30						30	
31	Trucks, Motor, Repair.....		6		6						6	
32	Trucks, Motor, 1 1/2 ton.....	1	28	16	45						45	
33	Trucks, Motor, Lighting.....		1		1						1	
34	Trucks, Motor, Photo.....		1		1						1	
35	Trucks, Motor, Radio.....		1		1						1	
36	Trucks, Motor, Winch.....			5	5						5	
37	Trucks, Motor, Tender.....			5	5						5	
38	Trailers, 3 ton.....	1	12		13						13	
39	Trailers, 1 1/2 ton.....		11		12					1	13	
40	Trailers, 1 ton.....		27		27						27	
41	Trailers, Kitchen, Rolling.....		3	5	8						8	
42	Trailers, Photo,,,,,.....		1		1						1	
43	Trailers, Radio.....		1		1						1	
44	Airplanes.....	3[h]	73		76						76	
45	Balloons.....			5	5						5	
46	Pistols.....	11	210	81	302		13	2	1	1	319	
47	Rifles.....	18	484	851	1353					4	1357	
48	Rifles, Automatic.....			5	5						5	
49	Guns, Machines, Anti-Aircraft...			30	30						30	
50	Guns, Machine, Synchronized.....	6[h]	152		158						158	
51	Guns, Machine, Flexible.....	6[h]	152		158						158	

and who possess the necessary technical qualifications.

(p) Must be a pilot and active flyer.

(s) Size varies with type and quantity of ground troops in the Corps.

(y) Includes 5 trailers, water tanks.

(*) Armed with pistol.

($) Armed with rifle.

OBSERVATION GROUP, AIR SERVICE

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
								Attached						
1	UNITS	Headquarters	Supply and Transportation Section	Engineering Section	Photo Section	Three Squadrons(a)	Total	Medical Dept.	Ordnance Dept.	Artillery	Infantry	Intelligence	Aggregate	REMARKS
2	Lieutenant Colonel	*1[p]					1						1	(a) Adjutant.
3	Majors					3	3				*1[k]		4	(b) 1 Engineer Officer and 1 Radio Officer.
4	Captains	1[c] *2[1an]	*1[n]	*2[b]		12	14					*1	15	(c) Acts as Group Operation Officer and flies with Group Commander.
5	1st Lieutenants			*1[1i]	1	75	79	1	*1	*1[d]			82	(d) Liaison Officer detailed from the Artillery.
6	2nd Lieutenants					36	37		*3				40	(f) Motorcycle Riders, 3 are for the motorcycles placed by the Air Service at the disposal of the B. I. O.
7	Total Commissioned	3	1	3	1	126	134	1	4	1	1	1	142	(g) Sergeant Major.
8	Master Electricians					15	15						15	(h) Maintained by one of the Squadrons in the Group.
9	Ordnance Sergeants								*3				3	(i) Compass Officer.
10	Sergeants, 1st Class	*1[g]			1	66	68	1					69	(j) One chauffeur of the ambulance.
11	Mess Sergeants					3	3						3	(k) Purpose of this Liaison Officer is to improve the knowledge
12	Sergeants				3	33	36	2	*15			$1[L]	54	
13	Corporals			$2[n]	9	63	74		*9	*1[m]		11 $2[1m]	86	
14	Chauffeurs, 1st Class		$3[1q]		1	27	31						31	
15	Chauffeurs		$4[1q]		1	42	47						47	
16	Cooks		*1			18	19						19	
17	Buglers	*2				6	8						8	
18	Privates, 1st Class	$2[m]	$5[f]		15	87	109	4[1j]					113	
19	Privates	$2[r]	$4			144	150	5	*27			$1	183	
20	Total Enlisted	7	17	2	30	504	560	12	54	1		4	631	
21	Aggregate	10	18	5	31	630	694	13	58	2	1	5	773	

22	Ambulance, Motor.....							1					1	
23	Cars, Motor.....		2			12	14					1°	15	
24	Cars, Motor, Light.....					3	3						3	
25	Motorcycles, with side-cars.....		2		2	30	34					2°	36	
26	Motorcycles.....					3	3					1°	4	
27	Trucks, Motor 3 ton.....				1	21	22					1°	23	
28	Trucks, Motor, Repair.....					6	6						6	
29	Trucks, Motor 1 1/2 ton.....		1			27	28					1	29	
30	Trucks, Motor, Lighting.....		1				1						1	
31	Trucks, Motor, Photo.....				1		1						1	
32	Trucks, Motor, Radio.....		1				1						1	
33	Trailers, 3 ton.....					12	12						12	
34	Trailers, 1 1/2 ton.....		1		1	9	11					2	13	
35	Trailers, 1 ton.....					27	27						27	
36	Trailers, Kitchen, Rolling.....					3	3						3	
37	Trailers, Photo.....				1		1						1	
38	Trailers, Radio.....		1				1						1	
39	Airplanes.....	1[h]				72	73						73	
40	Pistols.....	6	2	3	31	168	210		58	2	1	1	272	
41	Rifles.....	4	16	2		462	484					4	488	
42	Guns, Machine, Synchronized.....	2[h]				150	152						152	
43	Guns, Machine, Flexible.....	2[h]				150	152						152	

of the functioning of the Air Service and the infantry with each other.

(L) Draftsman.

(m) Clerks.

(n) Non-flyers. Whenever possible these positions should be filled by former pilots or observers who are unfit, by reason of disability, for service flying, and who possess the necessary technical qualifications.

(o) This transportation is provided and maintained by the M.T.S. to the Air Service but the Air Service must place it at the disposal of the B.I.O. for dissemination of the information gained by the Group. Chauffeurs and motorcycle riders are provided by the Air Service. (See notes f and q.)

(p) Must be pilot and active flyer.

(q) 1 is for the motor transportation at the disposal of the B.I.O.

(r) 1 telephonist.

(s) Number of squadrons depends upon number and deployment of divisions in Army Corps.

(°) Armed with pistol.

(§) Armed with rifle.

OBSERVATION SQUADRON, AIR SERVICE

	1	2	3	4	5	6	7	8	9	10	11	12
					1 Flight							
1	UNITS	Headquarters (1st Section)	Supply and Transportation (2nd Section)	Engineering (3rd Section)	Headquarters	6 Air Sections	Total 1 Flight	Total 3 Flights (4th to 21st Sections)	Total	Ordnance Dept. Attached	Aggregate	REMARKS
2	Major	*1[AA]						1	1		1	(a) Adjutant.
3	Captains	*d1[c]			*1[AA]		1	3	4		4	(b) 1 Engineer Officer and 1 Radio Officer.
4	1st Lieutenants	*1[an]				6d8[2p*]	8	24	25		25	(c) Observer acts as operations Officer and flies with the squadron Commander.
5	2nd Lieutenants		*1[n]	*2[bn]		*3[p]	3	9	12	*1[x]	13	(d) Observers.
6	Total Commissioned	3	1	2	1	11	12	36	42	1	43	(e) Armorers.
7	Master Electricians			*5[f]					5		5	(f) 1 Electrician, 1 Fitter (engine), 1 Fitter (machinist), 1 Rigger, and 1 Radio Mechanic and operator.
8	Ordnance Sergeants									*1	1	(g) Sergeant Major.
9	Sergeants, 1st Class	*1[g]	$2[h]	$1[oo]		$6[i]	6	18	22		22	(h) 1 Supply Sergeant and 1 Truckmaster.
10	Mess Sergeants		$1						1		1	(i) Riggers (rated as aviation mechanicians).
11	Sergeants	$1[m]	$1[j]	$3[k]		$2[L]	2	6	11	*5[e]	16	(j) Assistant Truckmaster.
12	Corporals	$1[m]	$1	$4[o]		$5[q]	5	15	21	*3[e]	24	(k) 1 Radio mechanic and operator, 1 fitter (general), and 1 rigger.
13	Chauffeurs, 1st Class		$4	$2		$1	1	3	9		9	(L) 1 fitter (general), and 1 fitter (engine).
14	Chauffeurs		$5			$3	3	9	14		14	(m) Clerk.
15	Cooks		*6						6		6	(n) Non-flyers. Whenever possible these positions should be filled by former pilots or observers who are unfit, by reason of disability, for service flying and who possess the necessary technical qualifications.
16	Buglers	*2							2		2	(o) 1 carpenter, 1 instrument repairer, and 2 radio mechanics.
17	Privates, 1st Class	$1[m]	$4[r]	$12[s]		$4[t]	4	12	29		29	
18	Privates		$2[u]	$4[v]		$14[w]	14	42	48	*9[e]	57	
19	Total Enlisted	6	26	31			35	105	168	18	186	
20	Aggregate	9	27	33	1	46	47	141	210	19[d]	229	

21	Cars, Motor		4						4		4	(p) Must be a pilot.
22	Cars, Motor, Light		1						1		1	(q) 1 Fitter (general), 2 fitters (engine), and 2 riggers.
23	Motorcycles with side-cars		2	2		2	2	6	10		10	(r) 3 Motorcycle riders and 1 clerk.
24	Motorcycles		1						1		1	(s) 1 acetylene welder, 2 blacksmiths, 2 sailmakers, 1 carpenter, 1 instrument repairer, 2 motorcycle riders, and 3 radio mechanics and operators.
25	Trucks, Motor, 3 ton		1			2	2	6	7		7	
26	Trucks, Motor, Repair			2					2		2	
27	Trucks, Motor, 1 1/2 ton		3			2	2	6	9		9	(t) 1 fitter (turner), 1 electrician, and 2 fitters (engine).
28	Trailers, 3 ton		2[y]	2					4		4	
29	Trailers, 1 1/2 ton		3						3		3	(u) Store-men.
30	Trailers, 1 ton		3			2	2	6	9		9	(v) 1 coppersmith, 1 vulcanizer, 1 instrument repairer, and 1 carpanter.
31	Trailers, Kitchen, Rolling		1						1		1	
32	Airplanes					8	8	24	24		24	(w) 1 instrument repairer, 1 coppersmith, 1 carpenter, 2 riggers, 4 fitters (engine), 2 motorcycle riders, and 3 for general utility.
33	Pistols	6	7	7	1	11	12	36	56	19	75	
34	Rifles	3	20	26		35	35	105	154		154	(x) Acts both as squadron ordnance officer and machine gun instructor.
35	Guns, Machine, Synchronized		2			16	16	48	50		50	
36	Guns, Machine, Flexible		2			16	16	48	50		50	(y) 1 is water trailer.

(z) NOTE. — In case the squadron is called upon to operate alone, and not as a part of a group, there will also be attached to it, while thus operating alone; the following personnel and materiel:

Medical Dept.: 1 1st Lieutenant; 1 Sergeant; 1 private, 1st class (chauffeur); 1 private and 1 ambulance motor, M. D. (all are unarmed).

Intelligence: *1 1st Lieutenant (Branch Intelligence Officer); $1 Sergeant (draftsman), $2 Corporals (1 draftsman and 1 clerk); and $2 privates and 1 motorcycle with side car.

Artillery: *1 1st Lieutenant (liaison between the artillery and the squadron); and $1 Corporal (clerk).

Infantry: *1 Major or Captain (attached from the division with which the squadron works). Changed every two or three weeks. Purpose is to improve the knowledge or the functioning of aviation and infantry with each other.

Air Service:

1 Lighting truck and $1 chauffeur.

1 Photo truck and photo trailer with $1 chauffeur.

1 Radio truck and radio trailer with $1 chauffeur when not with photo section.

1 Photo laboratory section; when necessary, table 39.

+ 1 Car, Motor, and $1 chauffeur.

+ 2 Motorcycles with side cars and $2 privates, 1st class as rider.

+ 1 Motorcycle with $1 private, 1st class, as rider.

(+) This transportation is to be placed at the disposal of the Branch Intelligence Officer for the dissemination of intelligence gained by the squadron.

(AA) Must be a pilot or observer.

(oo) Radio mechanic and operator.

(*) Armed with pistol.

($) Armed with rifle.

BALLOON WING, AIR SERVICE

	1	2	3	4	5	6	7
					Attached		
1	UNITS	Headquarters	3 Groups	Total	Medical Dept.	Aggregate	REMARKS
2	Colonel	*1		1		1	(a) Radio Officer.
3	Lieutenant Colonel	*1		1		1	(f) Wing Headquarters utilized to command all Balloon Groups in one Air Brigade.
4	Majors		3	3		3	(*) Armed with pistol.
5	Captains	*2	18	20		20	(§) Armed with rifle.
6	1st Lieutenants	*1*	45	46	3	49	
7	2nd Lieutenants		60	60		60	
8	Total Commissioned	5	126	131	3	134	
9	Master Electricians		36	36		36	
10	Sergeants, 1st Class	§1	174	175	18	193	
11	Mess Sergeants		15	15		15	
12	Sergeants		144	144	3	147	
13	Corporals	§2	243	245		245	
14	Chauffeurs, 1st Class	§2	138	140		140	
15	Chauffeurs	§2	249	251		251	
16	Cooks		51	51		51	
17	Buglers		30	30		30	
18	Privates, 1st Class	§2	525	527	33	560	
19	Privates	§2	1065	1067	15	1082	
20	Total Enlisted	11	2670	2681	69	2750	
21	Aggregate	16	2796	2812	72	2884	
22	Cars, Motor	1	18	19		19	
23	Motorcycles, with side cars	2	51	53		53	
24	Trucks, Motor, 3 ton F. D. W. Standard		90	90		90	
25	Trucks, Motor, 1 1/2 ton	1	48	49		49	
26	Trucks, Motor, Winch		15	15		15	
27	Trucks, Motor, Tender		15	15		15	
28	Trailers, Kitchen, Rolling		15	15		15	
29	Trailers, Water Tank		15	15		15	
30	Balloons		15	15		15	
31	Pistols	5	243	248		248	
32	Rifles	11	2553	2564		2564	
33	Rifles automatic		15	15		15	
34	Guns, Machine, Anti-Aircraft mounts		90	90		90	

BALLOON GROUP, AIR SERVICE

	1	2	3	4	5	6	7
1	UNITS	Headquarters	5 Companies	Total	Medical Dept. Attached	Aggregate	REMARKS
2	Major	*1		1		1	(*) Armed with pistol.
3	Captains	*1	5	6		6	(§) Armed with rifle.
4	1st Lieutenants		15	15	1	16	
5	2nd Lieutenants		20	20		20	
6	Total Commissioned	2	40	42	1	43	
7	Master Electrician	*2	10	12		12	
8	Sergeants, 1st Class	§3	55	58	6	64	
9	Mess Sergeants		5	5		5	
10	Sergeants	§3	45	48	1	49	
11	Corporals	§6	75	81		81	
12	Chauffeurs, 1st Class	§6	40	46		46	
13	Chauffeurs	§8	75	83		83	
14	Cooks	*2	15	17		17	
15	Buglers		10	10		10	
16	Privates, 1st Class	§5	170	175	11	186	
17	Privates	§5	350	355	5	360	
18	Total Enlisted	40	850	890	23	913	
19	Aggregate	42	890	932	24	956	
20	Cars, Motor, 7 Pass	1	5	6		6	
21	Motorcycles, with side-cars	2	15	17		17	
22	Trucks, Motor, 3 ton F. W. D. Standard		30	30		30	
23	Trucks, Motor, 1 1/2 ton	1	15	16		16	
24	Trucks, Motor, Winch		5	5		5	
25	Trucks, Motor, Tender		5	5		5	
26	Trailers, Kitchen Rolling		5	5		5	
27	Trailers, Water Tank		5	5		5	
28	Balloons		5	5		5	
29	Pistols	6	75	81		81	
30	Rifles	36	815	851		851	
31	Rifles, Automatic		5	5		5	
32	Guns, Machine, Anti-Aircraft mounts		30	30		30	

BALLOON COMPANY, AIR SERVICE

	1	2	3	4	5
			Attached		
1	UNITS	Total, 1 Company	Medical Department	Aggregate	REMARKS
2	Captain	*1		1	(c) Observer.
3	1st Lieutenants	2(c)=3		3	(*) Armed with pistol.
4	2nd Lieutenants	3(c)=4		4	($) Armed with rifle.
5	Total Commissioned	8		8[c]	
6	Master Electricians	*2		2	
7	Sergeants, 1st Class	$11	1	12	
8	Mess Sergeants	$1		1	
9	Sergeants	$9		9	
10	Corporals	$15		15	
11	Chauffeurs, 1st Class	$8		8	
12	Chauffeurs	$15		15	
13	Cooks	*3		3	
14	Buglers	*2		2	
15	Privates, 1st Class	$34	2	36	
16	Privates	$70	1	71	
17	Total Enlisted	170	4	174	
18	Aggregate	178	4	182	
19	Cars, Motor, 7 Pass	1		1	
20	Motorcycles, with side-cars	3		3	
21	Trucks, Motor, 3 ton, F.W.D. Standard	6		6	
22	Trucks, Motor, 1 1/2 ton	3		3	
23	Trucks, Motor, Winch	1		1	
24	Trucks, Motor, Tender	1		1	
25	Trailers, Kitchen, Rolling	1		1	
26	Trailers, Water Tank	1		1	
27	Balloons	1		1	
28	Pistols	15		15	
29	Rifles	163		163	
30	Rifles, Automatic	1		1	
31	Guns, Machine, Anti-Aircraft mounts	6		6	

ARMY OBSERVATION WING, AIR SERVICE

	1	2	3	4	5	6	7	8	9	10	11	12

1	UNITS	Headquarters	1 Photo Section	1 Air Park	3 Groups	Total	Attached				Aggregate	REMARKS
							Medical Dept. and Chaplains	Ordnance Dept.	Artillery	Intelligence		
2	Colonel	*1				1					1	(a) 1 Adjutant, 1 operation officer, 1 for pay-rolls.
3	Lieutenant Colonels				3	3					3	
4	Majors			1	9	10					10	(b) 1 regimental Sergeant Major and 1 for pay-rolls.
5	Captains	*3[an]		1	42	46		3			49	
6	1st Lieutenants		1	3	237	241	4	9	3	3	260	(c) 1 Clerk and 2 pay-rolls.
7	2nd Lieutenants			1	111	112					112	(d) 1 Clerk and 3 pay-rolls.
8	Chaplains						2				2	(f) 1 Clerk, 1 telephonist, and 2 motorcycle riders.
9	Total Commissioned	4	1	6	402	413	6	12	3	3	427	(g) 1 telephonist and 4 general utility.
10	Master Electricians	*2[b]		2	45	49					49	(h) Maintained by one of the squadrons in the wing.
11	Ordnance Sergeants							9			9	
12	Sergeants, 1st Class	$1[m]	1	5	204	211	3				214	(m) Clerks.
13	Mess Sergeants			1	9	10					10	(n) Non-flyers. Whenever possible these positions should be filled by former pilots and observers who are unfit, by reason of disability, for service flying and who possess the necessary technical qualifications.
14	Sergeants	$3[c]	3	9	108	123	7	45		3	178	
15	Corporals	$4[d]	9	12	222	247		27	3	6	283	
16	Chauffeurs, 1st Class	$1	1	11	93	106					106	
17	Chauffeurs	$3	1	22	141	167					167	
18	Cooks	*2		4	57	63					63	
19	Buglers	*2		2	24	28					28	
20	Privates, 1st Class	$4[f]	15	34	327	380	12				392	
21	Privates	$5[g]		54	450	509	16	81		3	609	(*) Armed with pistol.
22	Total Enlisted	27	30	156	1680	1893	38	162	3	12	2108	($) Armed with rifle.
23	Aggregate	31	31	162	2082	2306	44	174	6	15	2545	
24	Ambulances, Motor						3				3	
25	Cars, Motor	2		4	42	48				3	51	
26	Cars, Motor, Light				9	9					9	
27	Motorcycles, with side-cars	2	2	10	102	116				6	122	
28	Motorcycles				9	9				3	12	
29	Trucks, Motor, 3 ton	1	1	18	66	86				3	89	
30	Trucks, Motor, Repair			2	18	20					20	
31	Trucks, Motor, 1 1/2 ton	1		12	84	97					97	
32	Trucks, Motor, Lighting				3	3					3	
33	Trucks, Motor, Photo		1		3	4					4	
34	Trucks, Motor, Radio				3	3					3	
35	Trailers, 3 ton			3	36	39					39	
36	Trailers, 1 1/2 ton	1	1	17	33	52				3	55	
37	Trailers, 1 ton			10	81	91					91	
38	Trailers, Kitchen, Rolling			1	9	10					10	
39	Trailers, Photo		1		3	4					4	
40	Trailers, Radio				3	3					3	
41	Airplanes	1[h]			219	220					220	
42	Pistols	11	31	14	630	686		174	6	3	869	
43	Rifles	21		147	1452	1620				12	1622	
44	Guns, Machine, Synchronized	2[h]		4	456	462					462	
45	Guns, Machine, Flexible	2[h]		4	456	462					462	

ARMY OBSERVATION GROUP, AIR SERVICE

	1	2	3	4	5	6	7	8	9	10	11	12	13
								Attached					
1	UNITS	Headquarters	Supply and Transportation Section	Engineering Section	1 Photo Section	3 Squadrons	Total	Medical Department	Ordnance Department	Artillery	Intelligence	Aggregate	REMARKS
2	Lieutenant Colonel	*1[p]					1					1	(a) Adjutant.
3	Majors					3	3					3	(b) 1 Engineer Officer and 1 Radio Officer.
4	Captains	1c 2[an]				12	14				*1	15	(c) Observer acts as groups operations officer and flies with group commander.
5	1st Lieutenants		*1[n]	*2[b]	1	75	79	1	*1	*1[dk]		82	(d) Liaison Officer detailed from the artillery.
6	2nd Lieutenants			*1[l]		36	37		3			40	(f) Motorcycle Riders. 3 are for the motorcycles placed by the A. S. at the disposal of the B. I. O.
7	Total Commissioned	3	1	3	1	126	134	1	4	1	1	141	(g) Sergeant Major.
8	Master Electricians					15	15					15	(h) Maintained by one of the squadrons in the group.
9	Ordnance Sergeants								3			3	(i) Compass Officer.
10	Sergeants, 1st Class	*1[g]			1	66	68	1				69	(j) 1 Chauffeur of the ambulance.
11	Mess Sergeants					3	3					3	(L) Draftsman.
12	Sergeants				3	33	36	2	15		$1[L]	54	(m) Clerks.
13	Corporals			$2[m]	9	63	74		9	*1[m]	11 $2[1a]	89	(n) Non-flyers. Whenever possible these positions should be filled by former pilots or observers who are unfit, by reason of disability,
14	Chauffeurs, 1st Class		2[q]		1	27	31					31	
15	Chauffeurs		$4[q]		1	42	47					47	
16	Cooks		*1			18	19					19	
17	Buglers	*2				6	8					8	
18	Privates, 1st Class	$2[e]	$5[f]		15	87	109	4[j]				113	
19	Privates	$2[f]	$4			144	150	5	27		$1	183	
20	Total Enlisted	7	17	2	30	504	560	12	54	1	4	631	
21	Aggregate	10	18	5	31	630	694	13	57	2	5	771	

22	Ambulances, Motor					12	14	1			1°	15	for service flying and who possess the necessary technical qualifications.
23	Cars, Motor		2			3	3					3	
24	Cars, Motor, Light		2		2	30	34				2	36	(o) This transportation is provided and maintained by the M. T. S. to the A. S. but the A. S. must place it at the disposal of the B. I. O. for the dissemination of the information gained by the group. Chauffeurs and motorcycle riders are provided by the A. S. (See notes f and q).
25	Motorcycles					3	3				1°	4	
26	Trucks, Motor, 3 ton				1	21	22				1°	23	
27	Trucks, Motor, Repair					6	6					6	
28	Trucks, Motor, 1 1/2 ton		1			27	28				1	29	
29	Trucks, Motor, Lighting		1				1					1	
30	Trucks, Motor, Photo				1		1					1	
31	Trucks, Motor, Radio		1				1					1	
32	Trailers, 3 ton					12	12					12	
33	Trailers, 1 1/2 ton		1		1	9	11				2°	13	
34	Trailers, 1 ton					27	27					27	
35	Trailers, Kitchen, Rolling					3	3					3	(p) Must be a pilot and active flyer when necessary and practicable.
36	Trailers, Photo				1		1					1	
37	Trailers, Radio		1				1					1	
38	Airplanes	1[h]				72	73					73	(q) 1 is for the motor transportation at the disposal of the B. I. O.
39	Pistols	6	2	3	31	168	210		57	2	1	270	
40	Rifles	4	16	2		462	484				4	488	
41	Guns, Machine, Synchronized	2[h]				150	152					152	(r) 1 is telephonist.
42	Guns, Machine, Flexible	2[h]				150	152					152	(°) Armed with pistol.
43													($) Armed with rifle.

MONOPLACE PURSUIT WING, AIR SERVICE

	1	2	3	4	5	6	7	8	9
						Attached			
1	UNITS	Headquarters	1 Air Park	3 Groups	Total	Medical Dept. and Chaplains	Ordnance Dept.	Aggregate	REMARKS
2	Colonel	*1			1			1	(a) 1 Adjutant, 1 Operations Officer, and 1 for pay-rolls.
3	Lieutenant Colonels			3	3			3	(b) 1 as regimental Sergeant Major, and 1 pay-rolls.
4	Majors		1	9	10			10	(c) 1 Clerk and 2 pay-rolls.
5	Captains	*3[an]	1	33	37			37	(d) 1 Clerk and 3 pay-rolls.
6	1st Lieutenants		3	81	84	4	3	91	(f) 1 Clerk, 1 telephonist, and 2 motorcycle riders.
7	2nd Lieutenants		1	165	166		9	175	(g) 1 Telephonist and 4 general utility.
8	Chaplains					1		1	(h) Maintained by one of the squadrons in the wing.
9	Total Commissioned	4	6	291	301	5	12	318	(m) Clerks.
10	Master Electricians	*2[b]	2	45	49			49	(n) Non-flyers. Whenever possible these positions will be filled by former pilots and observers who are unfit, by reason of disability, for service flying and who possess the necessary technical qualifications.
11	Ordnance Sergeants						9	9	(*) Armed with pistol.
12	Sergeants, 1st Class	$1[m]	5	201	207	3		210	($) Armed with rifle.
13	Mess Sergeants		1	9	10			10	
14	Sergeants	$3[c]	9	90	102	7	45	154	
15	Corporals	$4[d]	12	195	211		27	238	
16	Chauffeurs, 1st Class	$1	11	78	90			90	
17	Chauffeurs	$2	22	123	147			147	
18	Cooks	*2	4	57	63			63	
19	Buglers	*2	2	24	28			28	
20	Privates, 1st Class	$4[f]	34	273	311	12		323	
21	Privates	$5[g]	54	432	491	16	81	588	
22	Total Enlisted	26	156	1527	1709	36	162	1909	
23	Aggregate	30	162	1818	2010	43	174	2227	

24	Ambulances, Motor.....					3			3
25	Cars, Motor.....	2	4	24	27				27
26	Cars, Motor Light.....			9	9				9
27	Motorcycles, with side-cars.....	2	10	69	81				81
28	Motorcycles.....			9	9				9
29	Trucks, Motor, 3 ton.....	1	18	63	82				82
30	Trucks, Motor, Repair.....		2	18	20				20
31	Trucks, Motor, 1 1/2 ton.....		12	84	96				96
32	Trucks, Motor, Radio.....			3	3				3
33	Trailers, 3 ton.....		3	36	39				39
34	Trailers, 1 1/2 ton.....	1	17	30	48				48
35	Trailers, 1 ton.....		10	81	91				91
36	Trailers, Kitchen, Rolling.....		1	9	10				10
37	Trailers, Radio.....			3	3				3
38	Airplanes.....	1[h]		228	229				229
39	Pistols.....	10	15	429	454			174	628
40	Rifles.....	20	147	1389	1556				1556
41	Guns, Machine, Synchronized.....	2[h]	4	474	480				480
42	Guns, Machine, Flexible.....		4		4				4

MONOPLACE PURSUIT GROUP, AIR SERVICE

	1	2	3	4	5	6	7	8	9	10
	UNITS	Headquarters	Supply and Transportation Section	Engineer Section	3 Squadrons	Total	Attached		Aggregate	REMARKS
							Medical Dept.	Ordnance Dept.		
2	Lieutenant Colonel	*1[p]				1			1	(a) 1 Adjutant and 1 operations Officer.
3	Majors				3	3			3	
4	Captains	*2[an]			9	11			11	(b) 1 Engineer Officer and 1 Radio Officer.
5	1st Lieutenants		*1[n]	*2[b]	24	27	1	1	29	
6	2nd Lieutenants			*1[t]	54	55		3	58	(f) Motorcycle riders.
7	Total Commissioned	3	1	3	90	97	1	4	102	(g) Sergeant Major.
8	Master Electricians				15	15			15	(h) Maintained by one of the squadrons in the group.
9	Ordnance Sergeants							*3	3	(i) Compass Officer.
10	Sergeants, 1st Class	1[*g]			66	67	1		68	(j) 1 chauffeur of the ambulance.
11	Mess Sergeants				3	3			3	(m) Clerks.
12	Sergeants				30	30	2	*15	47	(n) Non-flyers. Whenever possible these positions should be filled by former pilots or observers who are unfit, by reason of disability for service flying and who possess the necessary technical qualifications.
13	Corporals			$2[n]	63	65		9	74	
14	Chauffeurs, 1st Class		$2		24	26			26	
15	Chauffeurs		$2		39	41			41	
16	Cooks		*1		18	19			19	
17	Buglers	*2			6	8			8	
18	Privates, 1st Class	$2[p]	$2[r]		87	91	4[j]		95	
19	Privates	2[r]	$4		138	144	5	27	176	(p) Must be pilot and active flyer.
20	Total Enlisted	7	11	2	489	509	12	54	575	(r) 1 telephonist.
21	Aggregate	10	12	5	579	606	13	*58	677	(*) Armed with pistol.
										($) Armed with rifle.

22	Ambulances, Motor						1		1	
23	Cars, Motor		2		6	8			8	
24	Cars, Motor, Light				3	3			3	
25	Motorcycles, with side-cars		2		21	23			23	
26	Motorcycles				3	3			3	
27	Trucks, Motor, 3 ton				21	21			21	
28	Trucks, Motor, Repair				6	6			6	
29	Trucks, Motor, 1 1/2 ton		1		27	28			28	
30	Trucks, Motor, Radio		1			1			1	
31	Trailers, 3 ton				12	12			12	
32	Trailers, 1 1/2 ton		1		9	10			10	
33	Trailers, 1 ton				27	27			27	
34	Trailers, Kitchen, Rolling				3	3			3	
35	Trailers, Radio		1			1			1	
36	Airplanes	1[h]			75	76			76	
37	Pistols	6	2	3	132	143		58	201	
38	Rifles	4	10	2	447	463			463	
39	Guns, Machine, Synchronized	2[h]			156	158			158	

MONOPLACE PURSUIT SQUADRON, AIR SERVICE

	1	2	3	4	5	6	7	8	9	10	11	12
					One Flight							
1	UNITS	Headquarters (1st) Section	Supply and Transportation (2nd Section)	Engineering (3rd Section)	Headquarters	6 Air Sections	Total: 1 Flight	Total: 6 Flights (4th to 21st) Sections	Total	Ordnance Department Attached	Aggregate	REMARKS
2	Major	*1[p]							1		1	(a) 1 Adjutant and 1 operations Officer.
3	Captains				*1[p]		1	3	3		3	
4	1st Lieutenants	*2[an]				*2[p]	2	6	8		8	(b) 1 Engineer Officer and 1 Radio Officer.
5	2nd Lieutenants		*1[n]	*2[bn]		*5[p]	5	15	18	*1[x]	19	
6	Total Commissioned	3	1	2	1	7	8	24	30	1	31	(c) For squadron Commander. Maintained by one of the flights.
7	Master Electricians			*5[f]					5		5	(d) Radio mechanic and operator.
8	Ordnance Sergeants									*1	1	(e) Armorers.
9	Sergeants, 1st Class	*1[g]	$2[h]	$1[d]		$6[l]	6	18	22		22	(f) 1 Electrician, 1 fitter (engine), 1 fitter (machinist), 1 rigger, and 1 radio mechanic and operator.
10	Mess Sergeants		$1						1		1	
11	Sergeants		$1[j]	$3[k]		$2[L]	2	6	10	*5[e]	15	
12	Corporals	$1[m]	$1	$4[o]		$5[q]	5	15	21	*3[e]	24	(g) Sergeant Major.
13	Chauffeurs, 1st Class		$3	$2		$1	1	3	8		8	(h) 1 Supply Sergeant and 1 truckmaster.
14	Chauffeurs		$4			$3	3	9	13		13	
15	Cooks		*6						6		6	(i) Riggers (rated as aviation mechanicians).
16	Buglers	*2							2		2	
17	Privates, 1st Class	$1[m]	$4[r]	$12[s]		$4[t]	4	12	29		29	(j) Assistant truckmaster.
18	Privates	$1	$2[u]	$4[v]		$13[w]	13	39	46	*9[e]	55	(k) 1 radio mechanic and operator, 1 fitter (general), and 1 rigger.
19	Total Enlisted	6	24	31		34	34	102	163	18	181	(L) 1 fitter (general), and 1 fitter (engine).
20	Aggregate	9	25	33	1	41	42	126	193	19	212	(m) Clerk.

21	Cars, motor		2						2		2	(n) Non-flyers. Whenever possible these positions should be filled by former pilots who are unfit, by reason of disability, for service flying and who possess the necessary technical qualifications.
22	Cars, motor, light		1						1		1	
23	Motorcycles with side-cars		2	2		1	1	3	7		7	
24	Motorcycles		1						1		1	
25	Trucks, Motor, 3 ton		1			2	2	6	7		7	
26	Trucks, Motor, Repair			2					2		2	
27	Trucks, Motor, 1 1/2 ton		3			2	2	6	9		9	(o) 1 Carpenter, 1 instrument repairer, and 2 radio mechanics.
28	Trailers, 3 ton		2[y]	2					4		4	
29	Trailers, 1 1/2 ton		3						3		3	(p) Must be a pilot and active flyer.
30	Trailers, 1 ton		3			2	2	6	9		9	
31	Trailers, Kitchen, Rolling		1						1		1	(q) 1 fitter (general), 2 fitters (engine), and 2 riggers.
32	Airplanes	1[*]				8	8	24	25		25	
33	Pistols	6	7	7	1	7	8	24	44	19	63	(r) 3 Motorcycle riders and 1 clerk.
34	Rifles	3	18	26		34	34	102	149		149	(s) 1 Acetylene welder, 2 blacksmiths, 2 sailmakers, carpenter, 1 instrument repairer, 2 motorcycle riders, and 3 radio mechanics and operators.
35	Guns, Machine, Synchronized	2	2			16	16	48	52		52	

(t) 1 Fitter (turner), 1 electrician, and 2 fitters (engine).
(u) Store-men.
(v) 1 Coppersmith, 1 vulcanizer, 1 instrument repairer, and 1 carpenter.
(w) 1 instrument repairer, 1 coppersmith, 1 carpenter, 2 riggers, 4 fitters (engine), 1 motorcycle rider, and 3 for general utility.
(x) Acts both as squadron ordnance Officer and machine gun instructor.
(y) 1 is water trailer.
(*) Armed with pistol.
($) Armed with rifle.

DAY BOMBARDMENT SQUADRON, AIR SERVICE[A]

	1	2	3	4	5	6	7	8	9	10	11	12
					Flight							
1	UNITS	Headquarters (1st) Section	Supply and Transportation 2nd Section)	Engineering (3rd) Section	Headquarters	6 Air Sections	Total: 1 Flight	Total: 8 Flights 4th to 21st one	Total	Ordnance Department Attached	Aggregate	REMARKS
2	Major	*1[p]							1		1	(a) Adjutant.
3	Captains				*1[p]		1	3	3		3	(b) 1 Engineer Officer and 1 Radio Officer.
4	1st Lieutenants	1an*2[ldz]				2p*5[3d]	5	15	17		17	
5	2nd Lieutenants		*1[n]	*2[bn]		4p*8[4d]	8	24	27	*1[r]	28	(c) For squadron Commander. Maintained by one of the flights.
6	Total Commissioned	3	1	2	1	13	14	42	48	1	49	(d) Observers.
												(e) Armorers.
7	Master Electricians			*5[f]					5		5	(f) 1 electrician, 1 fitter (engine), 1 fitter (machinist), 1 rigger and 1 radio mechanic and operator.
8	Ordnance Sergeants									*1	1	
9	Sergeants, 1st Class	*1[g]	$2[h]	$1[o]		$6[i]	6	18	22		22	
10	Mess Sergeants		$1						1		1	(g) Sergeant Major.
11	Sergeants	$1[m]	$1[j]	$3[k]		$2[L]	2	6	11	*5[e]	16	(h) 1 supply Sergeant and 1 truckmaster.
12	Corporals	$1[m]	$1	$4[o]		$5[q]	5	15	21	*3[e]	24	(i) Riggers (rated as aviation mechanicians).
13	Chauffeurs, 1st Class		$3	$2		$1	1	3	8		8	
14	Chauffeurs		$4			$3	3	9	13		13	(j) Assistant truckmaster.
15	Cooks		*6						6		6	(k) 1 radio mechanic and operator, 1 fitter (general), 1 rigger.
16	Buglers	*2							2		2	
17	Privates, 1st Class	$1[m]	$4[r]	$12[s]		$4[t]	4	12	29		29	(L) 1 fitter (general), and 1 fitter (engine).
18	Privates		$2[u]	$4[v]		$13[w]	13	39	45	*9[e]	54	(m) Clerk.
19	Total Enlisted	6	24	31		34	34	102	163	18	181	(n) Non-flyers. Whenever possible these positions should be filled by former pilots and observers who are unfit, by reason of disability, for service
20	Aggregate	9	25	33	1	47	48	144	211	19	230	

21	Cars, Motor.....		2						2		2		flying, and who possess the necessary technical qualifications.
22	Cars, Motor, light.....		1						1		1		
23	Motorcycles, with side-cars.....		2	2		1	1	3	7		7	(o)	1 carpenter, 1 instrument repairer and two radio mechanics.
24	Motorcycles.....		1						1		1		
25	Trucks, Motor, 3 ton.....		1			2	2	6	7		7	(p)	Must be a pilot and active flyer.
26	Trucks, Motor, repair.....			2					2		2	(q)	1 fitter (general), 2 fitters (engine) and two riggers.
27	Trucks, Motor, 1 1/2 ton.....		3			2	2	6	9		9		
28	Trailers, 3 ton.....		2[f]	2					4		4	(r)	3 motorcycle riders and 1 clerk.
29	Trailers, 1 1/2 ton.....		3						3		3	(s)	1 acetylene welder, 2 blacksmiths, 2 sailmakers, 1 carpenter, 1 instrument repairer, 2 motorcycle riders, and 3 radio mechanics and operators.
30	Trailers, 1 ton.....		3			2	2	6	9		9		
31	Trailers, Kitchen, Rolling.....		1						1		1		
32	Airplanes.....	1[e]				8	8	24	25		25		
33	Pistols.....	6	7	7	1	13	14	42	62	19	81	(t)	1 fitter (turner), 1 electrician and 2 fitters (engine).
34	Rifles.....	3	18	26		34	34	102	149		149		
35	Guns, Machine, Synchronized.....	2[c]	2			16	16	48	52		52	(u)	Storemen.
36	Guns, Machine, Flexible.....	2[c]	2			16	16	48	52		52	(v)	1 coppersmith, 1 vulcanizer, 1 instrument repairer and 1 carpenter.
												(w)	1 instrument repairer, 1 coppersmith, 1 carpenter, 2 riggers, 4 fitters (engine), 1 motorcycle rider, and 3 for general utility.
												(x)	Acts both as squadron ordnance Officer and machine gun instructor.
												(y)	1 is water trailer.
												(z)	Operations Officer.
												(A)	The organization of a multi-engined daylight squadron is the same as the organization for this squadron, except that the number of observers is increased by 10 1st Lieutenants and 12 2nd Lieutenants and the synchronized machine guns are changed to flexible guns. This change is also carried into the organization tables of the higher units.
												(O)	Radio mechanic and operator.
												(*)	Armed with pistol.
												(§)	Armed with rifle.

DAY BOMBARDMENT GROUP, AIR SERVICE

1	UNITS	2 Headquarters	3 Supply and Transportation Section	4 Engineering Section	5 3 Squadrons	6 Total	7 Attached: Medical Department	8 Attached: Ordnance Department	9 Aggregate	10 REMARKS
2	Lieutenant Colonel	*1[p]			1	1			1	(a) Adjutant.
3	Majors	1[c] *2[1a,n]			3	3			3	(b) 1 Engineer Officer and 1 Radio Officer.
4	Captains				9	11			11	(c) Operations officer. Trained as observer. Files with group commander.
5	1st Lieutenants		*1[o]	*2[b]	51	54	1	*1	56	(f) Motorcycle riders.
6	2nd Lieutenants			*1[l]	81	82		3	85	(g) Sergeant Major.
7	Total Commissioned	3	1	3	144	151	1	4	156	(h) Maintained by one of the Squadrons in the group.
8	Master Electricians				15	15			15	(i) Compass officer.
9	Ordnance Sergeants							3	3	(j) 1 chauffeur for ambulance.
10	Sergeants, 1st Class	*1[g]			66	67	1		68	(m) Clerks.
11	Mess Sergeants				3	3			3	(n) Non-flyers. Whenever possible these positions should be filled by former pilots or observers who are unfit, by reason of disability for service flying who possess the necessary technical qualifications.
12	Sergeants				33	33	2	15	50	(p) Must be a pilot and active flyer.
13	Corporals			$2	63	65		9	74	(r) 1 telephonist.
14	Chauffeurs, 1st Class		$2		24	26			26	(*) Armed with pistol.
15	Chauffeurs		$3		39	42			42	($) Armed with rifle.
16	Cooks		*1		18	19			19	
17	Buglers	*2			6	8			8	
18	Privates, 1st Class	$2[m]	$2[f]		87	91	4[1j]		95	
19	Privates	$2[f]	$4		135	141	5	27	173	
20	Total Enlisted	7	12	2	489	510	12	54	576	
21	Aggregate	10	13	5	633	661	13	58	732	
22	Ambulances, Motor						1		1	
23	Cars, Motor		2		6	8			8	
24	Cars, Motor, Light				3	3			3	
25	Motorcycles, with side-cars		2		21	23			23	
26	Motorcycles				3	3			3	
27	Trucks, Motor, 3 ton				21	21			21	
28	Trucks, Motor, Repair				6	6			6	
29	Trucks, Motor, 1 1/2 ton		1		27	28			28	
30	Trucks, Motor, Lighting		1			1			1	
31	Trucks, Motor, Radio		1			1			1	
32	Trailers, 3 ton				12	12			12	
33	Trailers, 1 1/2 ton		1		9	10			10	
34	Trailer, 1 ton				27	27			27	
35	Trailers, Kitchen, Rolling				3	3			3	
36	Trailers, Radio		1			1			1	
37	Airplanes	1[h]			75	76			76	
38	Pistols	6	2	3	186	197		58	255	
39	Rifles	4	11	2	447	464			464	
40	Guns, Machine, Synchronized	2[h]			156	158			158	
41	Guns, Machine, Flexible	2[h]			156	158			158	

	1	2	3	4	5	6	7	8
1	UNITS	Headquarters Section	Supply and Transportation Section	Engineering Section	Total	Medical Dept. Attached	Aggregate	REMARKS
2	Major	*1[n]			1		1	(a) Adjutant.
3	Captains		*1[n]		1		1	(b) Supply Sergeant.
4	1st Lieutenants	*1[an]	*1[n]	*1[n]	3	1	4	(c) 2 Supply Sergeants and 1 truckmaster.
5	2nd Lieutenants		*1[n]		1		1	(d) 4 Supply Sergeants and 1 assistant truckmaster.
6	Total Commissioned	2	3	1	6	1	7	(f) 1 engine stores, 1 airplane stores, 2 general stores, 1 wireless stores, and 3 clerks.
7	Master Electricians		*1[b]	*1[l]	2		2	(g) Sergeant Major.
8	Sergeants, 1st Class	*1[g]	$3[c]	$1[j]	5		5	(h) 4 engine stores; 4 airplane stores; 7 general stores, 2 carpenters, 8 general utility, 8 motorcycle riders, and 1 blacksmith.
9	Mess Sergeants		$1		1		1	(i) Rigger.
10	Sergeants	$1[m]	$5[d]	$3[h]	9	1	10	(j) Fitter (general).
11	Corporals	$1[m]	$8[f]	$3[k]	12		12	(k) 1 rigger and 2 fitters (general).
12	Chauffeurs, 1st Class		$9	$2	11		11	(l) 1 carpenter, 1 clerk, and 1 sailmaker.
13	Chauffeurs		$22		22		22	(m) Clerks.
14	Cooks		*4		4		4	(n) Non-flyers. Whenever possible these positions will be filled by former pilots and observers who are unfit, by reason of disability, for service flying and who possess the necessary technical qualifications.
15	Buglers	*2			2		2	
16	Privates, 1st Class	$1[m]	$24[o]	$9[q]	34		34	
17	Privates		$34[h]	$20[r,s]	54	1	55	
18	Total Enlisted	6	111	39	156	2	158	
19	Aggregate	8	114	40	162	3	165	
20	Cars, Motor	3	1		4		4	(o) 2 engine stores, 2 airplane stores, 3 general stores, 2 wireless stores, 1 photo stores, 1 balloon stores, 1 carpenter, 7 clerks, 1 general utility, and 4 motorcycle riders.
21	Motorcycles, with side-cars		10		10		10	
22	Trucks, Motor, 3 ton		18		18		18	
23	Trucks, Motor, Repair			2	2		2	
24	Trucks, Motor, 1 1/2 ton		12		12		12	
25	Trailers, 3 ton		1[y]	2	3		3	
26	Trailers, 1 1/2 ton		17		17		17	
27	Trailers, 1 ton		10		10		10	
28	Trailers, Kitchen, Rolling		1		1		1	(q) 1 acetylene welder, 2 carpenters, 5 sailmakers, and 1 storeman.
29	Pistols	5	8	2	15		15	(r) 1 painter, 8 carpenters, 11 sailmakers.
30	Rifles	3	106	38	147		147	(s) Not allowed when park serves squadrons not equipped with these.
31	Guns, Machine, Synchronized (*)		4		4		4	(y) Water trailer.
32	Guns, Machine, Flexible (*)		4		4		4	(*) Armed with pistol.
								($) Armed with rifle.

PHOTO SECTION, AIR SERVICE

	1	2	3
1	UNITS	Photo Laboratory Section	REMARKS
2	1st Lieutenant	1[a]	(a) Photo Officer.
3	Total Commissioned	1	(b) Chief Plate Developer.
4	Sergeant, 1st Class	1[b]	(d) 1 Chief Draftsman, 1 Chief Printer and Enlarger, 1 Supply Sergeant.
5	Sergeants	3[d]	(e) 1 Cabinet maker, 1 Plate Developer, 1 Draftsman, 3 Printers, 1 Print Developer, 2 Camera Repairs and Installation.
6	Corporals	9[e]	(f) 2 Draftsmen, 3 Print Developers, 2 Washing and Drying Plates, 4 Washing and Drying Prints, 2 Motorcycle Riders, 1 Plate Developer, 1 Printer.
7	Chauffeur, 1st Class	1	(*) All armed with pistols.
8	Chauffeur	1	
9	Privates, 1st Class	15[f]	
10	Total Enlisted	30	
11	Aggregate	31*	
12	Motorcycles with side-cars	2	
13	Truck, Motor, 3 ton	1	
14	Truck, Motor, Photo	1	
15	Trailer, 1 1/2 ton	1	
16	Trailer, Photo	1	
17	Pistols	31	

Appendix B: Unit Costs

In February 1919 Maj. P. H. Jennings, Chief of the Disbursing and Legal Division of the Air Service, AEF, completed an estimate of the cost of establishing aero squadrons, balloon companies, and training centers, and maintaining them for the first year.[2] The figures—$6,000 for a pursuit plane, $2,800 for a spare engine, $75 for a bomb sight, $9 for a pair of fur-lined flying boots, and $0.57 a day for a man's rations—are interesting in this age of much more sophisticated equipment and greatly inflated prices. More important, however, is the information the estimates provide about the character and status of the U.S. Air Service at the end of World War I. They show, for example, that a day bombardment squadron with 18 Breguet 14 B2 aircraft with Renault 300 motors and a reserve of 7 additional planes could be expected to require 72 more planes a year for replacements, 49 extra motors, and spare parts amounting to almost 50 percent of the total cost of all 97 planes and 146 motors. The same attrition rate, 33 percent per month (figured on a basic allowance of 18 planes) was used for observation planes, but the rate for pursuit was higher—50 percent per month. Estimates for a day bombardment squadron have been selected for inclusion as an appendix to this volume.

Estimated Costs

1. Establishment and maintenance for 1 year of squadrons and balloon companies as per appended statements cost as follows:

Pursuit Squadron (based on Spad 7's with H.S. 180 motors)	$2,855,435.81
Observation Squadron (based on Breguet A-2's with Renault 300 motors)	3,419,200.06
Day Bombardment Squadron (based on Breguet B-2's with Renault 300 motors)	3,942,735.08
Night Bombardment Squadron (10 planes) (based on D.H. 9 planes)	2,006,000.00
Night Bombardment Squadron (10 planes) (based on Handley-Page planes)	4,500,000.00
Balloon Company	400,664.91

2. These figures indicate an annual cost per fighting unit in each kind of aero squadron (based on 18 pilots for a pursuit squadron, 18 pilots and 18 observers for an observation squadron, 18 pilots and 18 bombers for a day bombing squadron, 10 pilots and 10 bombers for D.H. 9 night bombarding squadron, 10 pilots, 10 observers and 10 bombers for Handley-Page night bombardment squadron) as follows:

Pursuit Squadron	$160,000 per active combat pilot

Observation Squadron	95,000 per active pilot or observer
Day Bombing Squadron	110,000 per active pilot or bomber
Handley-Page Night Bombardment Squadron	150,000 per pilot or observer or bomber

The above figures cannot be taken as representing the investment of the United States in individual airmen. They do not mean that the loss of a pursuit pilot represents a loss of $160,000. They do, however, indicate the cost of putting and maintaining each individual fighting unit on the front and they give an indication of the substantial asset that each pilot or observer or bomber represents to the United States.

3. The figures for a pursuit squadron are based upon the Spad 7's, while the experience here has been that Spad 13's were in the most constant use. It is estimated very approximately that a Spad 13 squadron would cost 25 percent more, due to the fact that the Spad 13 and its motor are more expensive and that it carries more armament, burns more gas, etc.

4. The figures cannot be taken as representative for the second year, as they include the cost of original establishment. It is estimated that 75 percent or 80 percent of these figures could be taken as the cost for the second year.

5. Our figures do not cover the entire cost of a squadron. The biggest items omitted are the proportion of general overhead expenses and of park equipment and expense. Another large factor in the expense would be the activity of operations and the mobility of the lines. If a squadron had to move its airdrome and all its equipment once or twice a month, that would mean a substantial increase in expense.

6. The figures contain no allowance for salvage. The salvage on such things as instruments, radio and photographic equipment might be fairly substantial.

7. As a matter of interest and possible use in further analyzing these figures, the average number of flying minutes per plane per day from September 1, 1918, to November 11, 1918, for the squadrons with the First Army, A.E.F., are given as furnished by Colonel Gorrell:

Pursuit	41
Day Bombardment	28
Army Observation	18
Army Corps Observation	21

8. The average cost of an airplane and motor (training and service planes included), based upon prices paid to the French

Government and including the 5 percent commission, is 38,500 Francs, or $7,060.

. . . . . .

P. H. Jennings
Major, Air Service

Day Bombardment Squadron
(Establishment and Maintenance for 1 Year)

Kind of Equipment or Supplies	Value
Airplanes and motors	$1,254,412.84
Spare parts	655,468.65
Transportation equipment	151,032.00
Special clothing for aviators	13,319.88
Oxygen apparatus	18,315.61
Airplanes instrument	11,209.17
Ordnance equipment (individual)	5,492.42
Ordnance equipment (squadron)	4,007.24
Armament	345,309.36
Radio equipment	62,834.31
Hangars, barracks, etc.	38,566.68
Ammunition and bombs	688,580.64
Airplane gasoline	186,261.87
Automobile gasoline	15,688.83
Castor oil	94,818.71
Auto lubricating oil and grease	3,151.78
Gas masks	2,760.00
Subsistence of enlisted men	37,657.05
Pay of officers and enlisted men	243,342.00
Flying field roads and improvements	20,790.00
Special clothing for chauffeurs and mechanics	2,208.16
Family allotments	10,260.00
Photographic Section	77,157.88
	$3,942,735.08

The above contains no estimate for:
Stationery and forms
General stores
Individual clothing and equipment of soldiers
Camp equippage
Cooking utensils
Office equipment
Medical supplies
Land rentals

Proportion of park expense
Proportion of general overhead expense
Wireless telephone equipment
Mileage
No allowance is made for salvage.

Airplanes and Motors

	Francs Unit Price	Total
25 Breguet 14 B2 Airplanes, equipped with Renault 300 motors, initial equipment	55,000.00	1,375,000.00
72 Breguet 14 B2 Airplanes equipped with Renault 300 motors for replacements (replacement figures @ 33 percent per month on the actual squadron of 18 planes, that is to say 6 planes per month including the first month)	55,000.00	3,960,000.00
49 Extra Renault 300 motors (50 percent extra)	24,000.00	1,176,000.00
		6,511,000.00
5 percent Commission to French Government		325,550.00
	Francs	6,836,550.00
Reduced to U.S. Currency @ 5.45		$1,254,412.84

Spare Parts

	Francs Unit Price	Total
Spares for 97 Breguet B2 Airplanes with Renault 300 H.P. motors	33,270.58	3,227,266.06
Spares for 49 extra Renault 300 H.P. motors	7,082.41	347,038.09
		3,574,304.15
Reduced to U.S. Currency @ 5.45		$ 655,468.65

The above figures include the French Government's 5 percent Commission

Special Clothing

	Francs Unit Price	Total
48 Boots, flying, fur-lined	47.25	2,267.00
48 Coats, pilot, general service	84.00	4,032.00
14 Gloves, flying, fur, 4 finger type	15.75	220.00
14 Gloves, flying, fur, 1 finger type	15.75	220.00
14 Gloves, flying, black leather, 4 finger type, detachable knit lining	15.75	220.00
15 Gloves, flying, black leather, 1 finger type, detachable knit lining	15.75	235.75
14 Goggles, type 1, Novial, yellow glass	24.80	347.20
14 Goggles, type 2, supertough, white glass	18.75	262.50
14 Goggles, type 2, supertough, white glass with mask	24.80	347.20
15 Gogglettes #3, white glass	22.65	339.75
48 Hoods knitted	3.60	172.80
26 Helmets, hard leather	29.40	764.40
25 Helmets, soft leather, fur-lined	24.95	618.75
48 Masks, face, soft leather	8.15	391.20
48 Scarfs, camels hair	6.60	316.80
26 Suits, flying, one-piece, fur-lined	136.50	3,549.00
25 Suits, flying, one piece, fur-lined, electrically heated	215.25	5,381.25
48 Suits, one piece, summer	70.00	3,360.00
		23,045.60
5 percent Commission to French Government		1,152.28
	Francs	24,197.88
Reduced to U.S. Currency @ 5.45		$ 4,439.96
200 percent for replacement	Total	$ 13,319.88

Transportation Equipment

	Unit Price	Total
2 Cars Motor	$2,500.00	5,000.00
1 Car Motor Light	800.00	800.00
7 Motorcycles with Sidecars	350.00	2,450.00
1 Motorcycle	300.00	300.00
7 Motor Trucks 3-ton	3,500.00	24,500.00
2 Motor Trucks, repair	6,000.00	12,000.00
9 Motor Trucks 1/2 ton	2,500.00	22,500.00
4 *Trailers 3-ton	1,025.00	4,100.00
3 Trailers 1-1/2 ton	425.00	1,275.00
9 Trailers 1-ton	400.00	3,600.00
1 Trailer kitchen rolling	600.00	600.00
		$ 76,125.00
Replacements for 1 year on the basis of 5 percent per month of the cost of the initial equipment		45,675.00
		$121,800.00
Replacement of spares for 1 year on the basis of 2 percent per month of the cost of equipment		29,232.00
	Total	$151,032.00

*One is a water trailer

Oxygen Apparatus

	Unit Price	Total
97 Dreyer Oxygen Apparatus complete with Y connections and light pressure tubing	$ 150.00	$14,550.00
194 Small oxygen cylinders with valves	7.24	1,404.56
194 Masks complete with low pressure hose connections	2.00	388.00
1 Oxygen hand transfer pump	220.00	220.00
60 Large oxygen cylinders	26.55	1,593.00
97 Manifold connections	1.65	160.05
		$18,315.61

Airplane Instruments

	Francs Unit Price	Total
97 Sets Technical Instruments	600.00	58,200.00
5% Commission to French Government		2,910.00
	Francs	61,110.00
Reduced to U.S. Currency @ 5.45		$11,209.17

Ordnance Equipment
Individual Equipment of a Soldier

81 Belts Pistol model 1912 without ring	1.44	116.64
181 Cans Bacon	.19	34.39
181 Cans Condiment	.13	23.53
181 Cans Meat	.41	74.21
181 Canteens	.58	104.98
181 Canteens covers dismounted	.65	117.65
181 Cups	.41	74.21
181 Forks	.03	5.43
181 Haversacks	3.89	704.09
230 Helmets steel	5.00	1,150.00
81 Holsters Pistol model 1916	1.79	144.99
181 Knives	.15	27.15
362 Magazine Pockets web double	1.06	383.72
162 Magazines extra	.50	81.00
181 Mess kits	.71	128.51
181 Pack carriers	.87	157.45
81 Pistols, caliber 45, 1911 model	14.75	1,194.75
181 Pouches for first aid pocket	.18	32.58
181 Spoons	.12	21.72
		$4,577.02
20 percent for maintenance and replacements		915.40
	Total	$5,492.42

Ordnance Equipment
(Squadron Equipment)

24	Axes	$ .65	$ 15.60
2	Bxs Cartridges, pistol, ball, calibre. 45, model 1911, 2000 per box	48.20	96.40
5	Bxs, cartridges, rifle	46.80	234.00
1	Chest, arm repair, 1910 model, complete with contents	56.23	56.23
1	Kit, pistol cleaning, model 1912	6.80	6.80
1	Locker, arm for automatic pistols, calibre .45, model 1911, capacity 50-arms	7.20	7.20
2	Outfits, marking, model of 1910, for stamping metal	5.27	10.54
149	Rifles	19.50	2,905.50
1	Stamp, seal	2.10	2.10
1	Stencils, personnel equipment, model 1910, Airplane Company	1.60	1.60
1	Stencil, Ord. Dept. Insigna	1.07	1.07
1	Stencil, outfits	2.33	2.33
			$3,339.37
	Add 20 percent for maintenance and replacement		667.87
		TOTAL	$4,007.24

Armament

		Francs Unit Price	Total
101	Vickers Machine Guns	4,590.00	463,590.00
202	Lewis Machine Guns, Air type	3,987.00	805,374.00
100	Rifles, Reserve Browning	687.00	68,700.00
100	Pistols, Signal 35m/m	20.00	2,000.00
98	Bombs, offensive S & R mark 5	687.00	67,326.00
100	Fixed machine gun sights optical	90.00	9,000.00
100	Open ring and bead sights 5"	40.00	4,000.00

100	Free machine gun sights, Norman wind vane	148.00	14,800.00
100	Bomb sights Wimperis N.A.	412.00	41,200.00
98	Synchronizing gears or type 2 Sop Kauper	650.00	63,700.00
98	Turret T.O. 3	530.00	51,940.00
100	Twin gun mount, Jumellage with Bowden	357.00	35,700.00
98	Fixed machine gun sight mounts for 5"	30.00	2,940.00
98	Stick trigger and Bowden 9-ft. fixed gun	75.00	7,350.00
100	Gunner's Belt French Standard	23.00	2,300.00
100	Gunner's Spring seat	20.00	2,000.00
97	Ammunition box for fixed machine gun	140.00	13,580.00
199	Magazines, Rifle reserve	7.00	1,393.00
1050	Free gun Mag. 97 Rds.	60.00	63,000.00
510	Free gun Mag. 47 Rds.	50.00	25,500.00
97	Compt. Free gun mag. for Lewis gun	5.00	485.00
97	Compt. Reserve rifle magazines	2.00	194.00
98	Reserve rifle racks	25.00	2,450.00
98	Fixed machine gun mounts	225.00	22,050.00
98	Signal Pistol racks	12.00	1,176.00
98	Signal ammunition racks	12.00	1,176.00
3	Oscillating shafts with ring mounts	32.00	96.00
3	Oscillating shafts ball sockets	55.00	165.00
3	Adjustable screw caps for ball sockets	4.00	12.00
5	Actuating levers with pins	2.00	10.00
5	Bowden return springs	33.00	165.00
3	Push rod guides	33.00	99.00
5	Push rods	3.00	15.00
8	Plunger levers complete	4.00	32.00
1	Adjustable arm	38.00	38.00
8	Oscillating shaft, spherical collars	27.00	216.00
1	Vickers gun for ground practice	4,278.00	4,278.00
1	Lewis gun for ground practice	3,987.00	3,987.00

1 Vickers Tripod	463.00	463.00
1 Lewis Tripod adapter	11.00	11.00
1 Vickers Belt box links	10.00	10.00
15 Lewis Mag. boxes	5.00	75.00
2 Vickers loading machine links	15.00	30.00
1 Vickers Loading Machine Belt	163.00	163.00
16 Loading handles, Lewis	1.00	16.00
1 Armorer's Tool Kit	825.00	825.00
2 Ammunition Gauges	110.00	220.00
18 Cleaning sets	55.00	990.00
12 Spare parts kits, Lewis	412.00	4,944.00
6 Spare part kits, Vickers	412.00	2,472.00
4 Oscillating shaft brackets	16.00	64.00
		1,792,320.00
5 percent Commission to French Government		89,616.00
	Francs	1,881,936.00
Reduced to U.S. Currency @ 5.45		$ 345,209.36

Airplane Gasoline

	Unit Price	Total
886,950 Litres Gasoline, Airplane (18 motors operating an average of 1-1/2 hours a day each and using 90 litres of gasoline per motor per hour—a total of 2430 litres per day, or 886,950 litres in 365 days)		
54,750 Litres Gasoline, Airplane for mounting and trying motors (estimated at 150 litres per day)		
941,700 Litres or 248,797 Gallons	$0.713	$177,392.26
5% Commission to French Government		8,869.61
		$186.261.87

Radio Equipment

			Francs
Instruments	Unit Price	Total	Total
18 Sets E8 Avion Telephone and Telegraph complete, for initial equipment	1,500.00	27,000.00	
72 Sets E8 Avion, Telephone and Telegraph complete, for replacements (33 % replacements per month)	1,500.00	108,000.00	
1 Set E3 bis with accumulators, for initial equipment	5,000.00	[?]	
Aerial accumulator accessories complete, initial equipment		8,500.00	
1 Set Accumulator charging, with accessories initial equipment	4,000.00	4,000.00	147,500.00
Transportation			
(a) 2 Trucks, Fiat, initial equipment	20,000.00	40,000.00	
(b) 1 Truck Crochat, initial equipment	45,000.00	45,000.00	
		85,000.00	
Replacements figured on basis of 5% per month of initial cost of equipment	51,000.00	51,000.00	
		136,000.00	
Spares figures on basis of 2% per month of total cost of equipment and replacements		32,640.00	168,640.00
Workshop			
1 Set, machine tools, tools and testing bench, initial equipment	10,000.00	10,000.00	10,000.00
			326,140.00

5% Commission to French Government		16,307.00
	Francs	342,447.00
Reduced to U.S. Currency @ 5.45		$62,834.31

(a) 1 Fiat Truck for mounting E3 bis set
1 Fiat Truck for mounting accumulator charging set
(b) 1 Crochat Truck for mounting workshop and test bench

Barracks, Buildings and Hangars

	Unit Price	Total
9,323 square feet, Barracks	$ 1.00	$ 9,323.00
1,220 square feet, Shop Buildings	1.00	1,220.00
3,300 square feet, Stores Buildings	1.00	3,300.00
900 square feet, Administration	1.00	900.00
650 square feet, Hospitals	1.00	650.00
850 Miscellaneous	1.00	850.00
		$16,243.00
Our year's maintenance at 15%		2,436.45
		$18,679.45
4 Bessoneau Hangars	5,975.00	23,900.00
Maintenance of four Bessoneau Hangars for 1 year	3,666.67	14,666.68
Total		$38,566.68

The Barrack space is estimated as follows . . .

	Square Feet Per Man			
Personnel	Quarters	Mess	Total	Total Square Feet
1 Senior Officer	140	13	153	153
48 Junior Officers	70	13	83	3,984
181 Enlisted Men	19-1/2	6-1/2	26	4,706
For Storage and Orderly Room				480
				9,323

Ammunition and Bombs

		Unit Price	Total
196,344	Rounds of ammunition, all types for Vickers or Lewis machine gun	$60.00 per m.	$ 11,780.64
27,072	Bombs	25.00 each	676,800.00
			$688,580.64

Lubricating Oil and Grease for Motor Transportation and Equipment

		Unit Price	Total
4015	Gallons, lubricating oil for motors equipment	$0.69	$2,770.35
2007-1/2	Pounds transmission grease	.19	381.43
			$3,151.78

The above quantities were determined as follows:

	Lubricating and Transmission Oil	Gallons Per Year	
21	Cars and trucks using an average of 1/2 gallon of oil per unit per day, making a total of 10-1/2 gallons per day or	3,822-1/2	
8	Motorcycles and sidecars using an average of 1/2 pint of oil per unit per day, making a total of 1/2 gallon per day or	182-1/2	4,015
	Transmission Grease	**Pounds Per Year**	
21	Cars and trucks using an average of 1/4 pound of grease per unit per day, making a total of 5-1/4 pounds per day, or	1,916-1/4	
8	Motor cycles and sidecars using an average of 1/32 of a pound of grease per unit per day, making a total of 1/4 pound per day or	91-1/4	2,007-1/2

Gasoline for Motor Transportation

	Unit Price	Total
23,642 Gallons Gasoline, automobile	$0.632	$14,941.74
5% Commission to French Government		747.09
Total		$15,688.83

The above quantity was estimated as follows:

Motor Transportation		Miles Per Unit Per Day	Total Miles Per Day	Total Miles in 365 Days	Miles Per Gallon of Gasoline	Gallons of Gasoline for 365 Days
Quantity	Kind					
2	Cars, Motor, heavy	50	100	36,500	8	4,563
1	Car, Motor, light	50	50	18,250	15	1,217
7	Motorcycles with sidecars	30	210	76,650	19	4,034
1	Motorcycle	30	30	10,950	19	576
7	Trucks, Motor, 3-ton	20	140	51,100	9	5,678
2	Trucks, Motor repair	7	14	5,110	7	730
9	Trucks, Motor, 1-1/2 ton	25	225	82,125	12	6,844
			769	280,685		23,642

Castor Oil

		Francs
137,970 Litres, Castor Oil (18 motors operating an average of 1-1/2 hours per day each and using 14 litres of oil per motor per hour—a total of 378 litres in one day or 137,970 litres in 365 days)		
8,504.5 Litres, Castor Oil for mounting and trying motors (estimated at 23.3 litres per day)		
146,474.5 Litres		
or		
140,615.5 Kilos	Frs: 3.50	492,154.25
5% Commission to French Government		24,607.71
		516,761.96
Reduced to U.S. Currency @ 5.45		$ 94,818.71

Gas Masks

		Unit Price	Total
230	Gas Masks	$12.00	$2,760.00

Special Clothing for Motorcyclists, Chauffeurs, Truck Drivers and Mechanics

		Unit Price Francs	Total Francs
For	Motorcyclists		
11	Breeches, kersey lined	25.00	275.00
11	Caps, winter	5.00	55.00
11	Gauntlets leather, woolen-lined five-finger	15.75	173.25
11	Goggles	18.75	206.25
11	Helmets, aviation, winter	35.00	385.00
11	Helmets, aviation, summer	25.00	275.00
11	Masks, face	8.15	89.65
11	Mufflers	6.60	72.60
11	Pea Jackets	40.00	440.00
11	Shoes, aviator, winter	50.00	550.00
11	Sweaters, special aviation	22.05	242.55
For	Chauffeurs and Truck Drivers		
24	Caps, winter	5.00	120.00
24	Gauntlets, wool-lined	15.75	378.00
24	Goggles	18.75	450.00
24	Mufflers	6.60	158.40
24	Pea Jackets	40.00	960.00
For	Mechanics		
90	Overalls, one piece	10.00	900.00
			5,730.70
	5% Commission to French Government		286.53
	Total		6,017.23
	Reduced to U.S. Currency @ 5.45		$1,104.08
	Add 100% for replacements		1,104.08
		Total	$2,208.16

Subsistence of Enlisted Men

		Unit Price	Total
66,065	Rations (181 men for 365 days)	$0.57	$37,657.05

Family Allotments

		U.S. Currency Unit Cost	Total
57	Allotments	$180.00	$10,260.00

Pay of Officers and Enlisted Men

		Rate Per Day	Total
82,800	Days (230 officers and enlisted men for 360 days) (360 days are used here and not 365 because the personnel is paid on a basis of 30 days in each month)	$2.94	$243,432.00

The average daily rate is approximately as follows:

	Officers	Salary Per Year	Total
1	Major, flying	$5,029.20	$ 5,029.20
3	Captains, flying	4,035.72	12,107.16
16	1st. Lieut., flying	3,315.50	53,048.00
1	1st. Lieut., non-flying	2,765.50	2,765.50
25	2nd. Lieut., flying	2,726.54	68,163.50
3	2nd. Lieut., non-flying	2,259.04	6,777.10
49			$147,890.46

Average yearly pay	$3,018.17
Average monthly pay	251.51
Average daily pay	8.38

	Enlisted Men	Approximate Monthly Salary	Total for 1 Month
5	Master Electricians	$ 96.00	$ 480.00
1	Ordnance Sergeant	51.20	51.20
22	Sergeants First Class	60.00	1,320.00
1	Mess Sergeant	57.20	57.20
16	Sergeants	51.20	819.20
24	Corporals	40.80	979.20
8	Chauffeurs First Class	60.00	480.00
13	Chauffeurs	51.20	665.60
6	Cooks	38.00	228.00
2	Buglers	33.00	66.00
29	Private First Class	36.00	1,044.00
54	Privates	33.00	1,782.00
181	*Total Pay for 1 Month*		*$7,972.40*

Average pay for 1 month	$44,046.00
Average pay for 1 day	1,468.00

Summary:	Rate Per Day	Total for 1 Month
49 Officers	$ 8.38	$ 410.62
181 Enlisted Men	1.468	265.70
		$ 676.32

Average rate per day $2.94

NOTE: The salaries of officers are figured at foreign pay rates plus maximum allowance in France.
For flying officers, 25 percent is added to regular pay.
Lists of personnel were taken from page 14 of Equipment Manual.

Flying Fields, Roads, Railroads
Water Supply and Electric System

	Unit Price	Total
50 Acres flying field Cost of preparing, grading, draining, etc. (value of land is not included)	$ 255.00	$12,750.00
600 Yards, Road macadam	1.00	600.00
1-1/2 Kilometers Railroad (industrial)	3,000.00 Km	4,500.00
Water Supply System	600.00	600.00
Electric System	600.00	600.00
		$19,050.00
Yearly Maintenance		
Flying Fields	$1,225.00	
Roads	125.00	
Industrial Railroads	240.00	
Water Supply System	75.00	
Electrical System	75.00	$ 1,740.00
Total		$20,790.00

Issoudun - (Art by J. Andre Smith)

Notes

Preface

1. See Introduction to Vol I, this series. Hereafter this work will be cited as "Gorrell's History."

Part I: Lessons Learned

Introduction

1. See Introduction, Vol I, this series.
2. See App A, Vol I, this series.
3. Extract in Vol II, Doc 29, this series.
4. These are in "Gorrell's History," Ser A, Vol 23.
5. "Gorrell's History," Ser A, Vol 15, p 167. Hereafter this work will be cited only by series, volume, and page in the following form: A-15, 167. If the passage referred to extends for more than one page, only the number of the first page will be given, if the page is numbered.
6. A-15, 165.
7. I. B. Holley, Jr., *Ideas and Weapons* (New Haven, 1953), p 191.

Reports

1. A-15, 1.
2. A-14, 193.
3. A-15, 105.
   a. Lahm had attended this school before the war.
   b. One of the worst defects of the DH-4 was the fire hazard resulting from the construction of the gasoline tank, which was in the fuselage between the pilot and the observer, and from the pressurization of the fuel system. When the tank was punctured by a bullet, gasoline was sprayed around inside the fuselage. In October 1918 the Technical Section of the Air Service, AEF, attempted to correct this condition by means of protected tanks and a non-pressure system using Selsden fuel pumps obtained in England.
4. A-1.
   a. Col. Wilson B. Burtt was Assistant Chief of Air Service for Policy, Col. Henry C. Whitehead was Assistant Chief for Administration, and Col. Robert O. Van Horn, Assistant Chief, Operations, Zone of Advance, during the time Foulois was Chief of Air Service, AEF.
5. E-20, 187.
   a. Hist of 1st Pur Gp, C-9, 9.
   b. c-9, 617
   c. Hartney later referred to these planes as "the finest little all-around pursuit ships on the entire front." Harold E. Hartney, *Up And At 'Em* (Harrisburg, Pa., 1940), p 233.
   d. Hartney, *Up And At 'Em*, pp 233-240.
   e. Small, 20-pound, fragmentation bombs.
6. A-15, 244.
7. A-15, 213.
8. A-15, 214.
   a. Kirby's victory was at 1050 hours on 10 November 1918 (First Army Air Service, GO 26, 15 Nov 1918). Another Fokker was shot down at 1315 hours the same day by two crews from the 104th Aero Squadron (First Army Air Service, GO 5, 28 Jan 1919), this being the last victory officially credited to a member of the U.S. Air Service.
9. C-7, 393. The signature block indicates that the report was prepared by order of Lt. Col. Bert M. Atkinson, the wing commander. There is no indication as to what part Wentworth or the wing's operations officer, Capt. Philip J. Roosevelt, had in the preparation of the report. Wentworth had been assigned to the wing as Roosevelt's assistant three days before the Armistice.
10. A-15, 224.
    a. E-6, 5.
11. E-7, 113.
12. A-15, 239.
13. E-18, 57.
14. E-18, 184. This appeared as a recommendation in the squadron's history.
15. E-13, 46. This was entitled "Notes on Aerial Combat."
16. E-13, 44. This was headed "Notes on Formation Flying."
17. E-6, 52.
18. E-6, 49.
19. E-6, 59.
20. E-6, 55.
    a. Frank Luke, Jr., the famous "balloon buster" of the 27th Squadron.

b. The ring sight most often used in the U.S. Air Service with fixed guns had two parts: (1) Front sight consisting of a ring five inches in diameter, inside of which was a smaller concentric ring of one inch in diameter, the smaller being attached to the larger by four cross wires; (2) A rear sight consisting of a small, red bead mounted on a conical, steel pin three inches high. The distance between the gunner's eye and the ring was 38 inches, the bead being half way between. The sight was mounted so a line between the bead and the center of the ring was parallel with the axis of the gun.

c. The Aldis Unit Sight was an English modification of the French Chretien "clear vision" collimator sight. In the U.S. Air Service it was used only with fixed guns. When used on U.S. planes, a ring sight, for which it was a substitute, was also installed. The Aldis sight consisted of a telescope mounted parallel with the axis of the gun. Non-magnifying, it projected a system of five, etched lines on the field of vision. An object directly ahead appeared in the center of this system of lines. Sighting was with the right eye, with the left eye open, which had the advantage of giving a natural view of the field ahead.

d. This may be garbled. At any rate the editor has not been able to determine what was meant.

21. E-6. 61.

22. E-7, 114.

a. Printed in Biddle, *Fighting Airman* (Garden City, 1968), pp 246-270.

23. E-18, 398.

24. C-8, 193.

25. A-15, 246.

26. E-3, 7.

a. Heater's account of "Americans on Day Bombing with the Independent Air Force" is in "Gorrell's History," B-12, 116.

27. A-15, 67. Wood, an observer, had been with the 24th Aero Squadron during the last weeks of the fighting. His paper on lessons learned, entitled "Mobility of Aero Squadrons," is not dated.

28. A-15, 37.

29. A-15, 72.

30. A-15, 60.

a. The report, dated 23 December 1918, gives the name of the organization as stated here. Presumably, this should be "V Corps Observation Group."

31. A-15, 57.

a. See Note 30a.

32. E-1, 130.

a. Dated 22 October 1918, the report was prepared in response to a memorandum Winant had received at 1830 hours the previous day with instructions to reply by noon. This, Winant said, did not allow enough time "to make a proper report."

b. Nourrice, an auxiliary, gravity tank in the center section of the upper wing.

33. N-17, 135.

34. N-17, 136.

35. A-15, 226.

36. E-17, 18.

37. N-17, 96. This report is headed, "Remarks on Methods of Carrying out Routine Missions."

38. E-9, 499.

39. E-10, 222.

40. A-15, 215.

41. A-15, 217.

42. A-15, 221.

43. E-8, 172.

44. E-8, 168.

45. E-9, 501.

46. A-15, 237.

47. A-15, 234.

48. N-17, 159.

49. N-17, 163.

50. N-17, 161.

51. E-8, 174.

52. E-8, 165.

a. The C.C. interrupter gear was an hydraulic mechanism for synchronizing the firing of a machine gun with the turn of the propeller of an airplane. It was developed by Gogu Constantinesco, a Romanian who, while associated with the Haddon Engineering Works in England before the war, had investgated the transmission of impulsive forces through liquids. In the development of the synchronizing mechanism for aircraft, Constantinesco was assisted by Maj. G. C. Colley.

53. E-9, 508.

54. E-9, 505.

55. E-8, 167.

56. E-8, 176.

a. A star in a circle had been used on airplanes of the

Aviation Section of the Signal Corps before the war, and continued to be used on training planes at home after the United States entered the war. In January 1918, however, the Joint Army and Navy Technical Aircraft Board had adopted the roundel—white (center), blue, and red—which was used to mark aircraft of the Air Service, AEF. See *Bulletin* of the Information Section, Air Service, AEF, Vol III, No 114, 20 April 1918.

57. E-8, 178.
58. A-15, 229.
59. E-17, 18.
60. A-15, 231.
61. A-15, 228.
62. N-17, 92.
63. N-17, 156.
    a. Teddy Bear, fur coat.
64. E-8, 179.
    a. Hist, 50th Aero Sq, in "Gorrell's History," E-8, 96-98, 141-142; Summary of Ops, CAS, I Corps, Nos 26/28, 5, 6, 7 Oct 1918, in "Gorrell's History," C-12, 194-201; Rpt from Corps Obs Wg recd in Info Office, AS, First Army, 1415, 7 Oct 1918, in "Gorrell's History," C-3, 208; Thomas M. Johnson and Fletcher Pratt, *The Lost Battalion* (Indianapolis, 1938), *passim*, especially pp 234-236 and map opposite p 70; James L. Hudson, *Hostile Skies* (Syracuse, 1968), pp 266-268. Johnson and Pratt state (p 235) that the panel seen by Roers had been laid out by the Germans to deceive American airmen.
65. E-8, 170.
66. E-8, 159.
67. E-9, 506.
68. E-9, 502.
    a. 1st Lt. J. W. Livingston.
69. A-15, 238.
70. E-9, 510.
    a. Kenneth P. Littauer previously had flown with the French and had commanded the 88th Aero Squadron.
71. A-15, 9.
    a. Norman Wind Vane Sight, used with machine guns on movable mounts.
    b. The editor has not found this sight in manuals and equipment lists of the Air Service, AEF.
72. A-15, 109. See introductory note to Doc. 3.
    a. Whitten J. East, a graduate of the U.S. Military Academy (1915), had been assigned to the 1st Aero Squadron from the Aviation School at San Diego in May 1917, had gone overseas with the squadron in August, and had been placed in charge of balloon affairs of the AEF on 8 September 1917. He returned to the United States in December and was commander at Mitchel Field at the time of his death in an automobile accident on 2 October 1918.
73. A-15, 21.
74. A-15, 163.
    a. The typed signature block on this document gives Jouett's middle initial as "J."
75. F-5, 469.
76. F-7, 187.
77. F-7, 186.
78. A-15, 88.
79. M-2, 105.
    a. Bellinger returned to Yale after the war and received a Ph.D. degree in 1925. A member of the Yale faculty, he was Lampson Professor of Latin for many years.
    b. See Vol II, Doc. 44.
80. A-15, 147.
81. M-8, 16.
    a. See also Blankenhorn's "The War on Morale; How America 'Shelled' the German Lines with Paper," *Harper's Monthly Magazine*, CXXXIX (September 1919), pp 510-524.
    b. Capt. E. Scholtz and Lt. H. C. Wookey were shot down and captured near Cambrai on 17 October 1917. Tried by a German court, they were found "guilty of treason," sentenced to 10 years of hard labor, and transferred from the prisoner-of-war camp to a prison for ordinary convicts. After the British threatened reprisal, the Germans cancelled the sentences and sent the two officers back to their prisoner-of-war camp.
    c. The reference undoubtedly is to the 88th Aero Squadron (III Corps Observation Group), commanded at that time by 1st Lt. Floyd E. Evans.
    d. Mitchell.
    e. For Blankenhorn the future included work in psychological warfare with the Office of Strategic Services in

North Africa and in the European Theater of Operations in World War II.

82. C-12, 339.

a. The group had been formed in April 1918, but an armament officer was not then authorized for group headquarters. In fact, the Tables of Organization of 15 September 1917 and of 15 January 1918 showed no armament officers authorized below wing level for corps observation. Ordnance personnel for corps observation groups and squadrons appeared in the new Tables of Organization that became effective on 8 September 1918.

b. Bureau of Aircraft Production, Air Service, U.S. Army, *Handbook of Aircraft Armament* (Washington, 1918), is an excellent guide to the machine guns and other armament of the Air Service. See also Benedict Crowell, *America's Munitions, 1917-1918* (Washington, 1919).

83. E-8, 153.

a. See note 82a.

84. N-17, 93.

85. N-17, 138.

86. A-15, 86.

a. William Mitchell, *Memoirs of World War I* (New York, 1960), p 242.

b. These demountable hangars, consisting of a framework covered with canvas with a canvas draw-curtain at one end, were about 65 feet wide and 90 feet long. They were purchased from the French at a cost of about $6,000 each.

c. A demountable building of wooden framing and truss construction covered with wire mesh and tar paper.

87. A-15, 195.

88. E-1, 87.

89. N-17, 137.

90. E-8, 161.

a. The Technical Section concluded that a porcelain or stone insulated plug could not be used satisfactorily in the Liberty engine and that plugs with mica insulation were required. The best one for the Liberty, the Technical Section believed, was the J.A. Moreau (J.A.M.); the second best, the Oleo 75 (Special for Liberty).

b. The first three were American, the next three French. The editor has not been able to identify the other two.

c. The gravity auxiliary tank was in the upper wing, center section. The Technical Section's modification of the DH-4 fuel system (see note b to Document 3, above) included the removal of this tank and the installation of a pressurized auxiliary tank under the pilot's seat.

91. M-40, 2. This is from a "Report on Radio Training in the American E.F." Hardinge was director of radio schools at the Second Aviation Instruction Center, as well as O.I.C. of the Training Section of the Radio Division.

a. The United States purchased 1,471 "Y" sets and 143 "U" sets from the French.

92. E-1, 88.

a. Trailing antenna of twisted copper wire (No. 28, 16-strand) 300 meters long, with lead weights on the end.

93. N-17, 140.

94. E-8, 157.

a. Special helmets fitted with receivers were provided for pilots and observers. The microphone, designed to eliminate motor noise, was strapped around the neck so as to be in front of the mouth, almost touching the lips, for talking, but could be pushed aside when not in use.

95. A-15, 234.

a. The Tables of Organization, 8 September 1918, authorized a radio officer for observation group headquarters, and a radio officer and eight enlisted men, including a master electrician, for an observation squadron.

96. C-12, 339.

97. L-3, 91.

a. See Vol I, this series.

b. Ltr, Krumm to Maj. Robert Loghry, O.I.C., Radio Base Section, 14 Dec 18, in "Gorrell's History," L-3, 90.

c. Conclusions of American E. F. Radio Conference, in "Gorrell's History," L-3, 97.

98. A-15, 160.

99. C-12, 342.

a. Air Service transportation, previously exempt from control by Motor Transport Service (later, Motor Transport Corps), came under MTS jurisdiction in May 1918.

The functions of MTS included allocation of vehicles and spare parts, both in short supply, among AEF organizations. Air Service units retained their authorizations for motor cars and trucks (see Appendix A) but seldom were able to obtain all of the vehicles and parts they needed.

100. N-17, 139.
101. E-8, 150.
102. A-15, 203.
103. L-3, 206.
104. L-3, 152.
105. L-3, 143.
106. A-15, 188.
107. A-15, 232.
108. A-15, 152.
109. A-15, 91.

a. For Jones' role in the historical program of the Air Service, AEF, see the Introduction, Vol I, this series.

110. C-3, 115.
111. A-15, 6.
112. A-15, 76. Memorandum for Col. Halsey Dunwoody. Assistant Chief of Air Service, Paris, and Chief of the Supply Section.
113. A-15, 196.
114. A-15, 149.

a. DeArmond's predecessor as Chief of Personnel had been Lt. Col. Hiram Bingham, who before the war had been professor of Latin American history at Yale University and had explored South America under the auspices of Yale and the National Geographic Society. After serving as Chief of Personnel he was head of the Third Aviation Instruction Center at Issoudun.

115. A-15, 143.

a. Col. Robert O. Van Horn, Assistant Chief of Air Service, Zone of Advance.

b. Receiving and replacement station for the Air Service, AEF.

116. A-15, 12.
117. A-15, 44.

a. Having decided to use both reports, the editor did not find it feasible to make any deletions to avoid such repetition.

b. The reference is to Carroll's memorandum, Document 116, above.

118. A-15, 55.
119. A-15, 191.
120. A-15, 189.
121. A-15, 202.
122. A-15, 194.
123. A-15, 197.
124. A-15, 199.
125. A-15, 206.
126. A-15, 193.
127. A-15, 204.
128. A-15, 71.
129. A-15, 242. This report, dated 19 December 1918, and addressed to the Commanding Officer, Air Service in Italy, was forwarded to Colonel Gorrell by Maj. Robert Glendinning on 20 December.
130. A-15, 207.

a. Doc 36, Vol II, this series.

131. A-15, 74.
132. A-15, 96.

a. Lahm later organized and commanded the Air Corps Training Center, the "West Point of the Air," at Randolph Field.

133. A-15, 112. Lahm's recommendations for the postwar Air Service (Doc. 132), submitted in response to Patrick's request of 10 December 1918, were dated 6 January 1919. This report, dated 9 January, was in the form of a personal letter to Gorrell. The following day, 10 January, Lahm lectured to the graduating class of the Intelligence Officers' School at Langres on the "Organization and General Use of the Air Service."
134. A-15, 140.

a. In 1920 Milling was assigned the task of organizing the Air Service Field Officers' School, which later became the Air Service Tactical School and still later the Air Corps Tactical School.

Part II: U. S. Bombing Survey

Introduction

1. The Statistics Branch of the War Department General Staff had made a study of British and French bombing during the first half of 1918. A copy of this report, dated 7 November 1918, had been sent to General Patrick. After he had seen it, it was sent to the Night Bombardment Section, where it was regarded as a "very important" document that should be preserved. Thus, in January 1919, it was

forwarded to Tours to be added to the section's history, which had already been submitted to Gorrell. Receipt of this report may have been a factor in Gorrell's decision to ask G-2 for a fuller report on Allied bombing.

2. Correspondence and other documents relating to the plans for and the conduct of survey are in the National Archives, Records Group 120, Boxes 5794, 5795, and 5799.

3. In addition, there was some bombing by pursuit and, less frequently, by observation units.

4. See Fig 2, Vol I, this series.

5. There are two copies of this report in "Gorrell's History," in R-1 and R-2. The reports are numbered differently in the two volumes, the numbering in R-1 being followed in the citations appearing subsequent notes. For this work, the three major parts have been rearranged so that the reports on the various towns come first, followed by the statistical summary, and then the narrative. The reports on the several towns, which are generally in alphabetical order in Gorrell's History," have been arranged by regions and types of targets.

Reports

1. R-1, Rpt 42.

a. The report includes a list of these raids, the first on 10 October 1915, the last on the evening of 10 November 1918. Of the 92 raids, nearly half (43) occurred in 1918. There were 16 during 1917 (all in the last seven months of the year), 28 in 1916, and 5 in 1915.

2. R-1, Rpt 13.

3. R-1, Rpt 18.

4. R-1, Rpt 35.

a. Barracks.

b. About 5 miles northwest of Longuyon.

5. R-1, Rpt 44.

6. R-1, Rpt 38.

7. R-1, Rpt 14.

8. R-1, Rpt 48.

a. Courcelles-sur-Nied. 1918.

b. Chailly-sur-Nied?

c. Peltre, about 3 miles south of Sablon.

d. Frontigny?

9. R-1, Rpt 39. See also the report on Rombas (Rpt 11, below), which includes data on damage to a factory at Maizieres.

10. R-1, Rpt 26.

a. The following has been extracted from a table of data pertaining to alerts and raids at the station. The table lists nearly 300 alerts, with a total alert time of more than 400 hours, in the period from April 1917 to November 1918.

b. This report on the bombing of forges and steel mills evidently was obtained from some German source.

c. For information on the bombing of Maizieres, see Rpts 9 and 11 above.

d. This was long before any American units in France were ready for operations.

11. R-1, Rpt 50. See also Rpt 9 on Maizieres.

a. The format of the above recapitulation has been changed slightly. The report contains detailed data on damages and losses for factories at Rombas and Maizieres, and on 253 damage claims made by various persons and the community of Rombas.

12. R-1, Rpt 28.

13. R-1, Rpt 61.

a. The report contains a summary listing of alerts by month from July 1916 to November 1918. The number of alerts during which no bombs were dropped was 396; the number of hours lost because of these alerts, 415.5.

14. R-1, Rpt 27.

a. In the report, the name of the factory is spelled both "Wendle" and "Wendel." The latter appears in the report on Joeuf (Rpt 12, above).

b. It is not clear what this amount represents, or how the amount was determined. All amounts apparently are marks except for the bonus, which is in francs.

15. R-1, Rpt 58.

a. Fifty-nine appear on the list that follows this resume of the results of bombing on the town of Thionville. They span a period from 4 April 1916 to 28 October 1918, with 5 in 1916, 24 in 1917, and 30 in 1918.

b. On the right bank of

the Moselle, opposite the town.

c. Air raid pay.

d. These raids were made by No. 55 Squadron of the RAF, 11 D.H.4's attacking on the 2d, and 12 on the 3d.

e. Six D.H.4's of Squadron 55 and 12 D.H.9's of Squadron 99, RAF. The objective had been the Bosche and Daimler works at Stuttgart, with munition works at Oberndorf as the alternate target, but because of bad weather the leader turned and bombed Thionville. This attack has been characterized as "one of the most successful of its kind made by British aeroplanes in the war." H. A. Jones, *The War in the Air*, Vol VI (London, 1937), p 140.

f. Iron Cross.

g. This is a German document translated in G-2, A-2c, GHQ, AEF. The raid numbers correspond to those in the list ("Statement of Damages . . .") which was appended and which is printed at the end of this document.

h. This raid is not listed in the report, printed above, on Metz. Six F.E.2b's of Squadron 100, RAF, bombed the Metz-Sablon rail yard on the night of 30/31 May.

i. The document contains no explanation for the use of two amounts, bracketed together, for this attack.

j. This abstract from Herr Kienle's day book was translated in G-2, A-2c, GHQ, AEF. Abstract I, which has been omitted, is a chart giving data on traffic interruptions and damages resulting from 181 air raids or alerts.

16. R-1, Rpt 37.

a. The format for the data pertaining to 17 raids has been changed.

b. On the southwest side of the city of Luxembourg. The report also contains a list of the 19 raids on Hollerich (23 August 1914 to 26 September 1918). The list shows 17 people killed and 49 wounded.

17. R-1, n. p. This report, which is not numbered, appears just before the first of the reports pertaining to the various towns. If numbered, it would bring the total number of reports to 66.

18. R-1, Rpt 22. The report, as printed, contains all of the information in the original report, but the format has been changed.

19. R-1, Rpt 19.

20. R-1, Rpt 54. The report contains a list of nearly 200 alerts and raids on blast furnaces at Rumelingen and Oettlingen between the end of July 1916 and the end of October 1918.

21. R-1, Rpt 16.

a. The report lists nearly 350 alerts and raids, beginning in May 1916 and running to November 1918, with the number of tons of steel lost as the result of each.

22. R-1, Rpt 49.

a. The data concerning the nine raids has been extracted (format changed) from a list of 48 raids and alerts that appears in the report.

23. R-1, Rpt 2.

24. R-1, Rpt 59.

a. The figures for "Material Damage Reported" and "Total Damages" are corrected figures shown on the copy in "Gorrell's History," R-1, the correction being the addition of the amount paid by insurance companies (421,456.31 marks) to the amount of material damage reported. The report, in the following section which has been deleted, gives detailed breakdowns of both direct and indirect damages.

b. Just east of Trier.

c. East of Trier, south of Kurenz.

d. About 3 miles southeast of Trier.

e. South of Trier and just east of Kernschied.

f. About 10 miles northeast of Trier, on the rail line to Coblenz.

25. R-1, Rpt 21.

a. Just west of Ehrang.

b. North of Ehrang.

c. East of the Pfalzel rail bridge, in the area between the Moselle and the Rumer, which flows into the Moselle from the south.

26. R-1, Rpt 32.

a. The cover sheet to the report lists these five towns, but in different order. All are within less than 4 miles of Conz. With relationship to Conz, they are situated as

follows: Karthaus and Herzlich, down the Moselle, on the right side of the river; Wasserlich, up the Moselle, on the right side; Oberemmel, to the south. When Merzlich and Karthaus merged in the 1940's, only Karthaus remained as the place name for the area.

27. R-1, Rpt 52.

28. R-1, Rpt 10.

a. The 93 bombs (not counting the one that fell in the gardens) were numbered consecutively in the order given in the report. Bomb # 79 was one of those dropped on 2 September 1918.

29. R-1, Rpt 8.

a. It seems possible, and indeed probable, that the amount given here was the result of more than one raid. If so, the number of raids (5) would have to be revised.

30. R-1, Rpt 62.

a. This number, evidently obtained by counting the months in which raids occurred, apparently is wrong. Wing No. 3, RNAS, for example, bombed Volklingen on 10 and again on 11 November 1916.

b. 10th Landstrum Infanterie-Ersatz-Bataillon?

c. Omitted.

31. R-1, Rpt 17.

a. The report which contains a list of the raids and alerts (date, time alert started and ended, total time), covers only the period from 1 February 1918 to the end of the war. It makes no reference to earlier raids, such as those by No. 3 Wing, RNAS on 24 November and 27 December 1916.

32. R-1, Rpt 6. The report on Bous lists the total number of alerts and hours lost monthly from September 1916 to November 1918. Of the 301 alerts, 80 percent were during 1918.

33. R-1, Rpt 63.

34. R-1, Rpt 41.

35. R-1, Rpt 33.

36. R-1, Rpt 7.

37. R-1, Rpt 55.

a. Not on G-2, A-7, GHQ, AEF, list of German airdromes, 11 November 1918, in "Gorrell's History," M-1.

38. R-1, Rpt 3.

39. R-1, Rpt 15.

40. R-1, Rpt 47.

41. R-1, Rpt 29.

a. Shells for 77-mm field gun.

42. R-1, Rpt 54.

a. This and the following messages reporting raids on Rieding were translated by G-2, A-2c, GHQ, AEF.

43. R-1, Rpt 53.

44. R-1, Rpt 56.

45. R-1, Rpt 45.

46. R-1, Rpt 66.

a. The report contains a list of more than 200 alerts between 14 January 1917 and 30 October 1918.

47. R-1, Rpt 46.

48. R-1, Rpt 30.

a. The report contains a list of 65 alerts (total time, 45 hours) during which no bombs were dropped. The earliest of these was on 22 April 1918.

b. The report contains information on only three factories.

49. R-1, Rpt 34.

50. R-1, Rpt 31.

51. R-1, Rpt 57.

a. Jones, *The War in the Air*, does not mention any bombing of Speyer. According to the London *Times*, Friday, 26 July 1918, the *Frankfurter Zeitung* had reported the bombing of Speyer on Sunday night. Speyer is included in the list, published in the *Times* on 15 August 1918, of places bombed by the Independent Air Force during July. The list of IAF targets in Jones, *The War in the Air*, Appendix XII, does not give the usual details about the execution of the mission of 21/22 July 1918 (p 62).

52. R-1, Rpt 36.

a. The plant often is referred to as being at Mannheim rather than at Ludwigshafen.

b. Just south of Ludwigshafen.

c. Between Ludwigshafen and Oppau.

53. R-1, Rpt 65.

54. R-1, Rpt 40.

a. The report, in the section deleted below, lists 23 alerts in the period from 22 May 1918 to 29 October 1918. The total, at the end of the listing, for total duration of the 23 alerts is 18 hours and 40 minutes. The figures given for the several alerts add to a total alert time of 18 hours and 34 minutes.

55. R-1, Rpt 25.

a. On the Main, just below Frankfurt.

56. R-1, Rpt 64.

57. R-1, Rpt 11.

58. R-1, Rpt 4.

a. Siegburg and Troisdorf are across the Rhine and about 5 or 6 miles to the northeast. See separate report (#59) on Troisdorf.

59. R-1, Rpt 60.

60. R-1, Rpt 12.

a. Spencer Grey later was a member of the staff of the Strategical Section of the Air Service, AEF. Colonel Gorrell, then chief of the section, said that Grey was considered "the world's greatest authority on questions dealing with aerial bombardment." (Gorrell, Early Hist. of Strat Sec., in "Gorrell's History," B-6, 171.)

b. The report lists 24 alerts (total 17 hours and 51 minutes) from October 1917 to November 1918.

61. R-1, Rpt 20.

a. The report contains a list (deleted below) of 35 alerts (total of 33 hours and 3 minutes) from 24 May to 10 November 1918.

b. The report contains data (deleted below) on five factories that were producing shells, chemicals, metal tubing, etc.

62. R-1, Rpt 43.

a. Some references to attacks on airdromes were included, however, in some of the other reports, such as the one on Mars-la-Tour (#6).

b. About 3 miles south of Morhange.

63. R-1, Rpt 9.

a. From the format and spacing in the original copy, it is impossible to determine how much of the above explanation, beginning with "40-50 bombs," pertains to 8 July, and how much to 7 August.

b. The ditto marks which follow apparently apply to the entire next entry (including the phrase concerning the results of the bombing), with only the figure for the number of planes being changed.

64. R-1, Rpt 5.

65. R-1, Rpt 23.

66. R-1, Rpt 20. Friesdorf is not on the list of German airdromes on 11 November 1918, compiled by G-2, A-7, GHQ, AEF, in "Gorrell's History," M-1.

Statistical Summary

1. R-1, 10.

2. Included in report on Frankfurt (#55).

3. Included in report on Luxembourg (#22).

4. Two places covered by the reports, Folpersweiler (#65) and Rechicourt (#40), do not appear in the above list.

Narrative Summary

1. R-1, 2. The first page of the narrative summary, deleted below, contains information about the way the survey was organized and conducted. That information has been used in the editor's introduction to Part II.

Maj. Harry M. Brown, Commanding Officer, 96th Aero Squadron.

Conclusion

1. The survey, of course, was only one of the many factors bearing upon the development of this and other USAAF bombing policies.

2. The way in which the survey was cited in the school's bombardment manual (see Note 3, below) seems to indicate that only the narrative summary, rather than the full report, was at hand. The citation was as follows: Report compiled by G-2, A.E.F., at request of A.S.A.E.F. *Conclusions Re Effects of Allied Bombing of Germany.* Library Air Corps Tactical School.

3. Air Corps Tactical School, *Bombardment Aviation* (Langley Field, 1931), p 12 and n 41, pp 13-15 and n 45, and Bibliography; Air Corps Tactical School, *Genesis of Bombardment Aviation, Preface to Bombardment Text* (Maxwell Field, 1938), pp 14-15 and n 44. The *Preface* was a revision of Section I, "Development of Bombardment Aviation," of the text published in 1931.

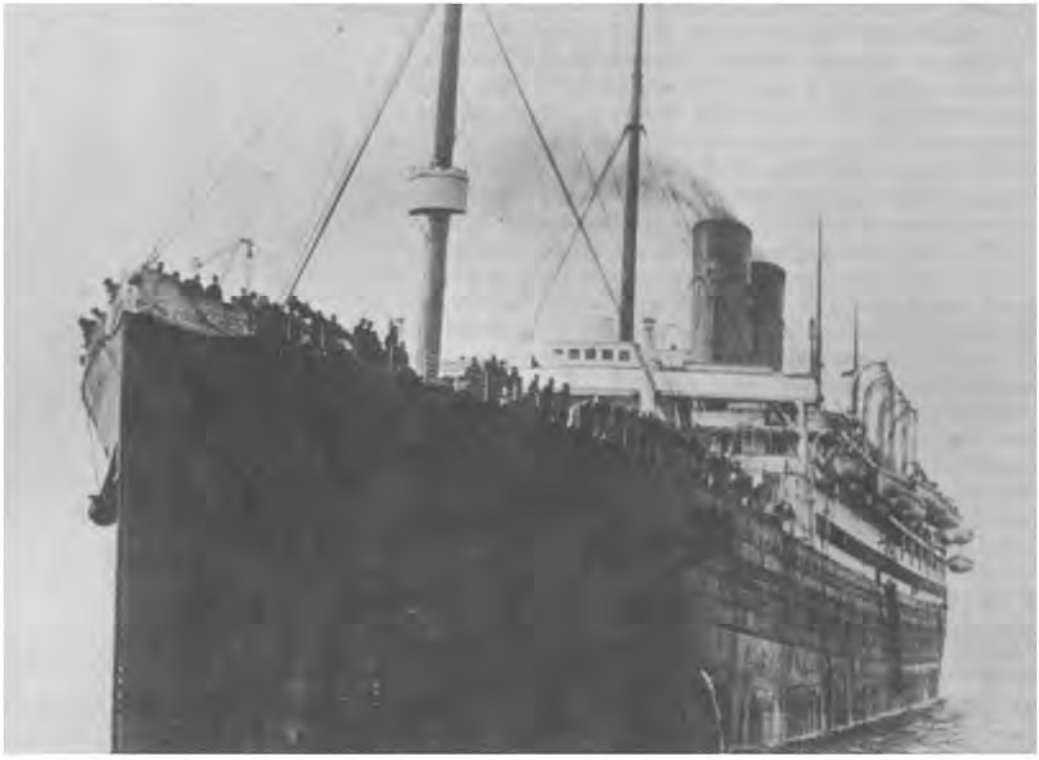
4. See, for example, Robert F. Futrell, *Ideas, Concepts, Doctrine: A History of Basic Thinking in the United States Air Force* (ASI, AU, 1971); [Thomas H. Greer,] Historical Study 89, *Development of Air Doctrine in the Army Air Arm, 1917-1941* (USAF Hist Div RSI, AU, 1955); I. B. Holly, Jr., *Ideas and Weapons,* (New Haven, 1953); and Raymond Richard Flugel, *United States Air Power Doctrine* (Norman, Okla, 1965).

5. The document evidently was in the school's library at Langley Field when the manual was written early in 1930. The library was moved with the school to Maxwell Field in 1931, to the School of Applied Tactics at Orlando during World War II, and back to Maxwell Field after the war to form the nucleus for the new Air University Library. After the USAF Historical Division moved from Washington to Maxwell Air Force Base in 1949, documents from the Tactical School Library were transferred to the Historical Division (now the Albert F. Simpson Historical Research Center). The survey report apparently is not listed in the present catalog of Air University Library.

6. The editor had used "Gorrell's History" for reference and research for more than 15 years before be discovered the report of the bombing survey in July 1974. A notice of the report has been published more recently in [Timothy K. Nenninger,] National Archives Microfilm Publication Pamphlet Describing M990, *Gorrell's History of the American Expeditionary Forces Air Service, 1917-1919* (Washington, 1975).

Appendices

1. A-12. The tables used in this appendix have been reproduced photographically from Hist. Div. USA, *United States Army in the World War, 1917-1919* (Wash., 1948), Vol. I, pp 389-423. In the Table of Organization covering Observation Group, Air Service (p. 512), line 13, column 12 has been changed from $^{11}\S^{1}{}_{m,}$ which obviously is wrong, to $^{1}{}_{L}\S 2^{1}{}_{m,}$ which makes it the same as the authorization for Headquarters, GHQ, Air Service Reserve. In the Table of Organization covering Observation Squadron, Air Service (p. 514), line 20, column 10, the original reference to remarks was "d," which clearly is wrong. It evidently should be "z" and has been changed accordingly.
2. I-24, 166.



The S. S. *Adriatic,* departing Brest, France, returned many Air Service personnel after the end of World War I.

Glossary of Abbreviations

A-2	Information Section, Military Information Division
A-2c	Press and Translations Branch, Information Section, Military Information Division
A-7	Air Intelligence Section, Military Information Division
AA	Antiaircraft
AC of S	Assistant Chief of Staff
AEF	American Expeditionary Forces
AFSHRC	Albert F. Simpson Historical Research Center
AIC	Aviation Instruction Center
Akt.-Ges.	Aktiengesellschaft
a.m.; a-M	am Main
AM; am	ante meridiem
Am EF	American Expeditionary Forces
App	appendix
AR	Corps d'Armee a moteur Renault
AS	Air Service
ASAEF	Air Service, American Expeditionary Forces
ASI	Aerospace Studies Institute
AU	Air University
BC	Battery Commander
BIO	Branch Intelligence Officer
BR	Bentley Rotary
Brig	Brigadier
B.T.	Battery-Target
c	centimeter(s)
CACS	Corps Air Service Commander
Capt	Captain
CAS	Chief of Air Service
CC	(Name given to synchronizing mechanism developed by Constantinesco and Colley)
CG	Commanding General
Chem	Chemische
C-in-C	Commander-in-Chief
cm	centimeter(s)
Co	Company
CO	Commanding Officer
C of S	Chief of Staff
Col	Colonel
DH	De Havilland
Div	Division
Doc	document
DSC	Distinguished Service Cross

EA	enemy aircraft
EF	Expeditionary Forces
F	franc(s)
FA	Field Artillery; Frankford Arsenal
FE	Farman Experimental
Fig	figure
FO	Field order
G-1	First Section (Administration), General Staff
G-2	Second Section (Intelligence), General Staff
G-2-A	Military Information Division, Intelligence Section, General Staff
G-2-D	Censorship Division, Intelligence Section, General Staff
G-3	Third Section (Operations), General Staff
Gen	General
GHQ	General Headquarters
G.m.b.H.	Gesellschaft mit beschrankter Haftung
Gp	group
Hist	Historical
Hr(s); hr(s)	hour(s)
IAF	Independent Air Force
Inf	Infantry
Info	Information
Ins	Insurance
Kil	kilometer
kg	kilogram(s)
km	kilometer(s)
Lieut	Lieutenant
Lt	Lieutenant
Ltr	letter
M; m	meter(s); mark(s)
Maj	Major
ME	Master Electrician
MG	machine gun
MID	Military Intelligence Division
Min; min	minute(s)
Mk(s)	mark(s)
mm	millimeter
MSE	Master Signal Electrician

MTC	Motor Transport Corps
n	note
NCO	noncommissioned officer
No(s)	number(s)
Obs	Observation
OCSO	Office of Chief Signal Officer
OIC	officer in charge
Ops	operations
p, pp	page, pages
PC	Post of Command
pf	pfennig
PM; pm	post meridiem
Pur	pursuit
QMC	Quartermaster Corps
RAF	Royal Air Force
recd	received
RFC	Royal Flying Corps
RNAS	Royal Naval Air Service
Rpt	report
RR	railroad
RSI	Research Studies Institute
Ry	railway
SCR	Signal Corps Radio (originally: Set, complete, radio)
SE	Scout Experimental
Ser	series
SOS	Services of Supply
SPAD	Societe pour Aviation et ses Derives
Sq(s)	squadron(s)
USAAF	United States Army Air Forces
USAF	United States Air Force
VB	Viven Bessieres (name of grenade)
Vol	volume
Wg	Wing
Z of A	Zone of Advance

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