48. Battle Orders
Air Service, First Army
September-November 1918

Battle orders issued daily by Col. William Mitchell, Chief of Air Service, First Army, and by his successor, Col. Thomas DeW. Milling, from the beginning of the Meuse-Argonne Campaign until the Armistice, generally consisted of five major parts. These (1) described the situation at the front; (2) indicated the actions to be undertaken by the First Army on the following day; (3) provided a general statement of the Air Service mission; (4) made detailed operational assignments to the various elements of the Air Service; and (5) supplied additional instructions, information, or comment. The general mission statements for the Air Service reveal a shifting of emphasis from time to time, even from day to day, as the battle progressed. Following are extracts from some of those battle orders.[1]

Headquarters Air Service,
First Army American
Expeditionary Forces

France, September 25, 1918.

Battle Orders No. 7.

1. The enemy continues on the defensive at all points along the front. . . .

2. The 1st Army attacks between the MEUSE AND THE AISNE RIVERS at 5–30 H September 26th. . . .

3. *Our air service will take the offensive at all points at daylight September 26, 1918, with the object of destroying the enemy's air service, attacking his troops on the ground and protecting our own air and ground troops.*

. . . . . .

France, September 29, 1918.

Battle Orders No. 11.

1. The offensive of the Allied Armies continues with success. . . .

2. The 1st Army continues the attack, as do the French, British and Belgian Armies. . . .

3. *Our air service will maintain the offensive at all points, and will assist the infantry and artillery in their advance in all ways.*

. . . . . .

France, September 30, 1918.

Battle Orders No. 12.

1. The offensive of the Allied Armies continues with success. . . .

2. The 1st Army will remain in place on October 1st, continuing its preparations for further advance.

3. *Our air service will maintain the offensive at all points and will thoroughly cover our position from hostile air attack or reconnaissance.*

. . . . . .

France, October 3, 1918.

Battle Orders No. 14.

1. The offensive of the Allied Armies continues with success. . . . Our air service continues to dominate the enemy's aviation.

2. The 1st Army attacks on the front west of the RIVER MEUSE on October 4th at 5.25 H. . . .

3. *The air service will concentrate its efforts on the battlefield and will take the offensive at all points at daylight October 4th, 1918, with the object of destroying the enemy's air service, attacking his ground troops, and protecting our own air and ground troops.*

. . . . . .

1. In Gorrell's History, N-2, pp 1–96 *passim*.

France, October 4, 1918.

Battle Order No. 15.

1. Our Army has made substantial gains all along the line against a stubborn resistance. The Allied Armies continue to advance. The German Air Service confronting ours, after vainly attempting all day to gain control over our Air Service, was defeated everywhere.

2. Our Army continues to attack with vigor.

3. *The air service will put forward great efforts to assist the troops on the ground by close operation with them. The same orders remain in effect for October 5th.*

4. The work of all branches of the Air Service, both French and American. has been extremely severe, not only on account of the presence of the enemy in great numbers, but on account of the weather and poor visibility. In spite of these difficulties, the Air Service have [*sic*] shown a dash and readiness to meet every call made upon them, in a way to excite admiration from all who have witnessed the work.

. . . . . .

France, October 7th, 1918.

Battle Orders No. 17.

1. The offensive of the Allied armies is being maintained. The front of the 1st Army had advanced in the ARGONNE FOREST. Our Air service continues to dominate the German aviation, notwithstanding the fact that it has been largely reinforced. . . .

2. The 1st Army will seize the heights east of the MEUSE RIVER, which are occupied by about three German divisions. . . .

3. *The air service will take the offensive at all points over the front of the attack and will maintain a protective barrage west of the Meuse River to the Argonne Forest. The enemy's air service will be destroyed, his ground will be attacked, and our own air and ground troops will be protected.*

. . . . . .

France, October 10, 1918.

Battle Orders No. 20.

1. The Allied Armies are advancing everywhere. The enemy in front of the 1st Army has thrown his divisions into the line by regiments, in his attempts to stop our advance. . . .

2. The first Army continues its attack on October 11th. . . .

3. *The air service will support the attack and will prevent the enemy from organizing along the heights of the Bois de Barricourt. The offensive will be taken at all points on the Front between the Meuse River and Grandpre inclusive.*

. . . . . .

France, October 11, 1918.

Battle Orders No. 21.

1. The offensive of the Allied Armies continues with success. . . .

2. The 1st Army continues its attack on October 12th. . . .

Our air service will maintain the offensive at all points, will support the attack from the Meuse River to Beaumont, and will thoroughly protect our positions from hostile air attack and reconnaissance.

. . . . . .

France, October 13, 1918.

Battle Orders No. 23.

1. The Allied Armies to our left are continuing their advance and the enemy is giving way before them. . . .

2. The 1st Army continues its attack on October 14th. . . .

. . . . . .

3. *The air service will concentrate its efforts on the battle field and will take the offensive at all points at daylight October 14th, 1918, with the object of destroying the enemy's air service, harassing and attacking his ground troops, and protecting our own air and ground troops.*

. . . . . .

France, October 18, 1918.

Battle Orders No. 28.

1. The enemy continues to fall back. . . . The 1st Army has captured 20,000 prisoners since the commencement of Operations on September 26th. . . . The German Air service opposing us, in vain, has attempted all day to gain control of the air by employing patrols of 25 to 50 machines, but has been defeated at every point.

2. The 1st Army will continue to improve its position for further attack by local operations on October 19th. . . .

3. *Our air service will maintain the offensive at all points, will protect our position from hostile air attack and reconnaissance, and will support our ground troops in their local operations.*

. . . . . .

France, October 20, 1918.

Battle Orders No. 30.

1. No change in enemy situation on our front. . . .

2. The 1st Army will continue to improve its position by local operations, maintaining contact with the enemy and developing his line of resistance.

3. The orders for tomorrow remain the same for all branches of the Air Service as prescribed in Battle Orders No. 28, *Special effort will be made to give information concerning the location of hostile artillery units.*

. . . . . .

France, November 3, 1918.

Battle Order No. 44.

1. The Allied Armies have forced the enemy into a precipitate retreat. . . . The aviation of the enemy has been destroyed or driven back wherever found, his balloons have been burned, and our airplanes continually harry and demoralize his ground troops with bombs and machine guns. . . .

2. The First American Army will take up the pursuit of the enemy west of the MEUSE and will make preparations to extend it to the east bank of the MEUSE. . . .

. . . . . .

3. *The air service will concentrate its efforts on the battle field, taking the offensive at all points at daylight November 4th, 1918. It will seize every opportunity to assist our troops, our corps air services will be protected, the enemy air service destroyed, and his ground troops attacked.*

. . . . . .

France, November 5, 1918.

Battle Orders No. 46.

1. The enemy continues to retreat with his infantry in confusion. His artillery is gradually increasing its fire. The Air Service of the enemy wherever encountered has been destroyed or forced to withdraw by our own aviation. . . .

. . . . . .

3. *The air service will take the offensive at all points on the morning of November 6th. The enemy air service will be destroyed and our own air and ground troops will be protected. Every opportunity will be seized to harass hostile ground troops with bombs and machine gun fire.*

. . . . . .

France, November 11, 1918.

Battle Orders No. 52.

1. (a) Yesterday the enemy threw into the line opposite our Third Corps his last available division on the western front.

(b) An armistice with Germany has been signed and all hostilities ceased at 11:00 H November 11th.

(c) The Allied Armies hold themselves in readiness for further advance.

. . . . . .

3. The Air Service will hold itself in readiness to resume operations at a moment's notice. No planes will cross the lines.

. . . . . .

6. Attention of all units is directed to training memoranda attached.

Aerial view of Conflans, 16 September 1918, one of the main bomb targets of the U.S. Air Service in World War I.

49. Objectives of Day Bombardment

November 1918

The interdiction and close-support functions of day bombardment units of the AEF at the end of the war are seen in the following extract from the history that the 2d Day Bombardment Group submitted in December 1918.[1] The group, which was not organized until the beginning of November 1918, was part of the Second Army, of which Col. Frank P. Lahm was Army Air Service Commander.

Air Service—Second Army, American Expeditionary Forces, Headquarters 2nd Day Bombardment Group.

Outline of Operations

Tactical:—

I. *Aims of Bombardment Group.*

1. Direct.

(a) Cutting of communications lines; by bombing railroad centers, thus destroying yards, warehouses, supplies, munitions, trains, and demoralizing transportation personnel; by bombing main roads.

(b) Destruction of enemy works; by bombing ammunition dumps, concentration camps, airdromes, supply depots, military factories, and military defenses.

(c) Smothering of enemy attacks; by bombing concentration of troops in reserve areas or in the zone of attack, or by bombing reinforcing troops on the march.

(d) Demoralizing an enemy retreat; by bombing retreating troops, by cutting communications, or by bombing newly established line of defense.

2. Indirect.

(a) Demoralize troops and lower their fighting morale.

(b) By engaging hostile pursuit, draw them away from the zone of attack.

II. *Choice of Objectives.*

1. Area; as in most cases this group operated with its army, 2nd American Army, its sector covering the sector of the 2nd Army and extending about 40 kilometers back of the front lines.

2. Nature of objectives; railroad centers, airdromes, and munition dumps constituted the original objectives. These were to be bombed continually until specific and individual objectives were to be assigned in case of an attack.

3. Choice of objectives for each mission; unless specific orders were received from A.A.S.C. this group would select the target for each mission, depending upon the following elements:

a. Importance of the target.

b. Number of planes available for mission.

c. Availability of protective pursuit planes.

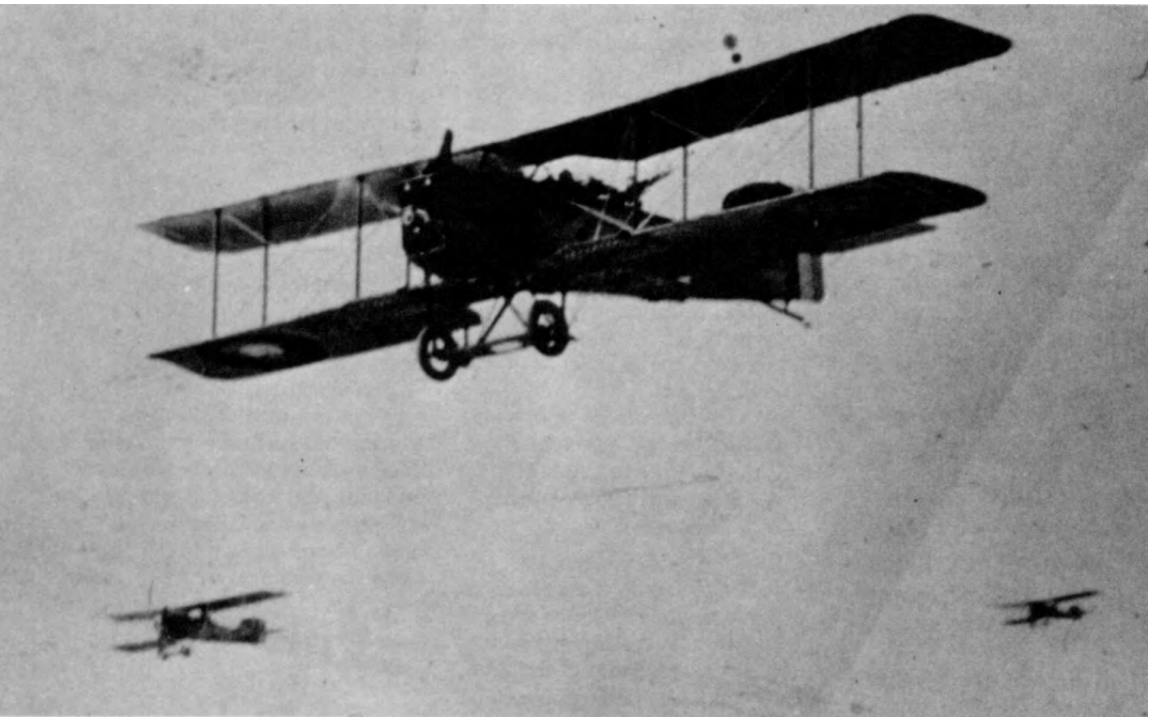
d. Presence and aggressiveness of enemy planes.

e. Weather.

For example, if Conflans showed unusual activity, and the enemy planes were numerous and sufficient bombing and pursuit planes were available the time of bombing would depend upon the weather.

. . . . . .

1. In Gorrell's History, C-8, p 176.



Breguets in formation.

50. Area vs Precision Bombing

November 1918

Aerial bombardment became possible with the development of aircraft capable of getting over a target with a bomb. Then came the problem of putting the bomb on the target. The history of the Bomb Unit, Aircraft Armament Section, Ordnance Department, AEF, the organization responsible for providing bomb sights for the Air Service, stated alternatives available then, as later, to persons attempting to solve the problem.[1]

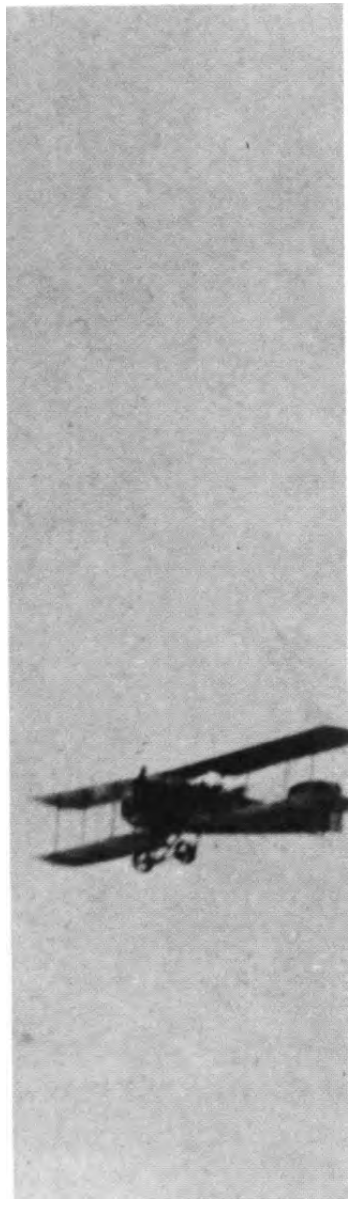
. . . . . .

1. Bombing from airplanes may in general be divided into two types, precision bombing and area bombing. In the first case a definite target is picked out upon which the majority of the bombs are to drop. In the latter the frank admission is made that accuracy is limited and a given area is covered in the hope that enough bombs will strike the target proper to accomplish the mission.

2. The French and British have both tended toward the latter general scheme of bombing, and the system of "sowing" bombs or releasing them in series or trail is the outgrowth of that tendency. The advantage of that system lies in the fact that the sights used in this work . . . are mounted outboard, obviating any necessity of the observer getting down inside the fuselage to sight, and therefore leaving him always ready at his guns, and offering him better protection. The disadvantage lies in the fact that admitting inaccuracy is apt to lead to carelessness in the use of sights; or their being practically ignored.

3. Bombing in general is done in formation, the leading plane of the squadron alone using a sight; and the other planes releasing their bombs when they are at what they judge to be the same point. The sighting observer is in that case protected by the other planes in the formation. His business is to sight, and his attention is not attracted elsewhere. For these reasons the general policy of the United States has been toward precision bombing; and the belief that the American Aviators would faithfully use their sights has been confirmed.

. . . . . .



1. In Gorrell's History, I-2, p 77.

Col. Charles DeF. Chandler.

51. Observation Balloons

November 1918

The work of the balloon observers was detailed in the following instructions which were issued by Col. Charles DeF. Chandler, Chief of the Balloon Section, AEF,[1] and republished in a bulletin of the Air Service, AEF.[2]

Instructions For Balloon Observers

Assignment of Balloons

1. When sufficient balloon companies are available they are normally assigned one to each Division, one to the artillery of each Army Corps, and others distributed to serve Army Artillery. The duties of the observer, therefore, vary somewhat, depending upon the assignment of his balloon.

2. For all balloons the observer is expected to regulate Artillery fire and conduct general surveillance of the enemy terrain within view. In addition to this, the balloons assigned to Divisions have Infantry liaison which consists in the use of preconcerted visual signals between the balloon and infantry, reporting these by telephone to the proper P.C.

3. In addition to the duties in the basket as indicated in the preceding paragraph, the observer takes his turn (usually by roster) for ground assignments such as officer in charge of chartroom and personal liaison with Division Headquarters or Artillery Brigade Headquarters.

4. When there is little movement of troops, giving time for the construction of sufficient telephone lines, the personal liaison to Artillery and Infantry Headquarters is not required to the same extent as during warfare of movement when very few telephone lines are possible; then a balloon officer assigned to Division Artillery Headquarters is expected to inform the balloon by courier, if no other means is possible, of the information desired by Division Headquarters and upon securing the information he should give personal attention that it is, without delay, made available to the officers who call for it. Likewise, the personal liaison with Artillery is expected to constantly inform the balloon of the location of batteries in their vicinity and arrange for temporary telephone of some kind from the nearest battery to the balloon position for location of fire.

General Surveillance

5. General surveillance consists in reporting all matters of military interest within view of the observer in the basket. Even while adjusting fire for Artillery the observer is expected to continue reporting events which come to his attention.

6. The military information most desired consists of the following:

Fugitive targets (troop and transport movements)

Position of enemy batteries (usually located by flashes)

Train movements, giving position of train and direction

The beginning of barrage fire, reporting its extent and changes

1. *Balloon Notes*, No. 66, 27 Nov 18.

2. *Air Service Bulletin*, Vol VII, No. 317, 7 Dec 1918. In the *Bulletin* the title was changed to "Observation."

Road transport and troop movements

Hostile balloons and airplanes

All airplanes brought down, both enemy and friendly

Fires, lights, smoke and explosions

Entrenchments or emplacements and any changes in these

Bridges of all kinds across streams and canals, particularly the construction or destruction of temporary bridges.

7. All of the general military information phoned from the basket is recorded in the chart-room log from which place it is telephoned to the various P. C's. according to the nature of the information. These miscellaneous reports are classified under a few general headings for the daily reports.

8. The reports of train movements are particularly important for the reason that increased railway activity is an indication that the enemy is either augmenting or reducing the movement of troops.

9. An enemy intending advance or retreat movements, usually constructs additional bridges over streams and canals. These are frequently visible from balloons and it is most important that any change in bridges, be promptly reported.

10. The observer should always be careful not to include his own deductions in reports. He should simply give facts briefly and in case of doubt as to what he sees the report should carefully state that the information is not certain; if the information is of sufficient importance the Intelligence officers will secure confirmation from other sources such as ground observation posts and airplanes.

11. All reports from the observer should answer the four questions of WHAT (definition of what was seen), WHEN (day and hour), WHERE (indicating the place), HOW (troops in march or at a halt, Artillery active or silent, etc.).

12. General surveillance by Army balloons is ordered by Army G–3 and the information of this nature when secured is transmitted by the balloon to the Army Air Service Commander.

13. Balloons forming a part of the Army Corps Group receive instructions concerning general surveillance from Corps G–3 and transmit the information secured to the Corps Air Service Commander (Memo No. 8, Hqs. 1st Army, A.E.F. Aug. 6, 1918).

Infantry

14. The observer can easily see Infantry in column and should be able to calculate its strength from the length of the column or time required while marching to pass a given point. . . .

15. If the infantry marches not in column of four's but by two's the corresponding change in the figures should be allowed. It will be easy to determine the number of companies, battalions, etc. by the intervals between units, but note that toward the end of a long march these intervals diminish and may even disappear by reason of the lengthening inevitable in every column. The tail of every unit from the battalion up will generally be indicated by the presence of wagons, which form its combat train. If it is impossible to give with reasonable accuracy the strength of marching organizations it will be satisfactory to report "An Infantry column of such a length and having such a time of defilement is passing along the road between A to B toward B."

16. When Infantry is in line or in mass, not in motion, the estimate of the strength is much more difficult than for marching columns and it becomes a matter of experience with the observer. It should be remembered, however, that a large unit does not move over a considerable distance in other formation than in column and if it deploys, it is for the purpose of going into action and then the information of most interest would be the front along which the deployment has been made, together with a number of the lines and the density of each line.

Artillery

17. Batteries in position are located best by the flashes either early in the morning or twilight in the evening. Particular effort should be made to determine the number of guns in each battery position.

18. It has been reported that dummy battery positions within view of the balloon are occasionally made more realistic by flashing a little powder in front of them. The nature of this flash and difference in the smoke should not deceive an experienced observer.

. . . . . .

20. There is a serious difficulty in accurately estimating moving Artillery for the reason that frequently Infantry marches with it for defence in case of enemy attacks. At considerable distance the wagons of the Infantry transport may be confused with Artillery guns mounted.

21. During preparation for an offensive, practically all Artillery and much of the Infantry movements are made at night and without lights which would otherwise be an indication to the balloon observer, but during open warfare involving advances and retreats, there will be plenty of Artillery moving in daytime.

Cavalry

22. During the present war comparatively little cavalry has appeared in formation within view of the balloons but the table for estimating the strength is given herewith. . . .[3]

Transport

23. Motor trucks are used extensively for movements of troops and supplies. These should easily be distinguished from horse-drawn vehicles or Artillery guns by the more rapid rate of movement along the roads.

24. The railway transport of rations, forage and ammunition requires many trains of cars each day, often amounting to 25 freight cars per day for each Division when considerable ammunition is being used. Continuous balloon observation will soon determine the amount of the normal railway activity for daily replacements so that any increase in the number of trains is a reliable indication that the enemy contemplates increased activity and troop movements.

25. On French railways to move a complete Division requires approximately 35 trains and an Army Corps of two Divisions from 100 to 200 trains, considering each train as transporting one infantry battalion, one battery or a squadron of cavalry.

26. For motor truck transportation, it is assumed that each truck carries from ten to fifteen men, there being approximately fifteen to eighteen trucks per company.

Night Observation

27. Information desired and obtainable by night ascensions embraces the following:

To report the beginning of enemy attacks.

To determine the limits of the front which is attacked.

To observe and report the signals of Infantry during barrage fire.

To observe and report marker signals from front lines for enemy bombing planes.

. . . . . .

Infantry Liaison

29. During position warfare which may be considered as including the so-called trench warfare, all infantry positions up to the most advanced outposts are usually connected by a telephone system so complete that visual signals to and from the balloons are ordinarily not necessary. Open warfare of movement gives little time for providing telephone circuits to advanced infantry so that the development of visual communication via balloon observers becomes important. Division headquarters should know at all times

3. Table omitted.

where the advanced infantry line is located and its changes.

30. Infantry liaison consists of:

Following the progress of assaulting troops and reserves.

Observing the signals from the line of the command posts and transmitting them to the General commanding the division.

Informing the command of everything going on in the vicinity of the firing line and beyond it.

Signalling out, if prearranged, to the advanced elements conventional signals as provided in the plan of liaison.

Means of Communication For Liaison

31. From the balloon to the command—The balloon is directly connected by telephone with the divisional command post and with the army control system.

It is, besides, provided with a radio apparatus enabling it to transmit its observations in case telephone communication should be broken.

From the balloon to the firing line and to the advance command posts.—The balloon can communicate with the advance elements:—

In daytime by means of a cylinder which folds and unfolds at will, thus making signals corresponding to dots and dashes. These transmissions are limited to the two signals, "Understood" or "Repeat", preceded by the call of that particular post which the balloon addresses.

At night by means of luminous signals, enabling it to send more complete messages.

From the firing line and the advance command posts to the balloon:—

In the daytime by means of position-marking panels. All men carrying panels, alternately open and shut their apparatus, taking care to set it facing the balloon.

By means of Bengal flares of a determined color. These signals constitute the surest way of indicating one's position. They must be concealed as much as possible from hostile view, by hiding them behind a screen, at the bottom or on the front side of a shell crater.

By 24 cm. projectors.

At night by Bengal flares or other luminous signals or projectors. At night the balloon indicates its presence and position by lighting luminous signals at regular intervals. The signalers of the different command posts take note of the direction of the balloon, orient their projector toward it and send their particular station call to the balloon. The balloon takes these messages from right to left successively and in turn immediately transmits them to the post of command by telephone or radio.

Grenade Fighting

32. Hand grenade fighting is more readily seen by the observer than other methods of Infantry fighting; the advanced infantry line has been determined by balloon observers more often by that method than by any other.

33. Army balloons receive instructions concerning Artillery adjustments from the Army Artillery commander, communicating results to their balloon group commander.

34. Army Corps balloons receive instructions concerning Artillery adjustments from the Corps Artillery Commander and transmit data to the Balloon Group Commander (Memo No. 8 Hqs. 1st Army, A. E. F., Aug. 6, 1918).

35. To insure efficient cooperation with Artillery for the regulation of fire, balloon officers should meet with the Artillery officers each evening for the purpose of securing detailed information concerning the batteries which will fire the following day and the targets which they will engage. It is a general rule that the evening conference should arrange to divide the observation so that balloons will observe fire for all targets which can be seen from balloons. All other targets will have the fire regulated by the airplanes of an observation squadron. When personal liaison of this kind is impossible the information from the Artillery should be obtained by telephone.

36. The balloon observers should know in advance the following:

Coordinates of targets.
Batteries which will fire.
Caliber and number of pieces to fire.
Nature of fire (salvo or one piece at a time).
Type of projectiles with time of flight and type of fuse.
Interval between shots.

37. After securing information concerning the targets the observer should then procure the firing maps and photographs covering the target area.

38. Adjustments are reported on the line battery-target. Distances are reported in meters to the "right" "left" "over" and "short" stating first the deflection followed by the range, thus "25 right" "50 over".

39. Figures are given by their digits, i.e. "two five right" "five zero over".

40. The telephone communication between balloon and battery should conform to the following example:

Battery: "Battery ready to fire."

Observer: "Ready to observe."

Battery: "No. 1 on the way, etc."
"No. 2 on the way, etc."

Observer: "No. 1 two five right, etc."

41. Shots should be reported "lost" if not seen but reported as "not in position to observe" when the movement of the basket, a passing cloud, or other obstacle prevents a proper view of the target. When a salvo is reported "lost" by an observer the Artillery fires the next salvo with data intermediate between that and the last salvo seen and the one lost but if the report is "not in a position to observe" the salvo is repeated with the same data.

42. In order to observe successfully for several batteries simultaneously it is necessary to have very efficient fire and telephone discipline also knowing accurately the batteries which are to fire.

Registration Points

43. All batteries need registration points for determining the error of the day thereby taking gunlaying corrections to account for changed atmospheric conditions. Balloon officers should frequently advise the batteries they serve of various clearly defined places in enemy lines which are easily visible from the balloon these being indicated on their artillery firing maps. If this is not done the battery commanders might select from their maps registration points not clearly visible from the balloon.

Army Artillery

44. If sufficient balloons are available the fire of special high power artillery can be more accurately reported by using two balloons so placed that one observes for deflection and the other for range.

Methods of Fire Affecting Balloon Observation

45. The balloon observer having continuous telephone communication with the battery firing, no system of signals is necessary such as must be employed for observation by airplane. It is therefore the fact, as a direct result, that the battery commander is not restricted in the conduct of his fire as he must necessarily be with observation by means of airplanes.

46. In the adjustment of artillery fire the balloon observer should therefore remember that his function is to OBSERVE the fall of the projectiles from the battery or batteries with which he is working. He should not attempt to prescribe to the battery commander, the methods of

fire of the battery nor the manner in which this fire is to be conducted. However, in order that the most efficient co-operation may be secured between the balloon and the battery, the battery commander should inform the balloon observer as to what methods are to be employed in making the adjustment. This is for the reason that, with observation by balloon, the method of fire adjustment will depend largely upon the ability of the observer to accurately determine the positions of the points of fall of the projectiles.

47. In general there are two methods of making this adjustment. If the observer can determine exactly the positions of the points of fall and can transpose these positions to the firing map or photographic map, the battery commander can then easily determine the distance of each point of fall from the target. The balloon observer may himself make this determination, simply informing the battery commander that such and such shot fell so many meters right (or left) and so many meters over (or short). The battery commander will then make the necessary corrections for each shot until he considers the fire adjusted.

48. In case communication between the observer and the battery is not entirely continuous it may be impractical to send the range and deflection errors after each shot. The balloon observer should then request the battery commander to fire a series of shots (6 or 8, for example). The observer observes the bursts of all shots of this series before making any report. After the last shot he calculates the center of impact of the series, with relation to an origin and system of coordinates known to the battery commander. He then informs the latter of the co-ordinates of this center of impact. The battery commander will then make the corrections necessary to bring the center of impact upon the target.

49. Through various causes, however, it is often found that the observer is unable to do more than determine the approximate errors in deflection and only the general "sense" of the shots in range (i.e., whether the shot fell short of, or beyond the target). In this case the battery commander should adopt a different method of adjusting his fire. With the elements of fire properly calculated, the deflection dispersion of any number of shots, will be slight and the battery commander will as a rule correct the deflection as a whole, basing his correction upon the total number of shots employed to adjust his fire. In case the deflection is less than four "probable errors" it will usually not be necessary for the battery commander to make any deflection corrections.

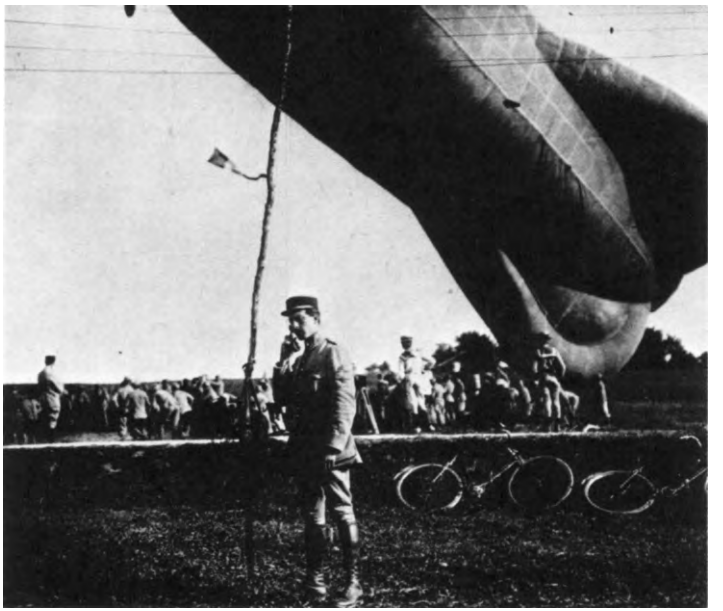
50. The range adjustment in this case is, however more complicated and requires a preliminary fire known as Trial Fire, the object of which is to place the zone of dispersion in an area which contains the target. In observing for Trial Fire, the balloon observer simply reports, after each shot, whether the shot fell short of, or over, the target. The battery commander makes the range corrections necessary, until he has bracketed the target by two shots, each of which is less than four "probable errors" from the target. He then assumes his trial elevation, the mean range of these two shots, thereby practically assuring himself that a number of shots fired with this trial elevation, will form a zone of dispersion which will contain the target.

51. The next procedure is to place the center of impact of all shots, upon the target itself. In order to do this the battery commander must resort to what is

known as Improvement Fire. As a rule this requires that twelve shots be fired with the elevation determined from the Trial Fire. The balloon observer reports the sense of each shot, either (and this is preferable from the point of view of the observer) immediately after it has burst, or upon completion of the series. If more than six shots have fallen over, or if more than six have fallen short, the battery commander subtracts six from this number and multiplies the result by $^1/_{12}$th of 4 probable errors. This operation will give a range correction which should be added to, or subtracted from, the trial range, according as the greater number of shots were short of, or over the target. The range as determined, is known as the Adjusted Range. If time or ammunition is lacking, the Adjusted Range can be determined with less than twelve shots, by the same process. The number of shots should, however, never be less than six. After the Improvement Fire has been completed and the Adjusted Range determined, the fire is considered as adjusted.

52. When the fire of a battery has been adjusted, the battery commander may either dispense with the services of the balloon observer, or he may request the latter to observe the fire for effect, in order that the center of impact may be kept continuously on the target. This is called Control of Fire and the observer need only give the sense of the shots or he may only give the sense of a number of shots, as for example; "Last six shots, over" or: "All shots falling short".

53. In the case of fire upon fugitive targets, or other objectives where the element of time is most essential the battery commander does not attempt to adjust his fire for precision. He simply attempts to bracket the target by quickly enclosing it between two ranges, one of which gives a majority of shots, over, and the other a majority of shots, short. The deflection is adjusted by adjusting the sheaf of fire on a certain portion of the target, and then opening the sheaf until the fire is distributed over the entire objective. The balloon observer as a rule, sends only the sense of the shot generally waiting until a salvo is fired and then communicating to the battery commander the sense of that salvo.



Telephone to a balloon.

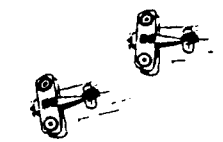
Maj. Harold E. Hartney, commanding 1st Pursuit Gp.

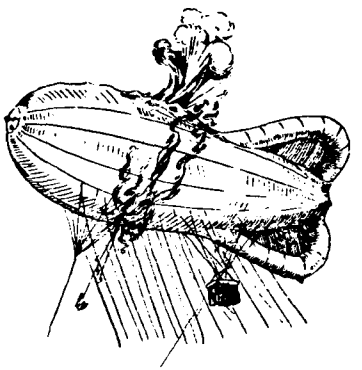
At right, Maj. James L. Dunsworth, commanding 1st Day Bombardment Gp. stops to chat with 1st Lt. N. McDonald.

52. A Combat Service

11 November 1918

During the war many officers in the AEF tended to regard aviation as one of the technical services of the U.S. Army. Struggling against this attitude, members of the Air Service sought recognition for aviation as one of the combatant arms. The position taken by the Air Service is seen, for example, in the following memorandum dealing with the allocation of supplies among the various elements of the AEF.[1] For another example, see the introductory paragraph of Sherman's Tentative Manual (Doc. 55).





Headquarters Services of Supply, American Expeditionary Forces, Office Chief of Air Service

November 11, 1918.
Office Memorandum No. 82.

1. The Air Service, although highly technical and specialized in character, is organized, equipped and trained for the sole purpose of taking its place on the fighting line with the other combatant services.

2. Air Service units, from the moment they arrive in France, form a part of the Expeditionary Forces and each Air Service unit is at all times a part of some distinct organization of these forces. In the S.O.S. these organizations are as a rule territorial, at the front they are tactical. At all times they are composed of units of all or several of the combatants arms as well as the purely technical services.

3. Whether in the S.O.S. or in the Armies at the front except for supplies which are peculiar to the Air Service, it receives its share of shelter and other equipment made available for the Army Organization to which it belongs and neither asks or wants more.

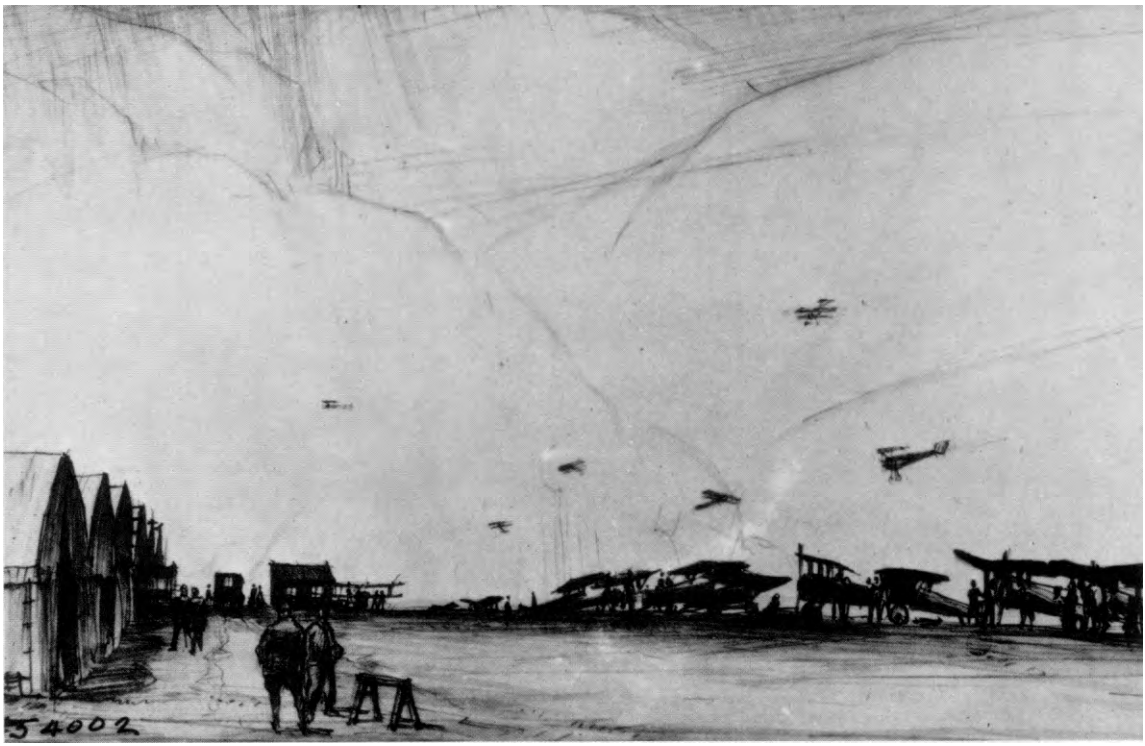
4. If Air Service Agencies discover supplies that are needed they should at once give notice to the proper authorities that such supplies may be made available where they are needed and ask that the Air Service share accordng to its needs in the distribution of such supplies. This is true for all classes of equipment which is used from the base ports to the fighting line. The Air Service asks for no special favors.

By direction:
H. C. Whitehead,
Colonel, A.S,
Chief of Staff.

1. In Gorrell's History, A-9, p 201.

Part IV: Postwar Review

"Dead Acres" in the St. Mihiel Sector. (Art by Andre Smith)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53. Mitchell: Provisional Manual of Operations

23 December 1918

While commanding the Air Service of the First Army, Mitchell pulled together in one document the routine procedures of his observation, day bombardment, and pursuit units.[1] Later, after he became commander of the Air Service, Army Group, those procedures were revised and reissued as a series of operations bulletins.[2] The series contained one addition of considerable significance—a bulletin on the "Organization and Employment of Attack Squadrons."

The bulletin on attack aviation evidently was written during the last days of the Meuse-Argonne Campaign, in which bombing and strafing of German troops and positions in the battle area became an important part of U.S. Air Service operations. Those attacks, made by bombardment, pursuit, and, to a lesser degree, observation units, led to plans for organizing units to specialize in attacks of that kind. The plan, as it appeared in the bulletin, was incorporated in a "Provisional Manual of Operations of Air Service Units" which Mitchell issued on 23 December 1918. A prefatory note stated that the United States did not yet have any experience in organizing and employing attack units. In fact, the first such unit was not organized in the U.S. Air Service until the 3d Attack Group was formed in 1921.

The routine procedures for observation, day bombardment, and pursuit which had been published in bulletins of the Air Service, Army Group, were also incorporated, with revision, in the "Provisional Manual," which was issued while Mitchell was with the Army of Occupation as Army Air Service Commander, Third Army.[3]

Headquarters, Third Army
American Expeditionary Forces.
Coblenz, Germany,
December 23rd, 1918.

The following Provisional Manual of Operations for Air Service Units is approved and published for the information and guidance of all concerned.

By command of Major-General Dickman:[4]

Malin Craig,
Chief of Staff.

Official:
Wm. Mitchell, Brig. General, U.S.A., Army Air Service Commander, Third Army.

Headquarters Air Service, Third Army American Expeditionary Forces.

Coblenz, Germany,
December 23rd, 1918

This manual treats of the activities of various types of units of the Air Service of the American Expeditionary Forces, and so far as subjects discussed are concerned, may be taken as a brief summary of experience of the American Squadrons gained during active operations.

For the most part, the notes deal with the routine procedure of groups and squadrons operating in the various fields of aerial activity. To these have been added articles published from time to time by these Headquarters as the need developed for a closer coordination of the work of the various units, both in their operations over the lines, and in the arrangement of a training program to satisfy their internal requirements and also to improve their liaison with other Arms:

The following subjects are discussed:—

(a) The Routine of a Corps Observation Group,

(b) The Routine of an Army Observation Group,

(c) The Routine of a Day Bombardment Group,

(d) The Routine of a Night Reconnaissance Squadron

1. Routine Procedure of Air Service Units, Cir No 1 CAS, 1st Army, 19 Aug 18, republished in *Air Service Bulletin*, Vol VII, No 305, 24 Dec 18.

2. In Gorrell's History, C-2, pp 232-267.

3. AFSHRC 248.211-61S.

4. Maj. Gen. Joseph T. Dickman assumed commanc of Third Army upon its organization on 15 November 1918, at which time Mitchell became Chief of Air Service, Third Army.

(e) The Routine of a Pursuit Unit.
(f) Organization and Employment of Attack Squadrons.
(g) Liaison of the Airplane with the Infantry.
(h) Instructions for the Improvement of Liaison between the Observation Air Service and Line Troops.
(i) Instruction of Observers and Pilots of Observation Squadrons.[5]

The notes on routine procedure are based upon actual practice of units of the types mentioned. The article dealing with the "Organization and Employment of Attack Squadrons" is based upon the experience of others in this field, as this experience has never been tested by an American attack Squadron. Active operations were suspended before the organization of a unit of this type was carried to completion.

The article on "Liaison of the Airplane with the Infantry" dealing as it does with a field in which the American airplanes operated with such conspicuous success, contains a record of the experience of our squadrons which is of the most importance.

The pamphlet entitled "Instructions for the Improvement of Liaison between the Observation Air Service and Line Troops" was issued as a guide to Observation Units in the outlining of a course of instruction for other Arms in working with the Air Service, which instruction was found to be most necessary for the purpose of insuring proper cooperation and understanding between the Arms concerned. This is the most important and the most difficult of all Air Service activities.

In all the squadrons, but especially in the Observation Squadrons, a consistent effort has been made to maintain the efficiency of the flying personnel by constant review and practice in their own fields of work. Training programs were instituted and daily instruction carried on with energy. In order that all might profit by the experience of others, it was found desirable to compile and publish the methods of those in charge of this instruction at the different units under the title of "Instruction of Observers and Pilots of Observation Squadrons."

These articles have been assembled in the form of a manual which will serve as a valuable guide in the organization and operation of future Air Service units.

Wm. Mitchell
Brig. Gen'l. U.S.A.,
Army Air Service Commander,
Third Army,
American Expeditionary Forces.

. . . . . .

THE ROUTINE OF A CORPS OBSERVATION GROUP.

Instructions for daily procedure.

1. The Group Commander, Corps Observation, is charged with the administrative and tactical command of the squadrons which make up his Group, and is responsible for the carrying out of the missions called for by higher authority. He will assign specific duties to each squadron of his command, and is responsible for their performance. He exercises immediate control over the photographic section, and will assure himself that it and the Branch Intelligence Office are properly equipped and operated.

2. He is responsible for the preparation, transmission and preservation of copies of all reports, messages and orders, and that all personnel and material is in condition for effective work.

3. The immediate control of the operations of the Group is delegated by the Group Commander to a Group Operations Officer, whose selection should be based upon his ability as a executive and experience as an observer over the lines. This officer should keep in constant touch with the operations of all of the squadrons of the group, and should advise them as to the best methods of carrying out

5. Items h. and i. have been omitted.

the operations which the group is called upon to perform. He is responsible to the Group Commander for the performance of duties assigned to the various squadrons, for the preparation and forwarding of operations reports, and should keep the Group Commander constantly informed as to activities of the Group.

4. The Group Operations Officer is responsible for the proper equipment and operation of the Group Operations Room, and will supervise the training of new observers assigned to the Group. In all matters connected with operations he should act as the adviser of Squadron Operations Officers.

Assignment of duties to Squadrons.

5. One squadron of the group will normally be assigned to carry out missions of surveillance and adjustment for the Corps Artillery, as well as photographic missions as ordered from G –2 of the Corps through the office of the Corps Chief of Air Service. The Corps Artillery squadron will make such adjustments of fire of the Corps Artillery as cannot be carried out by the Corps Artillery Balloons, and will have at all times an airplane of command at the disposal of the Corps Chief of Air Service.

6. One squadron will ordinarily be assigned to each division in line. The divisional squadrons will carry out missions of reconnaissance, infantry liaison, and such artillery adjustments as cannot be done by the divisional balloon. In addition, they will carry out photographic missions ordered through the office of the Corps Chief of Air Service.

7. Squadron Commanders in addition to their administrative functions will be responsible for the carrying out of duties assigned to their squadrons by the Group Commander. The actual control of operations within the Squadron will be delegated to an Operations Officer, selected for qualifications similar to those of the Group Operations Officer.

The Day's Work.

8. In preparing the program of work for the day in each squadron the Squadron Commander and Squadron Operations Officer should meet after flying is finished for the day to frame the schedule of operations for the succeeding day. They should be provided with the following data by the officers mentioned:

Engineer Officer: Airplanes available and airplanes equipped for photographic missions listed by number.

Radio Officer: Airplanes equipped with proper radio installation.

Ordnance Officer: Airplanes equipped with proper armament.

9. This data may be conveniently posted upon a chart in the Squadron Operations Office, or on the Squadron bulletin board in the Group Operations Room. In the assignment of missions to observers and pilots the flying record of each must be kept constantly in mind. For this purpose a chart should be kept posted to date, showing the number of flying hours of each, and the character of and date of missions performed.

10. A typewritten schedule of work should be prepared showing the character of each mission, the airplane assigned, the name of the pilot and observer selected to carry it out, the time of departure, and in case of a photographic mission, the size of the camera and the number of plates to be taken.

11. One pilot, one observer, and one airplane should be designated to respond to alert calls, to be called upon in case additional work is required, or upon the failure of an airplane to perform its mission.

12. A Pilot should be designated as Officer in charge of the Field, whose duty it is to see that the airplanes assigned to duty are properly inspected and equipped, and that the missions leave the field at the time scheduled. A copy of this schedule should go to the Engineer Officer, the Radio Officer, the Ordnance Officer, the Group Photographic officer, and the Group Operations Officer. One copy shall be posted on the Squadron Bulletin Board.

13. The Engineer Officer is responsible for the proper condition of the airplane, and that it is ready for flight at the time specified.

14. The Radio Officer will see that the airplanes are equipped with proper reels, and that the radio is in proper condition before the airplane leaves the field.

15. The Ordnance Officer must see that the machine guns are mounted upon the airplane, and that the proper number of magazines and other ordnance equipment is placed in it, and that the fixed guns are in proper condition and equipped with belts of cartridges.

16. It is the duty of the Photographic Officer to see that the airplanes sent out on photographic missions are equipped with the proper cameras and plates, and to arrange for the prompt return to the photographic laboratory of these articles, upon the return of the mission, so that the plates may be developed at once. The first prints are then identified by the Branch Intelligence Officer, assisted by the observer who performed the mission. During an attack, especially, speed in distribution of the photographs is of the utmost importance, and delivery of the first urgency prints should be made by airplane.

17. Just before leaving for the field the observer should report at the Observer's Room and bring up to the minute all information which will be of assistance in the performance of his mission; he should then proceed to his airplane in time to reach it half an hour before the time of departure. He must then inspect his equipment. The pilot who is about to make a flight should also be at his airplane at least a half hour before the time set for departure and must inspect his airplane and armament and warm up his engine.

18. A daily form should be prepared and posted in the Operations Office of each squadron, upon which the observer, before leaving to carry out his mission, must enter his name and that of his pilot, the number of the airplane, character of mission and time of departure. Upon his return he must proceed without delay to the Operations Office, and enter upon the form the time of landing, with a short record of results obtained on the flight. He must then fill out a careful report of the mission, in the preparation of which the pilot can often render valuable assistance.

19. Each pilot will be assigned an airplane. He is responsible for the calibration of his own ammunition, must load his own belt, and load and unload his gun himself. He is responsible for the aligning of the sights of his own gun.

20. Each observer should be assigned two movable guns, mounted in pairs, as well as six magazines. He is responsible for the calibration of his ammunition, the loading of his magazines, and the aligning of his sights.

21. Squadron Commanders will detail to the headquarters of the unit to which their squadron is assigned, an observer to act as Liaison Officer. That all observers may benefit by this experience, it is suggested that this

detail be made for a period of one week, except during periods of intense activity, when one Liaison Officer should act throughout the period to insure continuity of the Liaison.

22. In all squadrons an Assistant Operations Officer will be appointed to act as assistant to the Squadron Operations Officer, and will familiarize himself with all his duties. He will take personal charge of the training of new observers assigned to the squadron, under the direction of the Group and Squadron Operations Officers. On account of the rapid expansion of the service, the constant training of officers who can go to newly formed squadrons fully acquainted with the duties and practical workings of an Operations Department is imperative.

Group Operations Room

23. To insure the proper functioning of the squadrons of a Corps Observation Group it is essential that the personnel be furnished with complete, accurate and up-to-date information in regard to the disposition, operations and plans of our own forces and those of the enemy. It is, therefore, of fundamental importance that each group have a conveniently located Operations Room in which all this information is assembled and placed at the disposal of the observers and pilots.

24. The Group Operations Officer is responsible for the proper upkeep of this room. He is assisted by the Branch Intelligence Officer detailed to the group by G–2. Should a squadron be operating alone, responsibility for the maintenance of an Operations Room will devolve upon the Squadron Operations Officer.

25. The information that must be available in the operations room may be classified under the following subjects:

(a) Photography
(b) Artillery
(c) Infantry
(d) Reconnaissance
(e) Miscellaneous

Photography

26. One copy of each photograph will be kept on file in the Intelligence Office and two copies placed in the Operations Room at the disposal of the observers.

27. The Intelligence Officer will keep a card index of photographs taken, showing the size of camera used, coordinates of the center, index number of the photograph, altitude and date on which taken, together with a record of the character of the photograph, whether good, fair or poor. These cards are filed according to the coordinates of the center of the photograph, each card representing a square kilometer and containing a record of all photographs whose center is within this square. Photographs will also be listed in a book

Photo finishing room.

under their index number showing the coordinates of the center, the date when taken, the name of the observer who carried out the mission.

28. The photographs filed in the Operations Room are arranged in pigeon holes according to their coordinates, each pigeon hole representing one square kilometer on the map and containing the photographs whose center is in that square. The pigeon holes are numbered in the same way as the Plan Directeur; horizontally, according to the "X" coordinates and vertically according to the "Y" coordinates. These files are kept up-to-date and complete by the Intelligence Officer, replacements being made when necessary.

29. Areas covered by photographic missions will be graphically represented upon a map, each plate being outlined, the index number and date attached, and the area covered by the mission colored. Each map will show the missions performed during a week, and each month a second map will be prepared showing graphically in the same manner the areas photographed during the calendar month.

30. A panoramic view of the sector is a valuable asset to the operations room and should be obtained if possible. Assemblages of photographic missions carried out by observers of the group tend to make the operations room attractive, and are very valuable for study of the sector.

31. A stereoscopic instrument and magnifying glass must be available for the study and interpretation of photographs.

Artillery.

32. The most important map in the Operations Room is the general map of the sector (1 to 10,000 or 1 to 20,000) showing the position of all of our artillery elements and the enemy organization in depth, particularly enemy batteries and battery emplacement locations.

33. Friendly battery positions, including the name of the unit and the number and caliber of guns should be shown by tags or markers which can be moved as necessary. Artillery P.C.'s and panel stations should be similarly marked, the markers of the latter including information as to radio call and type of panel used.

34. This map should be checked daily and all information pertaining to the artillery should be kept up-to-date and should be accompanied by a chart showing the daily activity of each enemy battery.

35. Fugitive target batteries should be shown upon a special map, similar markers being used to indicate their location and that of their panel stations with radio calls and type of panel. Upon this map the field of fire of each of these batteries should be indicated.

36. A general map of artillery objectives (1/20000) issued by Army G–2 and showing important objectives, such as road intersections, ammunition dumps, material depots, bridges, railroads, camps, aviation fields, and other objectives should also be posted.

37. A list should also be posted showing the name and location of the various artillery units with which the command is to work, the coordinates of the P.C., the coordinates of the panel stations, the radio calls, the type of panels and the wave lengths.

38. A relief map is of great vaue in an operations room for the study of the terrain. It is particularly valuable in case of adjustment of fire upon an objective upon the reverse slope, as by a study of the contours, the observer will be able to plan his method of flying the mission in advance.

39. A map should be provided showing the position of friendly balloons and the defiladed area from the three general ascension levels.

Infantry.

40. A map showing the parts of the line held by the different infantry commands, marking by tags the location of the various P.C.'s of units both in the line and in reserve, must be posted. On this map the successive objectives in case of an attack can be shown. It must show the outline of our trenches and detail of the enemy trenches, strong points, dug-outs, machine gun emplacements, etc. This map is of the utmost importance to the infantry observer in order that he may familiarize himself completely with the sector over which he must work.

Miscellaneous.

41. The Operations Room, being the information center, must contain all data obtained from various sources which bear upon the activities of the group. In it should always be found a large scale map showing the entire front line.

42. All orders or letters of interest to the personnel, daily communiques, the weather forecast and visibility report will be posted upon a bulletin board in a conspicuous place.

43. Summaries of information and bulletins from the Air Service and from the Army, Army Corps and Divisions shall at all times be available.

44. Under the supervision of the Intelligence Officer a stock of maps of all scales shall be kept on hand for the use of pilots and observers.

45. Maps showing the position of all friendly airdromes, and a map of enemy airdromes and balloon positions shall be posted. In addition, illustrations of enemy aircraft are of value. All possible information in regard to types and markings of enemy airplanes must be at the disposal of the observers and pilots.

46. The room should be equipped with a blackboard and large tables, chairs and benches, and material such as ink, pencils, drawing pens, paste, glue, elastic bands, thumb tacks; paints and pins, should be provided. Buzzers for practice in radio manipulation should be mounted. Forms for written reports of missions and a basket to file them in must be provided.

47. The Operations Room will be well lighted and always be kept clean and in an orderly condition. Every effort should be made to make it as comfortable and attractive a place as possible.

48. Owing to the fact that information of the most secret nature is constantly displayed, a rule barring all persons other than authorized personnel from the room must be rigidly enforced. Under no circumstances should other persons be admitted without special permission from the Group Commander.

THE ROUTINE OF AN ARMY OBSERVATION GROUP

49. The mission of Army Observation is the reconnaissance, in depth, both visually and by photograph, of the Army sector. The Army Observation Group is placed at the disposal of the General Staff of the Army and the missions carried out in conformity to its orders. Orders assigning missions are received by the Group Commander who transmits them to the Group Operations Officer, who is in immediate control of the operations of the group.

The Group Operations Room.

50. It is essential to the proper conduct of operations that both pilots and observers of a group have a thorough knowledge of their sector, and access to all available information in regard to enemy activity in it. For army work, it is especially necessary to

be familiar with the main lines of communication, dumps, detraining and unloading stations, and airdromes.

51. In order that this information may be conveniently assembled and placed at the disposal of the pilots and observers of the group, a Group Operations Room is maintained, equipped with large scale maps showing the location of principal enemy works, with photographs of all principal towns, dumps, railroad centers, airdromes, and anti-aircraft batteries. Bulletins and charts of special interest are posted from time to time. The Group Operations Officer is responsible for the proper upkeep of this room.

52. Pilots and observers are required to spend as much time as possible in the Operations Room, studying the sector. Instruction in reference to the work is given by means of talks, pointing out the most important features of the sector, suggesting methods of preparations for missions, and impressing upon the personnel the importance of their work, especially during an attack.

Method of assignment and execution of missions.

53. After flying for the day has ended, the Group Operations Officer will prepare a schedule dividing the work assigned for the following day between the various squadrons of the group. The division of work is based upon the number and character of the missions to be performed, and the airplanes and personnel available at the close of the day's flying, as shown by reports furnished by each of the squadrons.

54. A copy of this schedule is issued to each squadron Operations Officer, with whom a conference is held in order that the work may be clearly understood. One flight in each group will always be held on alert to carry out any special mission that may be called for.

55. The Squadron Operations Officers will assign the missions among the flights in their respective squadrons, flight leaders being given all necessary instructions covering the nature of the mission, the routes to be followed and the time of departure. In case of a photographic mission, objectives, size of camera, altitude, and number of plates to be exposed, are specified. The instruction as to the most advantageous method of carrying out a mission and the assignment of the individual pilot and observer to it is left to the discretion of the flight commanders.

56. In carrying out the various missions the flights follow accustomed routes over certain portions of the sector. As soon as a flight departs, the Squadron Operations Officer posts a tag or marker in the Group Operations Office showing the time of departure, number of airplanes, area to be covered, and the nature of the mission, this tag being taken down immediately upon the return of the mission. The Group Operations Officer is thus kept constantly informed as to the amount and character of the work as it is being carried on.

57. The alert flight remains in the vicinity of Group Headquarters to carry out special and Command missions.

58. On landing upon the field at the conclusion of a mission, the observers go immediately to the Squadron Operations Room, and make a complete report of all information obtained, plates exposed, weather conditions at the lines, and the activity of enemy aircraft and anticraft. This information is handed without delay to the Branch Intelligence Officer, who places it at the disposal of the Group Commander and the Army Intelligence Officer.

59. All the plates exposed are taken immediately to the photographic laboratory, developed and printed. Three proofs of each are sent to the Intelligence Officer. The latter distributes the proofs among the observers concerned, who identify them by indicating on each different print

the coordinates of its center, time of exposure, and the altitude at which taken.

60. All three proofs are marked, and two are sent immediately to the Army Intelligence Office, the third being sent back to the laboratory in order that plate may be permanently marked. As soon as practicable, the required number of prints are distributed according to a list on file in the Intelligence Office.

Normal Employment of the Group.

(a) During an inactive period, or before an attack.

61. During an inactive period, or the period preceding an attack, the group should dispatch daily visual reconnaissance missions, covering all important lines of communication in the sector, to include both the roads and railroads. At such times, all movements of size are carried out at night and it is therefore necessary to make observations at break of day, or at dusk in order to obtain the information. Missions should be sent out some fifteen to thirty minutes before daybreak. They can then be over the objective as soon as there is sufficient light to observe. These observations at daylight and dusk are supplemented by visual reconnaissance carried out in conjunction with the photographic missions during the day.

62. Photographs should be taken as frequently as possible of all enemy works, such as dumps, lines of defense in rear of the front lines, concentration points, aviation fields hospitals and railroad yards. As most of these will be found on or near main roads and railroads, it is advisable to make photographic assemblages of the lines of communication, and thus insure the discovery of new works, rather than to take isolated photographs of the works themselves. All photographic missions should be accompanied by at least one airplane whose duty it is to carry on visual reconnaissance which will often locate something of interest, to be photographed, either on the return trip or at some future time. During the periods mentioned, it is not necessary that Army Headquarters assign in detail the missions to be performed by the group, a general indication of what areas in the sector are considered of the greatest importance being sufficient. Under these circumstances, it is the duty of the Group Commander to so direct operations that the sector is systematically covered by both visual and photographic reconnaissances, special attention being paid to the areas referred to.

(b) During an attack, or in an active sector.

63. The general scheme of visual reconnaissance during an active period remains the same as that followed in an inactive sector, except that in such a period, enemy movements will take place in daylight, as well as night. For this reason, enemy lines of communication must be kept under constant observation. From time to time, the General Staff will require confirmation of information received from other sources, or will want the accuracy of certain deductions to be verified. It therefore becomes necessary to reserve a far larger portion of the command for the fulfillment of emergency calls.

64. The photographic work carried out during an active period will be closely supervised and directed by the Army, which will indicate, as far in advance as possible, the objectives to be photographed, together with the order of their importance.

65. A schedule is made out each day, listing the missions, both visual and photographic, to be carried out upon the following forenoon. This schedule is based upon the information received from the Army and a knowledge of the general situation. A sufficient reserve should at all times be held for special work.

66. At least one flight (6 teams with their airplanes) should be kept on alert so that when a special request is received, the mission can be dispatched with the least possible delay. While the greatest care must be exercised to be ready for an alert call, equal care should be taken that too great a portion of the command does not remain idle for lack of requests from the Army. If emergency calls do not come in, alert airplanes may be employed as deemed necessary by the Group Commander.

THE ROUTINE OF A DAY BOMBARDMENT GROUP.

67. The missions of Day Bombardment Aviation are the following:

(a) To destroy and harass the rear areas of the battlefield and to attack military and industrial objectives within and beyond the range of artillery.

(b) To cause a dispersion of enemy anti-aircraft defences (pursuit patrols, anti-aircraft batteries, etc.), throughout the zone of vulnerable bombardment objectives.

(c) To destroy in combat the enemy's air forces.

(d) To obtain information of military value by surveillance of enemy activity carried on in the course of the bombing expedition.

Preparation of a Bombing Expedition.

68. Day bombardment objectives are designated by G–3 and transmitted by the Army Chief of Air Service to the Commander of the Day Bombardment Group. Unless specifically covered in orders from higher authority, the Group Commander will issue orders specifying:

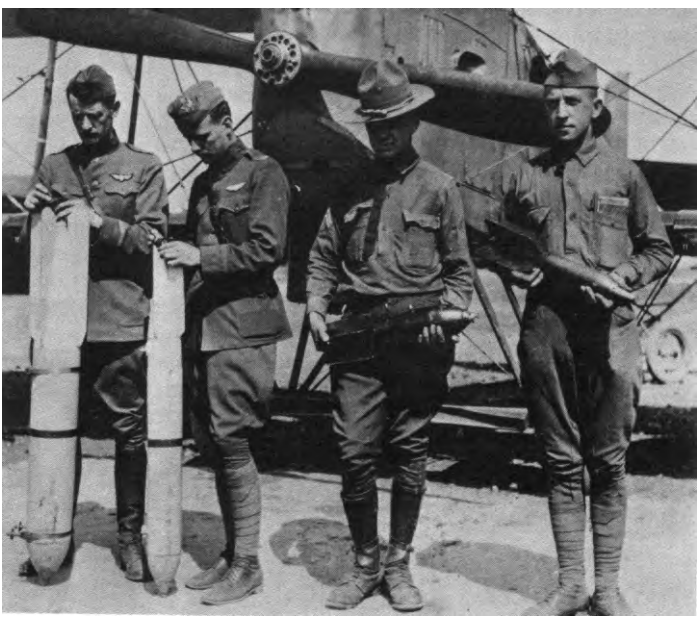
(a) The number of formations and the number of airplanes in each.

(b) The types and weight of projectiles.

(c) The route, altitude, and order of departure of each formation.

69. The method of pursuit cooperation will be explained to the Commanders of the squadrons forming the Group.

70. Unless the objective must be kept secret until the moment of departure, detailed orders should be issued in time to permit each pilot and observer to familiarize himself with all available information in regard to the main objective, the route, secondary objectives, and the region to be observed or photographed. A day bombardment expedition must be able to leave the field rapidly upon emergency order. In this case only the formation leader and deputy leader of each formation need know the exact route to be followed.



Four different types and sizes of bombs used in raids: (l. to r.) 155-mm, 115-mm, 90-mm, and 75-mm.

For the other pilots and observers a sketch of the objective and a general knowledge of the terrain, so that they may return to our lines in case of accident, will suffice.

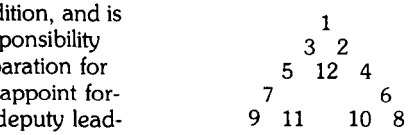
71. Each Squadron Commander will designate the airplanes, pilots, and observers to take part in an expedition, and is charged with the responsibility for their proper preparation for the mission. He will appoint formation leaders and deputy leaders and will assign to each airplane its position in the formation.

Formations.

72. Day Bombardment Squadrons will invariably work in formation. These formations should be large, as many as eighteen airplanes being easily controlled by a leader when working at high altitudes. For low flying formations in bad weather, eight is the maximum that can be employed. All formations must have the following characteristics:

(a) Simplicity.
(b) No dead angles.
(c) Concentration of fire to the rear.
(d) Concentration of fire below the center of the formation.
(e) Compactness.
(f) Each airplane must be able to see the leader.

73. All formations, whatever the number, should fly in a "V" formation with the rear of the V closed. Formations of more than ten should have one airplane in the center of the V at the average altitude of the V. Airplanes in formation should be numbered as follows:



Number 1 is the leader and flies at the lowest altitude, Numbers 2 and 3, 4 and 5, and similarly placed pairs should fly at the same altitude, number 2 and 3 about fifty meters higher than number 1, and about thirty meters to the right and left of number 1 respectively. Number 4 takes the same position relative to number 2 as number 2 with reference to number 1; and number 5 takes the same position with relation to number 3.

74. Formations should be as compact as possible, especially when dropping projectiles; and during a combat, formations should close up. Too much emphasis cannot be laid upon the training of day bombardment pilots in formation flying. If the pilots maintain a regular echelonment in height, in case of emergency they can close up quickly upon the leader, by diving. The guide should never open his throttle wide, and observers should always warn their pilots whenever their own or any other airplane appears to be getting out of formation. It is fatal for an airplane to leave the formation, and the formation should not be broken up even to protect an airplane which has left it.

75. Whenever the landing field is sufficiently large, the formation is made up on the ground, the pilots having first warmed up their engines. If this procedure cannot be followed for lack of room, for example, when several squadrons are leaving at about the same time, the airplanes will take off in the order of their number in the formation, each airplane beginning to taxi when the wheels of the preceding airplane leave the ground. Number 1 throttles down when he has attained sufficient altitude to do so with safety, and flies slowly until all the airplanes are in place. He may then take up his travelling speed—never full speed. The only practicable maneuver in formation flying is an "8" upon an extremely wide curve, covering at least five kilometers.

Combat.

76. Aerial combat is not merely an incident of day bombardment, but is one of its integral phases. The normal combat of a day bombardment unit is a fight between the formation and enemy pursuit airplanes that attack it. Observers must be on constant watch for enemy aircraft and upon sighting them, the observer fires an agreed signal of warning, which signal is repeated by all the other observers. All the observers should then test their machine guns. Number 1, upon learning that enemy aircraft are in sight, should slow down and the formation should tighten up as much as possible. The pilots must make every effort to keep in formation and keep the formation compact. Under no circumstances will they be permitted to attempt an individual maneuver.

77. In the course of aerial combat it will sometimes be found that the mass of the enemy pursuit airplanes will attempt to create a demonstration by maneuvering and shooting at long range while two or three climb and then dive upon the formation, in an effort to separate one or more of the bombing airplanes from it. Observers must keep a careful lookout at all times for such attacks. The majority of attacks, however, will come from below. If the observer opens fire when the enemy is at least 300 meters distant, in most cases he will not come to close quarters. If allowed to approach nearer, the safety of a bombing airplane depends upon putting the enemy airplane out of action.

78. As there is always the likelihood of an airplane becoming separated from the formation, bombing units should be thoroughly trained in single combat against pursuit patrols. In the course of such a combat a pilot will do little shooting, but will exert his efforts to keep his observer in a favorable position. He will avoid maneuvers such as regular spirals or straight dives, but should fly an irregular course and watch his observer so as to place the latter in a position from which he can shoot to the best advantage. If the enemy gets into a position where he can shoot without being shot at, the pilot must do everything possible to spoil his aim. A climbing turn made very steeply toward the side upon which the weapons are carried is the best maneuver, as it will allow the observer to use his guns. While the pilots ordinarily attempt to place the observer in shooting position, experience has shown that at times the pilot is obliged to turn on his pursuers. The pilot should, therefore, take every opportunity to perfect his maneuvering ability and gunnery.

Bombing the Target.

79. In passing over the objective the formation will not be allowed to break up, but will tighten up as compactly as possible. Sighting errors thus produced are negligible considering the dispersion of the projectiles and the size of the usual day bombardment targets.

80. Greater accuracy is obtained by permitting the leading observer to sight for the whole formation. Accurate bombing is an art in which certain observers will excell, and these observers should be used as leaders and deputy leaders. Excitement adds to inaccuracy and if but one observer uses the sights he will know that all of the other airplanes are acting as his protection. When the leader has adjusted his sights and is approaching the target in line of sight he fires a signal "Prepare to drop bombs". When the leader's bombs start to leave the racks the other observers in the formation drop their bombs. Excellent results have been obtained by this method of bombing, which was adopted after extensive experience in active service. The greatest accuracy has been obtained when the formations reach their altitude before crossing the lines, the leader being thus given an opportunity to check his calculations before the objective is reached.

81. When several formations are directed against the same objective they should approach it at thirty second intervals, one behind the other. Upon leaving the objective they should all turn in the same direction.

82. In the performance of a day bombing expedition, it is most essential that the bombardment formation reaches the objective exactly at the time designated, in order that successful coordination between the work of the bombardment units and the pursuit units may be assured, with the object of causing the greatest possible damage to the enemy and of maintaining our ascendency in the air.

83. A Group Operations Officer will be appointed by the Group Commander of the Day Bombardment Group, and to him will be delegated the immediate supervision over the operations of the group. He will also act as the representative of G–2. It is his duty:

(a) To compile and keep available for the Group Commander and the personnel of the Group, all information of value in the preparation of a bombing mission.

(b) To keep an indexed file of photographs, and a stock of maps for use of pilots and observers. He will also post in the operations room a map (1 to 80000 or 1 to 50000) of the sector in which the group is operating, as well as a 1 to 200,000 scale map showing the line of the entire front with its changes as they occur.

(c) To post upon a bulletin board all orders and communications of interest to pilots or observers of the group, and bulletins from the Army or its Corps or Divisions.

(d) To post a map showing the location of friendly airdromes and hospitals.

(e) To file the flight report of each crew and to interrogate personally the pilots and observers to get additional information if possible, and to transmit the information obtained to the Army Intelligence Section.

(f) To supervise the work of the Photographic Section, the developing of all plates and the printing and distribution of photographs.

84. The Group Operations Officer should receive the charts from the Army Chief of Air Service, showing bombing targets and intelligence in reference to them. He should keep duplicate copies of these, marking one of them daily with the bombardments effected. It is one of his most important functions to keep up-to-date at all times available information in reference to the locations of enemy anti-aircraft batteries, enemy airdromes, and the number and identity of the squadrons which occupy them. The photographs taken by the Bombing Group itself, will often assist in establishing the whereabouts of new airdromes and the occupation of old ones. A Day Bombardment Group may furnish information of great value from visual and photographic reconnaissance conducted during the course of the bombing expeditions, especially in regard to location of enemy airdromes and works, and the number of enemy troops.

85. The Group Operations Officer is responsible for the liaison of the group with the pursuit units in addition to the liaison with the Army Chief of Air Service, G–2, and G–3, and he should notify the pursuit group of the bombardment group's plan of operations and advise them as far in advance as possible of the hour, the altitude and return route of all expeditions.

THE ROUTINE OF A NIGHT RECONNAISSANCE SQUADRON.

86. The mission of Night Reconnaissance is to provide information to the Higher Command in regard to the trend and extent of movements behind the enemy's line made under cover of darkness. These are usually extensive if operations are impending. It is therefore imperative that the routes followed by the enemy in moving troops and material should be reconnoitered thoroughly and frequently at night, due to the fact that the most perfect day reconnaissance will often fail to disclose any abnormal activity. During active operations, the battle-field must be patrolled consistently by night reconnaissance airplanes.

87. A night reconnaissance unit is ordinarily assigned for duty with an Army, the missions of strategic reconnaissance and night surveillance being assigned through the office of the Army Chief of Air Service.

Organization.

88. The Commanding Officer of a Night Reconnaissance Squadron is responsible for the activity and efficiency of the unit. It is his duty to insure the proper performance of the duties assigned to the subordinate officers of the Squadron.

89. In addition to the pilots and observers, and the necessary enlisted personnel, the unit commander will be assisted by the following officers:

Operations Officer.

90. The duty of the Operations Officer attached to a night reconnaissance unit will be to advise the Commanding Officer of all tactical matters connected with the field of operations. Upon receipt by the unit of orders assigning the missions for any given night, under the authority of the Commanding Officer, he will prepare and post a schedule designating the pilots and observers and the hours during which each of the routes of enemy movements will be reconnoitered. The Operations Officer will procure all available information of the enemy's rear areas, particularly in regard to railheads, routes, of transports, detraining points, billeting areas, camps, depots, anti-aircraft, divisions and airdromes. It is his duty to supervise the preparation of the personnel for the execution of the missions assigned to them, and he will assure himself that all information obtained by the unit in the course of a mission is passed on without delay to the Branch Intelligence Officer. The Operations Officer will have charge of the landing lights, searchlights, etc., on the ground. He will see that these are lighted at the hours specified by the Unit Commander for airplanes to leave the airdrome or whenever an airplane overhead gives the correct signal for landing. He will also make a daily report of operations to the Chief of Air Service of the Army under which he is operating, which report will cover the routes, hours of flight, and all information obtained. He must make certain that every pilot and observer is familiar with the correct landing signal for the day before leaving the ground.

Branch Intelligence Officer.

91. A Branch Intelligence Officer will be detailed by G–2 of the Army for duty with every night reconnaissance unit. This officer will see that all information obtained is transmitted to Headquarters without delay. He will make out routes covering points of concentration and the main arteries of movement in the enemy's rear areas, and he will transmit the orders for reconnaissance missions to the Unit Commander.

Supply Officer.

92. The Supply Officer will requisition and procure the supplies necessary for the unit. These will include Quartermaster and commissary supplies for which he will establish the necessary liaison with the Chief Quartermaster of the Army to which the unit is attached. In addition, he will establish the necessary channels for securing technical, Ordnance and Air Service supplies. The Supply Officer is also responsible for the squadron transportation, its proper upkeep and repair.

Engineer Officer.

93. The Engineer Officer will supervise the work of the several aero sections, and the work of the mechanics assigned thereto. He will keep on hand at all times a reserve of spare parts of electrical material, i.e., dynamo spares, searchlight spares, landing flares, etc., sufficient to meet the immediate needs of the unit and will advise the Supply Officer relative to such needs.

Adjutant.

94. The Adjutant is charged with the administrative work of the unit.

Study of Routes and Landmarks.

95. Useful and reliable reports may be expected only from observers who are perfectly familiar with the terrain, both as a result of detailed study of all maps covering the sector, and from knowledge acquired from previous flights carried out, both by day and at night. Constant effort should be made to reduce, as far as possible, the necessity for using a map by acquiring an exact knowledge of the salient features and landmarks.

96. The position of the stars and moon, (according to the hour and the phase of the moon,) should be utilized for the purpose of orientation, especially for checking the indications obtained from the compass. In order to determine with exactitude the angle of the course of the airplane, the indications given by the stars and compass must be combined with the effect of the drift resulting from the action of the wind at the altitude attained. The latest obtainable meteorological data is essential to the night flying pilot not only to enable him to judge the possibility of flying, but to permit him to correctly determine his course while he is in the air.

97. Within our own lines, there exists an organization of signal lights of the front, marking out the aerial routes which furnishes the pilot and observer with necessary indications and direction marks to enable them to take the direction of their objective and to find their field on return. Familiarity with the system of signal lights is of course essential.

98. In spite of all precautions taken within both our own and enemy lines, permanent lights will be found which form excellent landmarks. Groups of searchlights placed around important localities and objectives,

and generally lit up on the passage of any airplane are visible from very far away, and can be used as direction points and guides. The star shells fired almost continuously from the trenches, and flashes of the cannon in an active sector will permit any lost plane to find the lines again.

99. Whenever the enemy is carrying out night bombardment, their ground signal lights and direction rockets, the location of which is generally permanent, form indications of the highest value to our airplanes.

Visibility In General.

100. The closest possible study must be made of the effect of varying weather conditions upon visibility. Visibility at night is extremely variable. It depends upon two things: the clearness of the atmosphere, (absence of mist and fog) and the light afforded by the moon. The visibility of natural landmarks at night is found in general to take the following order: woods, important towns or other localities; roads, rivers and other water courses or bodies of water, (brooks, canals, lakes and ponds).

101. On clear moonlit nights the visibility is very good. At an average altitude the visibility for practical purposes of direction may extend from 10 to 15 kilometers. Woods show up as clearly defined black (or dark) blots, easily recognizable by their shape and outline. Roads appear white or grey if bordered by trees or just after rain. Water courses may be recognized by the dark strips formed by the valleys, nearly always bordered by trees or meadows, and by the reflection of the moon in the water. Canals are still more easy to identify owing to their rectilinear form.

102. On misty nights the reflections of the light on the mist interferes with observation. It is then necessary to place oneself between the moon and the point to be observed or the road to be followed.

103. On dark nights it is quite possible to see quite well, but the visibility is generally confined to the vertical. For this reason, it is not possible to fly by known direction points and landmarks, but it is necessary to follow step by step the itinerary, paying ceaseless attention to locating one's position accurately on the map. When direction signal lights are given, they may, of course, be used to fly by. On dark nights when utilizing woods as landmarks and direction points to fly by, it is better, if the woods be of large dimensions or extent, to follow along their edges than to try to fly straight across them. Large towns and localities show up in the form of grey blots with sharply defined edges. White roads, not bordered by trees, in dry weather, show up clearly, but should be followed in all their detours lest they be lost. The same may be said for water courses, which are, however, more difficult to see and are frequently only visible by the dark line of the trees and meadows bordering them, or by the bank of mist lying in the valley.

104. On bad nights when the hygrometric state of the air is pronounced, and particularly if it

is very dark and the sky is covered over, the visibility is extremely restricted. It is then very difficult to direct oneself other than by signal lights, or to find objectives except those which are lighted up. Nevertheless, it is always necessary to pay the strictest attention to watching the ground, and an experienced observer rarely fails to pick up sufficient indications to locate himself. Sorties on nights such as these should be carried out only in the event of real necessity and only over objectives close to the lines.

Visibility of Special Objectives.

105. (a) Stations: The rails are of dark color and do not show up well, but the platform, paths, etc., which practically always exist, make characteristic white patches which are easy to recognize. Sometimes red and green signal lights will be seen and often, especially when there is a great deal of activity at the station, various white lights and even arc lights are shown.

(b) Factories: When lit up they can be seen as readily as by daylight. They are usually beneath a luminous halo which can be seen from a great distance. In general, all lights are put out as soon as an alert is sounded and frequently a few will be left in order to draw the bombardment to false objectives, such as slag heaps, etc. Iron castings look like huge reddish explosions.

(c) Airdromes: From an average altitude the hangars are only visible on clear nights, but it is always possible to locate them from their relative position from the roads that feed them. Airdromes in use at night show only a very restrained amount of light—three or four red lights and occasionally a row of small searchlights lighted at the instant that an airplane is landing. Rockets and other signal lights are also used, and give useful indications as to the location and activity of the various fields.

(d) Villages: These appear as a grey blot with roads, paths and sometimes railways converging into them.

(e) Camps and Bivouacs: In open ground these are not difficult to find; the numerous paths around them make it still more easy to locate them. In woods they are rarely visible at night.

(f) Convoys and Columns: Convoys carrying lights show up that portion of the road which they occupy. Motor car headlights give characteristic white spots on the roads. Columns without lights are difficult to spot except on clear nights at a low altitude.

(g) Trains: On moonlight nights the smoke of a locomotive can be seen at a great distance, at low altitude the train itself is visible. On dark nights only the tail lights can be seen and occasionally the firebox when it is opened (especially the reflection of the fire on the smoke overhead). Only exceptionally are trains lighted up.

Execution of a Mission.

106. The altitude at which a reconnaissance is carried out depends on visibility; in order to recognize details by vertical observation, it is necessary to fly low. Good visibility is attained by flying away from the moon.

107. By allotting clearly defined reconnaissance areas to individual airplanes flying at fixed times, it will be possible to obtain reports covering practically the whole night.

108. If it is not possible to reconnoiter railway lines, roads and watercourses for movement by repeatedly flying along their whole length, one reconnaissance should be carried out between midnight and 3:00 A.M., as the beginning or end of any important movement will take place during that period. The direction of railway movement and activity at stations can be recognized by the glare from locomotives and the white smoke issuing from them. Size and nature of train movements and of entraining and detraining operations can only be observed by airplanes flying at low altitude. Increased activity at stations can be recognized by the unavoidable increase in lights on sidings and platforms.

109. Troop movements and traffic on treeless roads and over open country cannot escape an observer's attention. On roads bordered with trees, in villages, and in country affording facilities for cover, however, airplanes will have to fly low, when, as experience has shown, even the slightest movements can be detected.

110. When ordering reconnaissances for concentrations of troops, camps, billets and airdromes, individual airplanes should not be allotted too large an area, and observers should be instructed in detail as to roads of approach of columns and assembly areas, from information gained by photographic and visual observations by day.

111. Night reconnaissance airplanes will be sent out singly in order not to attract the enemy's attention, which would cause him to extinguish lights and alarm his defences. It is recommended that Airplanes should cross the lines at great heights and then glide down. It may also be advisable to fly with the engine throttled down. Machine guns should only be used for self defense or when there is a chance of causing serious losses to the enemy. A machine which limits itself to reconnoitering may sometimes be taken by the enemy for one of his own aeroplanes.

112. Parachutes flares are most useful for night reconnaissance.

Enemy Defense Against Night Reconnaissance.

113. As regards the enemy's defensive measures against night reconnaissance airplanes, complaints received are chiefly concerned with the blinding effect of searchlights, which may render all reconnaissance impossible; on the other hand anti-aircraft and machine gun fire have not been heavy. It will be found advisable to employ night pursuit for the purpose of neutralizing enemy searchlights and anti-aircaft defense. Enemy night pursuit is a growing danger to night reconnaissance.

THE ROUTINE OF A PURSUIT UNIT.

Duties.

114. Pursuit aviation has a double mission to perform:

(a) Offensive.

(b) Protective.

115. *Offensive Patrols* are dispatched to cross the enemy's lines in sufficient strength to cruise over his rear area, search out enemy aircraft, and attack them with the object of causing maximum casualties and inflicting the greatest possible damage to his air service and with a further object of obtaining a definite moral superiority. Offensive patrols should cover low, intermediate, and high altitudes, and it must always be borne in mind that pursuit aviation furnishes its own protection and that the advantage of altitude will frequently outweigh the advantage of numbers in a combat so that low or intermediate patrols should invariably be accompanied by high protection.

116. *Protective Patrols,* have a double mission to carry out:

(a) To place Corps Observation Aviation in a position where it will be, and will feel, that it is protected.

(b) To protect our ground troops from the results of enemy artillery adjustment, reconnaissance, and photographic airplanes, as well as from attack by pursuit and attack airplanes.

117. Protective patrols are not to be regarded as defensive in character. All pursuit aviation is offensive in character, but the limitation of the area in which protective patrols are ordered to fly and to fight and the end which it is desired to accomplish by the utilization of protective patrols distinguishes them from offensive patrols, whose mission is to attack and destroy enemy aircraft of every sort wherever found.

118. The performance of the double role of protective patrols cannot be accomplished by the maintenance of a permanent barrage of the sector. Such a procedure is fatiguing for the pilots, expensive in material in comparison with the results obtained and renders it impossible for us to undertake offensive expeditions in force. Consequently a permanent barrage will only be resorted to at times of intense preparation for attack while it is imperative to prevent all reconnaissance of our rear areas on the part of the enemy air service.

119. It is to be noted that barrage patrols can only afford effective protection to our army corps air service when active over a limited breadth of front which, as a rule, should not exceed 15 kilometers. The size and altitude of protective patrols will depend upon the general activity of the sector, and the strength and degree of aggressiveness of enemy aviation. On special occasions a triple tier barrage may be established for short periods of time. The depth that protective patrols will penetrate into the enemy rear areas will be prescribed in orders. Patrols must not exceed this depth except in extraordinary circumstances; for them to do so leaves the Army Corps aviation unprotected. For a protective patrol to leave this area assigned to it, in order to attack enemy airplanes or for any other reason, constitutes a serious offense.

120. In order to protect effectively our Army Corps airplanes, barrage patrols should operate from 5 to 9 kilometers over the enemy lines.

121. For the rigidity of a fixed system of protective patrols there will be substituted a system which will comprise patrols especially directed against enemy army corps aviation and in addition a number of airplanes on alert, ready to take off in a few minutes, to cope with any marked increase of enemy aviation over a part of the sector of the enemy aviation in cases where ground activity makes an increase of aerial activity advisable.

122. The size of the alert or mobile reserve will be prescribed in orders. The group commanders will be responsible for its proper utilization. It is not intended to use the planes on alert to counter attack every enemy airplane reported by our A. A. A. Observation Post or the Gonio Stations. The alert will be used by group commanders as a sort of "support System" to reinforce our aviation in case of increased enemy aviation or in case of activity on the part of infantry or artillery.

123. In addition to the routine offensive protective patrols, pursuit aviation will perform 4 types of special missions:

(a) Close protection of Corps airplanes.
(b) Cooperation with Day Bombardment.
(c) Attacks on balloons.
(d) Attacks on ground troops.

124. *Close Protection of Corps Aviation* will only be arranged in special cases where the Corps Aviation has to perform particularly difficult and delicate missions. The group commander of the Corps Observation Group will request such protection from the nearest pursuit group commander and the latter will be the judge as to whether or not his missions will permit him to furnish the protection requested. It has been found that by furnishing the daily schedule of operations to the Corps Air Service in advance the Corps Air Service is generally able to arrange its missions so that they coincide with the time of a routine pursuit patrol, and this patrol after it has concluded its protection of the Corps airplanes is able to continue its patrol of the lines.

125. *Cooperation With Day Bombardment* is valuable, in that it enables pursuit patrols to obtain contact with enemy pursuit airplanes. Owing to the long range and slow speed of day bombardment airplanes, a covering protection should not be afforded. A day bombing expedition should rely upon its own strength to defend itself from attack of enemy airplanes.

126. By sending out pursuit patrols to meet day bombardment units over the objective and again at the line when returning from their raid it will often be possible to attack enemy pursuit airplanes which are following the bombers in the hopes of picking off a straggler. Under these circumstances our pursuit airplanes by knowing the altitudes and route which the day bombardment will follow, can obtain the advantage of altitude and surprise, as the enemy pursuit will have its attention directed to the bombers whom they are pursuing.

127. *Attacks on Balloons* are dangerous and difficult and should only be undertaken in order to destroy the work of some balloon which is particularly embarrassing to our troops. Very light patrols, of one or two airplanes, make the attack with a patrol overhead to protect the attacking airplanes from being surprised. Demonstrations against the entire line of enemy balloons along a considerable length of front often give valuable results by causing all the enemy balloons to be hauled down; these results are especially to be sought during the preparation of an offensive or when the attack is in progress. They must be organized with great care and precision in order that the attack may take place simultaneously along the entire front. In attacking a balloon, it must always be borne in mind that only the front part is vulnerable. At least the rear third has nothing in it but air.

128. *Attacks on Ground Objectives* often give valuable results during a major operation. The objectives of attack should, as a rule, be the enemy reserves, either in mass formation or on the march. They should be undertaken in force as the result desired is the maximum moral effect. The employment of a large number of pursuit airplanes in attacking ground objectives increases the safety of the operations by multiplying the targets at which the enemy must shoot. In a calm sector, machine gun attacks of objectives on the ground, trenches, machine gun emplacements, artillery positions, etc., produce very little effect either moral or material. They will not be attempted.

Notes on Routine Procedure.

129. *The Group Commander* will dispose tactically of his forces in order to cover the instructions or orders issued by the Army to which the Group is attached.

130. *All Tactical Work in Pursuit Units* will be performed in formation, the size of these formations varying in accordance with the situation, the mission, and the enemy's dispositions.

131. *The Formation* of five or six airplanes, i.e., the flight, will be the basis of all tactical operations, in order that the tactical efficiency of the several flights may reach maximum, it is advisable that the pilots live together on the ground as much as possible, and in addition, work together in the air at all times. Formations of five or six airplanes are extremely maneuverable and at the same time can be controlled to the best advantage by a single patrol leader. It is probable that of a flight of six airplanes and pilots, not more than five will be available for duty on any given day. Where the mission requires a greater number than five or six airplanes, two or more flights acting independently, but in liaison with one another, will be employed.

132. Either one of the following methods may be employed for the formation of flights depending upon the direction of the wind and the size of the landing field:

(a) Formation on leaving the ground—The patrol leader takes off first, flying at less than full speed, and the others follow him in order. When the patrol leader has reached the approximate altitude which he has set beforehand for formation, he will make a half circle and return over the flying field, each pilot then taking up his appointed place. Upon passing over the flying field, the patrol leader can determine the number of airplanes which have been unable to take off.

(b) Formation over a selected spot—This method of forming patrols is especially useful when several patrols are to take off at the same time. In this case, the patrol leader is the last to take off and the deputy patrol leader the next to last. The altitude of assembly is fixed beforehand and depends upon the mission, ceiling, etc. It is never greater than 2,000 meters. Otherwise, the airplanes are likely to become dispersed before the patrol is formed. The assembly point is a few kilometers from the flying field, never more than ten, over some striking landmark. Upon arrival at this point, each pilot makes left-hand turns, while he is climbing, until he has reached the designated altitude which he must maintain precisely. The patrol leader climbs

to an altitude of 200 meters below the patrol and describes right-hand circles. When he considers it proper, he turns toward the lines flying extremely slowly and balancing his wings to attract attention. The other pilots then assume their places. If no airplane is seen turning to the right below the patrol, the deputy patrol leader flies to the flying field to ascertain that the patrol leader has been unable to take off. A ground sheet signal gives the indication. If the patrol leader has been unable to take off, the deputy patrol leader assumes the leadership of the patrol.

133. All formations should comprise a double echelon in depth and in altitude, the airplanes at the rear being highest up so that they can take advantage of their altitude to close in on the patrol leader by diving, in case of necessity. The usual formation is that of an inverted "V", the patrol leader at the head. Number two and number four on his left rear and number three and number five on his right rear; number two and number three should be about 200 meters apart and about 50 meters above and to the rear of number one. Number four and number five should be about 400 meters apart and about 100 meters above and to the rear of number one. When the patrol is composed of six airplanes, number six takes position above, behind, and to the left of number four, or above, behind and to the right of number five.

134. In formations of several flights, the same principle is employed. The flight leader of the entire formation flies at the head of the leading flight. One flight behind, above and to the left of him and another flight behind, above and to his right.

135. *Single Flight Combat.*— The patrol leader determines the advisibility of combat. He will be permitted a considerable latitude in making his own disposition when the combat is joined. As a rule, airplanes number four and number five of his formation will remain above to afford protection from enemy airplanes, which may in the vicinity. The patrol leader himself will always lead the attack. In the attack teamplay leads to victory. It is, therefore, essential that all members of one flight shall talk over on the ground and practice in the air the evolutions, which the Flight Commander will use in attacking different types of enemy aircraft.

136. In case of a combat when several patrols are flying together and a large force of enemy airplanes is sighted, the leader of the forward and lower flight will detemine what action to take, the leaders of the other flights guiding on him. In such cases, it is generally preferable to attempt to attack the rear man of the enemy formation. The inability to maneuver formations of more than five airplanes, makes it possible to throw the enemy into confusion and to attack his airplanes separately. The attack by the formation leader upon the leader of the enemy's formation should, as a rule, be avoided unless the formation leader is confident of possessing superior material. The attack by the leader of the formation upon the leader of an enemy formation invariably leads to a melee in which both formations become separated, which is difficult to break off inside the enemy's lines, and which simply becomes an engagement of individuals.

137. *The Rally*—After a combat every effort should be made to regain the formation as speedily as possible. This is easy to accomplish inside our lines if conspicuous land-marks are designated beforehand within four or five kilometers of the line. Within the enemy lines, the rally is far more difficult to execute. In this case, each pilot will fly toward the fixed rally point, within our lines, but will watch at all times to give assistance to any of our pilots who appear to be in trouble. When the rally point has been reached, patrol reforms in accordance with the principles laid down in paragraph 132 (b).

138. In making disposition of his forces, the Group Commander will endeavor at all times

to keep in hand a mobile reserve of airplanes capable of taking off in a few moments to counter-attack any increased enemy aviation over our front, or to reinforce our patrols on the front in case ground activity makes increased aerial activity advisable.

139. In sectors where general conditions render it safe to install the pursuit airdrome very close to the front, i.e., 20 to 25 kilometers, it should be possible to arrange a very close liaison with the front, the anti-aircraft artillery, the goniometric stations, etc. In such cases a number of airplanes to be determined by circumstances, always at least one flight, will be held on alert, ready to take off and attack every enemy airplane crossing our lines and every enemy airplane making adjustments close to its own lines. Under these circumstances, flights will perfect themselves in taking off quickly and getting into formation immediately. In answering "alert" of this character, speed in leaving the airdrome and taking up formation is of paramount importance.

140. *Group Operations Officer.* Alerts of a character requiring instant response should come in to the office of the Group Operations Officer. He will decide whether or not the alert is to be answered, bearing in mind the number of airplanes instantly available, the number, type, and probable mission of the enemy airplanes reported, their altitude and direction of flight. He will transmit the alert to the flight or squadron which is standing by to respond to such calls, together with his estimate of the situation. The Flight Commander on duty will, as a rule, decide the number of airplanes which will actually be used to respond to an alert transmitted to him, but the group Operations Officer should be authorized to give orders on the subject in the name of the Group Commander regarding the number of airplanes to respond if, in his judgment, orders are necessary.

141. After a patrol leader has left the ground, he is responsible for carrying out the patrol's mission. He should be permitted complete independence of judgment in the leading of his patrol, and in exceptional cases, may depart from the designated route if the situation makes it advisable. The Group Operations Officer is responsible that complete information is given to the Squadron Operations Officer relative to every mission, and in exceptional cases he will explain the objective of the mission to the patrol leader personally. The patrol leader will only depart from the mission assigned to him in such cases as this appears to be essential.

ORGANIZATION AND EMPLOYMENT OF ATTACK SQUADRONS.

Composition of Attack Squadrons and Attack Groups.

142. An Attack squadron will normally consist of 18 airplanes, (either mono-plane or bi-plane), divided into three flights.

143. An attack group will consist of two or more attack squadrons, the normal composition being three squadrons.

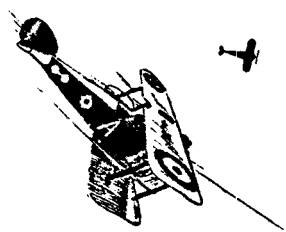
144. In addition to the combat squadrons, there will also be one park squadron assigned to each battle group. Whenever practicable, all squadrons of an attack group will be located on the same airdrome.

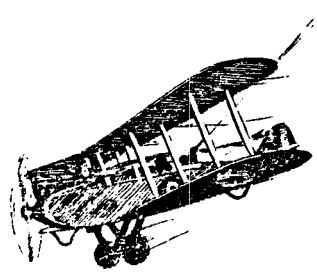
Missions and Duties of Attack Squadrons.

145. The use of low-flying airplanes on the battle-field and their cooperation in fighting on the ground, by open gun fire, or by attacking with bombs and hand grenades, is particularly effective from the point of view of morale, both on our own and the enemy's troops.

146. The systematic and aggressive participation in the battle of flying formations against ground targets is of great importance. During offensives, attack squadrons operate over and in front of the infantry and neutralize the fire of the enemy's infantry and barrage batteries. On the defensive, the appearance of the attack airplanes affords visible proof to heavily engaged troops that Headquarters is maintaining close touch with the front, and is employing all possible auxiliaries to support the fighting troops. The morale of the troops and their confidence in a successful defense is thereby materially strengthened. The object of the attack squadrons, in addition to the losses inflicted by them, is to shatter the enemy's morale by continuous attacks in formation, and thus to exert a decisive influence on the result of the battle. Confusion to the enemy's front line troops, dispersion of his infantry and machine gun fire from their normal targets, the demoralization of traffic, the dispersion and delay of reinforcements, as well as the actual losses inflicted upon his forces, are the means by which the mission of the attack squadrons is accomplished.

147. Whenever the situation warrants, attack squadrons should operate in conjunction with bombing squadrons. The area of attack may thus be extended deeper into the enemy's lines, the bombing squadrons operating beyond the attack squadrons, and normally as far back as the rear areas of the enemy's corps, and, in some cases, to the rear areas of his army.

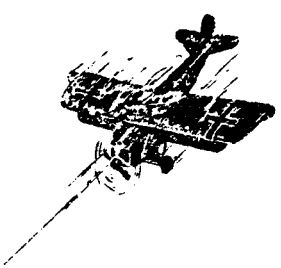




Employment of Attack Squadrons.

148. The successful employment of attack squadrons depends upon their concentrated, continuous, uninterrupted engagement at the decisive time and place. This condition limits their use to that particular portion of the battle front upon which the entire operations depends, and prohibits their distribution over relatively unimportant portions of the battle line.

149. The proper execution of the missions of attack squadrons makes the fullest demands on the physical and mental capabilities of the personnel. While employed on attack missions, attack squadrons must devote themselves exclusively to their particular sphere of action. Tasks forming part of the normal duties of the observation, pursuit or bombardment squadrons must not be assigned to attack squadrons simultaneously with their attack missions. Attack squadrons, however, will report to the proper Headquarters immediately after landing, all observations made during their flights which may be of value. Their duties in connection with observation are the same as now specified for pursuit squadrons.



150. Attack squadrons are to be employed in *DECISIVE* infantry actions. At other times (when the military situation is such that there is no probability of attack missions being required), attack squadrons may be employed as protection for corps and army observation units.

151. Attack groups will normally be held under the direct command of the Chief of Air Service of an army or, (in extended operations) of the Chief of Air Service of the Army Group. Liaison must be maintained so that the entire forces of the attack units can immediately be thrown into action at the point designated. This requires that the personnel of the attack squadrons be constantly in touch with the progress of the battle and the exact locations of the leading elements of our own and the enemy's troops. It also requires that they be thoroughly familiar with the location of the enemy's artillery, machine gun nests, bivouacing centers, his lines of communications and routes or reinforcement immediately in rear of the battle front.

152. The information outlined in the preceding paragraph will be obtained through close liaison with the Chief of Air Service of the Army and Corps, Observation Groups, Balloons, Pursuit and Bombardment Groups, Ground Observation Posts and the General Staffs.

153. During active operations, the attack units will be kept ready for immediate action, both during the day and night. Their efficient use requires that they strike at the given point at the decisive instant, and with their maximum force. Their airdromes should be located as far forward as communications and the terrain will permit. Advanced airdromes will be reconnoitered, and communications installed beforehand, and these advanced airdromes will be utilized as the military situation requires.

(a) *Offensive.*

154. In the offensive, attack squadrons will be employed in force to destroy the enemy's forward infantry lines and harass his forward artillery. They will be used to neutralize infantry and machine gun fire. They will prevent the organization of supports and their movement forward to the main line of resistance. They will prevent the sending forward of reinforcements. They will isolate and demoralize enemy concentrations. They will prevent designated routes of communications from being used. They will prevent the sending forward of ammunition, especially by horse-drawn caissons to the front lines. The above missions will be accomplished by the use of bombs, hand grenades, airplane cannon, and machine guns.

155. Accurate knowledge of the ground is the first condition for the successful action of attack squadrons. The personnel must be thoroughly familiar with their own forward battle zone, and the composition and formation of the ground troops that are to make the attack, the position and location of the forward elements of the enemy's ground troops, his centers of resistance and lines of reinforcement and withdrawal.

156. Attack squadrons must not be engaged before the attack is made by the ground troops. The proper moment for the leading elements of attack squadrons to pass over our front line is the moment when the infantry units advance to the attack. Attack squadrons should therefore be continuously engaged until a decision on the ground has been reached. They should be ready and should strike again if counter attacks are being prepared.

157. In case the advance is being successfully accomplished, the attack squadrons must utilize every possible means of turning the enemy's withdrawal into a rout.

158. Light artillery, especially that using gas to delay our advancing troops, are one of the normal targets for attack squadrons. The enemy's barrage batteries are normal targets for our attack squadrons. Special flights should be detailed to attack these batteries.

159. Special attack squadrons or flights may be detailed for harassing traffic in certain areas behind the enemy's front lines. Their missions will usually be best accomplished by rendering designated traffic centers impassable.

160. Attack airplanes should not be given missions against enemy aircraft. Their relation to enemy aircraft is normally a defensive one only.

(b) *Defensive.*

161. The use of attack squadrons on the defensive against the enemy's counter-attacks made during our offensive operations has been indicated above. When our troops are on the defensive and the enemy's preparations indicate that his infantry attack is imminent, the attack squadrons must be held in constant readiness both by day and night. Continuous liaison must be maintained during this period regarding the enemy's assembly points, troop movements and probable line of advance.

162. The enemy's leading elements become of secondary importance after the advance is actually started, and the force of attack squadrons should be concentrated upon his supports and reserves, his barrage batteries, and possibly upon certain of his interdiction and harassing batteries. Normally, the enemy's second and third assault waves will be targets of prime importance for attack squadrons after the advance has begun. If the enemy's leading elements attack by the infiltration method, our attack squadrons should concentrate upon the "follow-up" forces, and except under very unusual conditions, cannot be used against the enemy's leading elements.

163. If the enemy's infantry advance is made in connection with tanks, the isolation of the tanks from their infantry supports becomes one of the missions of attack squadrons. The

Signal Corps radio truck used to receive and transmit messages.

attack by airplanes upon tanks should be made with bombs and airplane cannon.

Transmission of Orders.

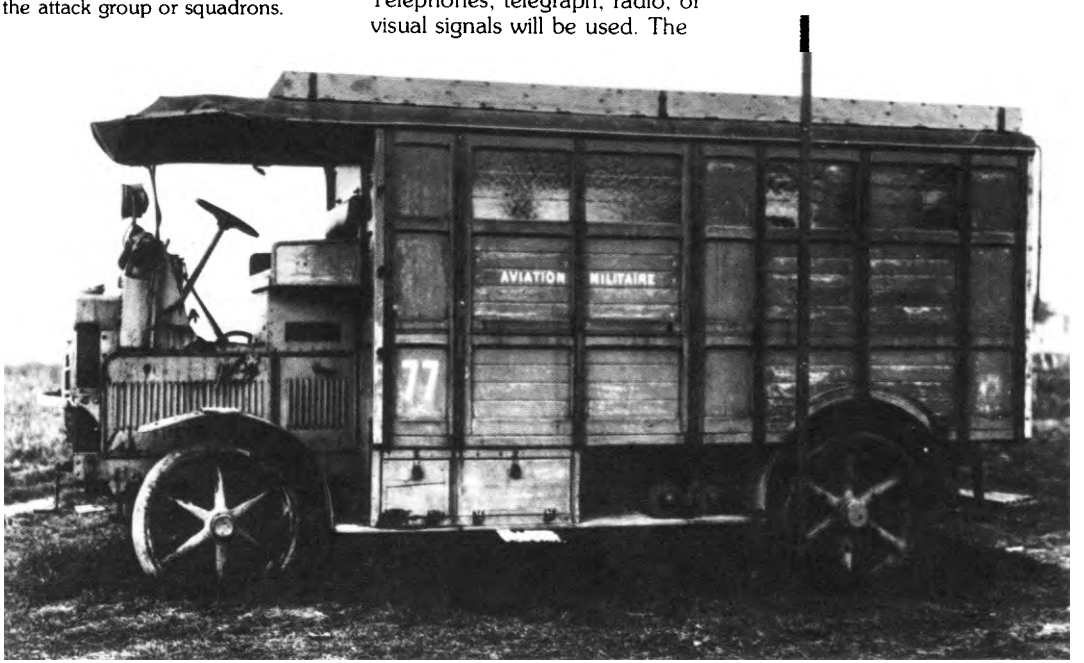
164. The commander of the attack squadron or attack group will receive detailed orders from the Headquarters to which his organization is attached. These will state the following:

(a) Exact location of our own and the enemy's front lines.
(b) Objective and sector of the attack.
(c) Nature of the preparatory phase.
(d) Method of attack.
(e) "D" Day.
(f) "H" Hour.
(g) Targets especially assigned to the attack group or squadrons.

165. Each attack squadron of the group will be given one target, one mission, or one area to cover. If the position of our front line is not exactly known, as, for instance, during rear guard actions, the enemy's batteries, routes of advance, and road centers, will normally be given as targets.

166. During active operations, especially when our troops are acting defensively, every means for the rapid transmission of information and orders must be employed. If a division intends to counter-attack, this information, giving the hour and sector, must be transmitted to the attack squadron or group assigned. Telephones, telegraph, radio, or visual signals will be used. The attack squadron or group, will, if necessary, maintain one or two airplanes over the Division P.C., for the receiving and transmission of information concerning the time of the proposed counter-attack. Upon receipt of this information, the liaison plane will return to its airdrome and transmit its information by radio, dropped message, or by landing.

167. Selected men of the leading elements of the infantry organization should be informed of the time that attack squadrons are to operate over their sector, and particular care should be taken that the panels or flares used to mark the front line are properly displayed.



Training and Tactics.

168. The lower the altitude at which attack airplanes operate, the greater the morale and material effect. For this reason, attack airplanes will operate as low as the terrain and their weapons permit. If machine-gunning troops in the open, descents as low as ten meters are advocated. Then flying at this height, the direction of attack should be parallel to, or away from our troops. Extremely low attack is especially valuable against columns of troops or convoys, along a straight road, in cuts, and against troops massed on open hill-tops. When using bombs, the airplane should be flown just high enough to be outside the danger zone of the explosion. For the engagement of batteries in action, a height of two hundred or three hundred meters is more favorable. If the batteries are exposed in the open where the terrain permits an attack from the flank or rear, at one hundred meters, or less, (depending upon armament of the airplane), may accomplish better results.

169. Attack squadrons and groups must make use of every opportunity to carry out training behind the front for their work. The most important features of this training are simulated attacks in close formation, flight following flight, and the preparation of time schedules of departure from the airdrome, formation of flight, attack, expenditure of ammunition, and return to the airdrome, replenishment of fuel and ammunition, and repetition of attack. Particular attention should be paid to the training of flight leaders, deputy flight leaders, and the control and maneuvering of the flight as a unit. Theoretical and practical instruction and training must be given to each individual until he has completely mastered his airplane and weapons.

Relation to other Aircraft.

170. Attack squadrons are for use against the enemy's ground forces. They are not, primarily, for use against enemy aircraft, except balloons. Their use against balloons should be considered as of minor importance, except in connection with attacks against enemy artillery.

171. During the preparatory phase of an operation, they may efficiently be used as protection for low-flying infantry and artillery airplanes. These missions should be utilized for familiarizing the personnel of the attack squadrons with the sector.

172. During the operations of attack squadrons, against their normal targets, they should be protected from enemy aircraft, either by pursuit airplanes, or by one or more flights of the attack group operating as protection at a higher altitude. If the group does not contain a squadron equipped with machines of the pursuit type suitable for engaging enemy aircraft, thereby requiring that protection be furnished by one or more flights of attack airplanes, the schedule of operations should be worked out so that the protection flights be relieved by other protection flights before their fuel has been consumed, and they will then descend and expend their ammunition against ground targets before returning to their airdrome.

173. Particular attention and thought should be given by all attack personnel to the means

and methods of improving the efficiency of attack squadrons, particular attention being given to maneuvers and new weapons.

LIAISON OF THE AIRPLANE WITH THE INFANTRY.

174. The functions of the infantry airplane in its cooperation with the infantry is separated into two distinct categories, which will be specified hereafter under the titles of: THE INFANTRY COMMAND AIRPLANE. THE INFANTRY CONTACT AIRPLANE.

I. The Infantry Command Airplane.

Function.

175. The Infantry Command Airplane acts as the liaison agent under the direction of the division commander, between the attacking infantry and the division P.C., and as an agent of liaison for the P.C.'s of the infantry itself, of the artillery and of neighboring troops, as circumstances require and in conformance with instructions from proper authority.

176. It follows the operations of the front line troops for the purpose of obtaining the position of their lines when desired, and transmits same to the division P.C., and gathers such information as possible concerning the enemy and our own troops during the preliminary reconnaissance which is made prior to asking for the position of the front line from the infantry.

177. It transmits to the infantry the orders of the division commander; transmits to the division commander the communications of the subordinate P.C.'s made by signals; and in general keeps the division commander informed of the progress of our own front lines and as to the situation in the immediate enemy lines.

The Mission.

178. It is not feasible to limit exactly the duties of the Infantry Command Airplane where such duties may temporarily coincide with those of the artillery surveillance or counter-attack airplane. It is desirable that the Infantry Command Airplane report all activity of interest that he may see during his preliminary reconnaissance, so that his message may well include a report of enemy batteries in action; the activity of enemy and our own neighboring troops, and similar information of importance. He should always report the activity of enemy aircraft, enemy balloons, and anti-aircraft. It must be borne in mind, however, that this airplane has for its specific mission the determination of the infantry front lines, and that all other considerations are secondary. To keep the command well informed as to the situation of our front line is the first and most important duty of the Infantry Command Airplane. The difficulties that he will have to overcome to be successful do not permit those in command to expect him to give other information regularly or to have him undertake other missions. However, if, as frequently happens in the war of movement, it is not immediately possible to obtain the position of the front line, the observer may render other services in the interval which will elapse until the time when he can obtain its position.

179. He may temporarily assume the functions of a counter-battery or surveillance airplane. He may relay to the command and to the artillery the signals made by the infantry such as a request for a barrage, or for an increase of artillery range, or a request for ammunition. In the case of strong resistance by the enemy, checking our advance at any point, he may inform the command by radio or by a dropped message on the P.C., or may drop a message on a group of infantry, giving location and importance of the opposing forces.

180. The command must realize that an absolutely fixed time for obtaining the position of the line is impracticable. This is true both at the beginning of an attack, when an Infantry Command Airplane will invariably be over the lines, and later during the war of movement when circumstances may easily arise rendering it impossible to obtain the line at a specific time. At the beginning of an attack the line should not be demanded until sufficient time has elapsed for the infantry to gain some predetermined objective.

181. Infantry commanders and troops must assist the aviator so far as lies within their power. A watch must be maintained for his signals, and a prompt response made to his request for the position of the line. It must be borne in mind constantly that the success of the mission depends upon a thorough mutual understanding and cooperation between the infantry and the airplane.

The Execution of the Mission.

182. An observer, in order to render a comprehensive, valuable report must bring up to the last moment the information he obtained before leaving the airdrome. This will be done by flying over our artillery line before going to the front; locating the important P.C.'s and observing the activity of our own and the enemy's artillery, the progress of the artillery engagement, and the aerial activity; then proceeding to the lines he will note the enemy activity on the ground; the grenade and bayonet fights, and any other information of importance and interest to the command. When he has thoroughly grasped the general situation he takes advantage of a favorable opportunity and discharges his signal asking that the Infantry indicate their position.

183. The Signal used by the airplane in identifying himself, asking for the line to be indicated, sending "understood" and making other pre-arranged signals, are made by rockets of various descriptions, discharged from a Very pistol. The significance of the various rocket signals used is specified in the plan of liaison, and may be changed from time to time, if circumstances demand.

184. The infantry will at all times have specially detailed lookouts whose duty it will be to observe the movements of the Infantry Command Airplane and report to the proper officer when the airplane signals its request for the line to be shown. The responsible officer will see that panels are promptly displayed. If the signal "Where are you" is again displayed by the airplane after the panels are shown, steps will be taken to immediately indicate the line by means of Bengal flares. These should be habitually used to mark the line in wooded country, and under

other circumstances where the airplane may have difficulty in locating the lines. If the Infantry Command Airplane does not send the signal "Understood" after ten minutes have elapsed, the panel should be taken in and no more flares will be lighted.

185. After having determined the lines the Infantry Command Airplane will proceed toward the division P.C., sending by radio the information gathered, and confirming same by his written message which will be dropped at the P.C. Normally the mission of the Infantry Command Airplane is completed by this act. If it is desired to communicate with other P.C.'s, messages should be delivered after completing the mission for the division.

II. *The Infantry Contact Airplane.*

Function.

186. The Infantry Contact Airplane takes an active part in the offensive operations, and acts as the liaison agent of the front line infantry and the accompanying artillery.

The Mission.

187. It attacks the enemy on the ground with machine guns and light bombs, and by such maneuvering may easily indicate the position of enemy strong points and centers of resistance. By signals and methods pre-arranged with the infantry batteries and accompanying guns, it indicates targets which should be taken under fire, and also indicates objectives to the heavy machine guns and mortars. Its communication with the ground troops will be entirely by visual signals and dropped messages. In order that the results obtained by this airplane are commensurate with the risks undertaken, such close liaison must exist between it and the troops on the ground that prompt and unfailing advantage is taken of every signal and message given by it. Success depends upon a liaison perfected to an extent hitherto unknown, in our service; a liaison must be founded on mutual knowledge, confidence, and admiration. The Infantry Contact Airplane by its signals and dropped messages gives to the smallest party of infantry information invaluable to them in their advance.

188. Such close liaison and cooperation should exist between the infantry and the Infantry Contact Airplane that a message dropped near any group of infantry, however small, will be recovered by them and carried at once to a responsible officer and action taken without delay according to the contents of the message. In this way minor units will have information of their immediate front of greatest value to them.

189. When the information gathered warrants it, and upon the completion of its mission, the Infantry Contact Airplane communicates with the desired P.C., imparting such information as it has collected. For subordinate P.C.'s in particular this is important, as by this means information is received which will not be obtained by other means for a long period of time.

III. Liaison.

(a) *Relations of the Air Service with Ground Troops.*

190. The success of the infantry mission, command or contact, depends entirely upon the maintenance of an intimate liaison between the air service and the infantry, from the division commanders down to the soldiers in the front lines. In order to foster the spirit of cooperation necessary to success, every effort will be made to have officers of the air service units visit the infantry in the lines, for the purpose of becoming acquainted with their work, their difficulties, and the way they live. Infantry officers will also be encouraged to visit the airdromes, when circumstances warrant, to become familiar with the operations and work of an observation squadron. When possible, selected officers will be taken over the sector by airplane. Special efforts should be made to enable officers of the division and corps staffs to see the lines from the air.

(b) *Airplane to Ground Communications.*

191. Radio and visual signals furnish the most reliable and generally used means of communication between the airplane and the ground. In the American Army at the present time the dropped message is employed to a large extent.

192. The observer sends by radio all his observations, confirming his information by a dropped message at the P.C. Rocket signals, discharged from a Very pistol, and other visual signals are used for communication with the front line troops and for other special purposes, as provided in the plan of liaison.

193. The observer tests his radio set before leaving the vicinity of the airdrome, with the ground testing station there, so that no airplane ever proceeds to the front without its radio being adjusted to the stations with which it may have to communicate.

194. The dropped message is invariably used to confirm the radio message at the P.C., for which primarily intended. This is important, as the radio messages are frequently lost by the receiving station. The dropped message is used by the Infantry Contact Airplane to communicate with the advancing troops, and, by special agreement, with the infantry batteries and accompanying guns.

(c) *Ground to Airplane Communications.*

195. For the infantry airplane, these signals are all visual. They comprise panels, Bengal flares, signal lights, and rockets, and any other improvised means for attracting attention of the plane.

(d) *Panels.*

196. Marking panels are used by the front line infantry to indicate their position to the airplane, either at the demand of the airplane, at a prearranged hour, or at the initiative of the infantry commander when for some reason he wishes to indicate his position to the Infantry

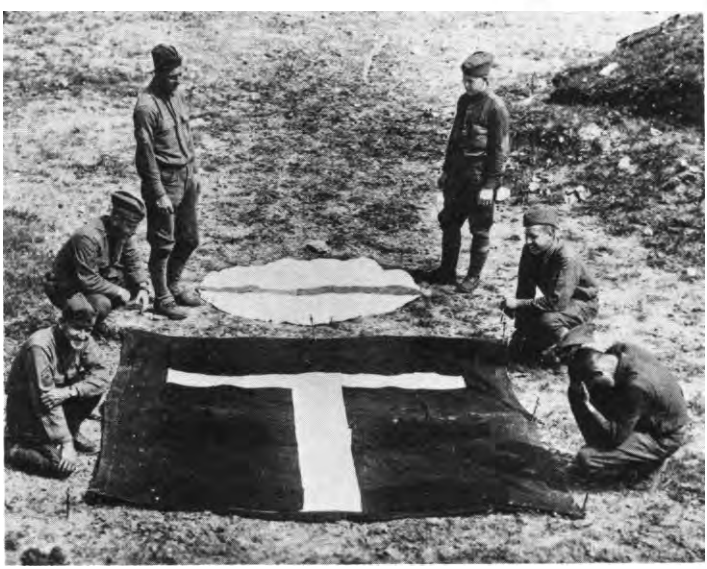
Command Airplane. The Infantry Command Airplane, having seen the panels displayed without request, will immediately take the position of the line, give the signal understood, and proceed as in his regular mission. Identification panels are used to indicate the location of the P.C.'s and in case of stations equipped with radio receiving sets, the display of a panel means specifically "Here is P.C., so and so, with radio set erected, listening in, and ready to receive messages." By this means the observer locates stations with which he may wish to communicate, and all stations so adjusted may intercept his message.

(e) *Flares and Rockets.*

197. The Bengal flare is used to mark the infantry line in woods, during misty weather or fog, when it is difficult for the airplane to see the panels. If after the line has been marked by the panels, the airplane again demands the line, flares should be lit. In lighting flares, care must be taken to have airplane in a favorable position, going away from the line, as flares remain lit only about thirty seconds.

198. After the airplane has signalled "Understood," or after a period of ten minutes has elapsed, the panels should be concealed and no more flares lighted.

199. Rockets and other signals are used for special purposes, as indicated in the plan of liaison.



Panel markers for communication with airplanes.

IV. Training.

200. The preliminary instructions of infantry must be thorough and must be continued constantly while in repose or behind the front lines, in order that the principles of close liaison and cooperation with the airplane may be kept constantly in view.

201. Instruction must be given which will impress the importance of the work done by the airplane, and the absolute necessity of complying with its demands promptly. This instruction must be aimed at all infantrymen, from the regimental commander to the private. It must be borne in mind that after the observer has asked for the line, both he and the pilot are concentrating their attention on the ground; that it is very difficult at that time to maneuver so as to avoid machine gun fire from the ground or anti-aircraft fire, and that the airplane during this interval is at the mercy of enemy

aircraft, completely without defense. Furthermore, the longer the airplane must remain over the lines at a low altitude the heavier becomes the hostile machine gun fire. The enemy is specially trained in this type of fire, and heavy casualties invariably result to the airplane. The destruction of the infantry airplane not only means the loss of two highly trained and specialized officers, difficult to replace, but it means that a very serious delay results in the arrival of information to the command at a time when very probably other means of communication do not exist. The success or failure of an operation may easily depend on the certainty of receiving the information which it is the mission of the Infantry Command Airplane to transmit promptly.

V. Exercises.

202. Exercises will be held at frequent intervals for the purpose of perfecting the liaison between the infantry and the Infantry Command and Contact Airplanes. These exercises will be held at concentration points in the rear, and with troops in repose behind the lines or newly arrived in Corps areas. A course of instruction will be established in each Corps at the airdrome of the Corps Observation Group, which will have for its purpose the instruction of officers and non-commissioned officers in infantry liaison, and to give those

attending the course such a knowledge of the Air Service and its operation, possibilities, and limitations, as will establish a firm, mutual understanding and confidence. A large part of the instruction will take the form of practical exercises under conditions simulating actual service as closely as possible. Every effort will be made to make the course interesting to the students.

203. In the armies on the front, arrangements will be made whereby officers of the air service, particularly of the observation units, may visit troops in the line, for the purpose of gaining first hand knowledge of the operations of ground troops, which will aid them in aerial operations, and tend to strengthen the confidence and liaison with ground troops.

204. All commanding officers of troops having control over observation air service will take such steps as are necessary to perfect the cooperation, confidence and liaison between the infantry and the air service. It should be borne in mind in this respect, that as the most suitable place to gain a knowledge of the infantry is in the front lines, so the most suitable place to gain a knowledge of the air service is on the airdrome and in the air.

AA guns on French trucks operated by 2nd Balloon Co., 1st Army Corps., Montrieul, France, 8 July 1918.

Brig. Gen. Mitchell and his staff, Coblenz, Germany, November, 1919: (l. to r.) Capt. I. W. Miller, Capt. R. Valois, Lt. Col. L. H. Brereton, Gen. Mitchell, Maj. I. D. Joralemon, and Capt. O. E. Marrell.

54. Notes of the Characteristics, Limitations, and Employment of the Air Service

1919

During the war, officers and soldiers of the infantry and artillery often expressed dissatisfaction with the way aviation was being used. Such comments were summarized and answered in a paper, "Notes on Employment of the Air Service from the General Staff View Point," [1] prepared in February 1919 under the direction of Colonel Gorrell, Assistant Chief of Staff, Air Service, AEF. After being circulated for comments, the paper was revised in France, given a new title, "Notes on the Characteristics, Limitations, and Employment of the Air Service," and later published in Washington in an *Air Service Information Circular.*[2] The latter version is printed below.

The original paper contained sections, omitted from the published version, concerning principles of command, complaints of aviators against the infantry and artillery, the "temperament" of fliers, and the status of the Air Service as a combat arm. These paragraphs seem to be of sufficient interest to warrant their being printed as an addendum.

Principles of Air Service Operations.

1. What is the function of an Air Service? These are its chief purposes:

The Air Service aids the Infantry, helps adjust Artillery, assists in keeping the staff informed, destroys the enemy air service, by using machine guns and bombs, assists in deciding actions on the ground, and prevents the enemy air service from rendering similar assistance to the hostile forces.[3]

2. The Air Service has difficulty in keeping the staff informed because there are many things which it is hard or impossible for airmen to see because of atmospheric conditions, the speed at which airplanes travel, the blind angles on all airplanes, and the fact that from an airplane the ground appears in plan, without contours. The Air Service can not take the place of Cavalry, but the Air Service can bring back accurate, cool reports, not warped by the sights and sounds of the battlefield.

1. In Gorrell's History, D-1.
2. Vol I, No 72, 12 Jun 20.
3. The revised statement is more positive than the original: "The Air Service tries to keep the staff informed. The Air Service helps adjust artillery. The Air Service tries to destroy the enemy air service. The Air Service tries to help decide action on the ground by using machine guns and bombs." Only significant changes in content will be pointed out in these notes.

These reports can be of value only if they are quickly decoded and transmitted. The airplane secures and carries reports quickly. A well-trained staff uses them quickly.

3. Adjusting Artillery from the air in a war of movement is difficult unless all who take part in the adjustment, Artillery and airmen alike, are thoroughly trained. The first essential is a thorough understanding between the ground and air forces and a well-developed system of cooperation and of signaling or communicating information. First, the Air Service must know approximately where the Artillery posts of command are located. Second, the artillery panel crews must answer signals promptly and properly. Third, the radio must work. Fourth, the details of the shoot must be carried out smoothly, and this can be accomplished only when efficient ground communication exists. Fifth, though perhaps it should be put first, the airplane must find the target at which the Artillery is to shoot.[4]

4. Airplanes in fighting in the air must try to keep clear of enemy airplanes an area about 10,000 yards deep in front of the line of battle. If they are successful the Infantry see few air fights and therefore think our planes are not operating. Complete success is impossible. The idea of a submarine barrage by submarines against submarines is ridiculous, but no more ridiculous than the conception of a complete aerial barrage 2½ miles high, 5 miles deep, and as broad as the front over which the battle is raging. A perfect aerial barrage is impossible because of the difficulty a plane has, first, to see another in the air, and second, to attack it. Therefore, enemy airplanes occasionally get past the most numerous and aggressive friendly pursuit concentrations. They must be accepted by our ground troops with the same philosophy as the enemy's shelling.

5. Low-flying enemy airplanes must be fought by ground troops utilizing their machine guns and rifles. In firing from the ground on low-flying enemy aircraft remember that many a machine is hit, the pilot wounded, and the observer killed, when the airplane does not fall nor appear to be damaged. Do not become discouraged because the enemy plane which is being fired at does not fall. Many machines of our Army, disabled by enemy fire from the ground, have come home in crippled condition, with observers dead and pilots wounded. The enemy did not have the satisfaction of seeing them fall.

6. If proper understanding, cooperation, and communication exist, airplanes can enter effectively into the battle on the ground.[5] The moral damage they do with their bombs and machine guns is to the material damage as about 20 to 1, but success in battle comes from the destruction of the enemy's morale, and not from the enemy's annihilation. The best relations based upon intimate knowledge and personal acquaintance and friendship, must exist between the Air Service and the other arms. Otherwise there will be misunderstandings and recriminations.[6]

7. The above points are illustrated and explained in the succeeding pages.

Functions of the Air Service.

8. Whatever the future development of aviation may be, up to the end of the war in 1918 its most important function had proved to be securing and transmitting information concerning the developments in and beyond the line of battle. The work of keeping the command informed was rendered difficult because what the Air Service could do and what it could not do were not sufficiently well known either to the staffs or to the troops, and

4. The original contained the additional statement: "This is not always easy."

5. The original began: "If good liaison exists. . . ." Similar changes were made in other places where "liaison" was used in the original.

6. The original contained an additional paragraph: "Finally, the Air Service is a combatant arm and not a staff service. It must be utilized as such."

because the American Army did not have at its disposal a sufficiently large air force. The purpose of this pamphlet is to set forth simple statements of the capabilities and limitations of the Air Service.

9. As has been pointed out, the Air Service, in order to assist the Infantry, besides keeping the command informed, adjusts Artillery; fights in the air against the enemy air service; attacks ground objectives, both tactical and strategical; and prevents the enemy air service from rendering similar assistance to the hostile forces.[7]

10. The work of keeping the command informed is done by—

(*a*) Visual reconnaissance;

(*b*) Photographic reconnaissance;

(*c*) Thorough mutual understanding and the prompt communication of information.

Limitations of Reconnaissance.

11. Visual reconnaissances by daylight and by well-trained observers often furnish information of great value. These missions sometimes fail for reasons which are readily apparent. An airplane can not stand still to scrutinize a stretch of country. A thousand men hidden in a wood or a village can not be compelled by an airplane to expose themselves. Therefore, if they wish to remain hidden they can do so. Hence negative information, while valuable, is not always accurate. Again, the Air Service can not replace the Cavalry. If, however, the presence of concealed hostile troops is suspected, this can often be verified or disproved by airplanes dispatched on special missions, while circling at a very low altitude over the locality concerned.[8]

12. An airplane passes over the country so rapidly that troops on the ground can sometimes deceive the aerial observer; for example, a column may alter temporarily its direction of march, etc. Hence even positive information must be carefully weighed in order to determine its value.

13. No man, no matter what his flying experience, can stand on the ground and estimate the state of visibility in the air. A ground mist frequently reduces visibility from the air on days which may appear perfect for observation purposes to men on the ground.[9]

14. To the aerial observer certain things show more or less clearly, due to the fact that backgrounds and shadows affect visibility. Fields show up from the air like checkerboard squares. Soldiers standing on the line where two fields meet are hard to see, while if they are a few feet within one field or the other they show up clearly. On the line between two fields, if they are seen at all, it is generally because they are revealed by their shadows. The best cover from airplane observation is natural shadow.

15. Wheel tracks and paths are readily noted by an observer and show clearly on airplane photographs. Freshly turned earth is quite conspicuous and no amount of camouflage can conceal it completely.

7. The last clause was added in the revision.

8. The last sentence was added in the revision.

9. The original contained an additional sentence: "The only answer to the question of what is the visibility on any given day is 'Take the air and see.' "

Capabilities of Reconnaissance.

16. As the limitations of aerial observation are seldom appreciated, so also its capabilities are seldom comprehended.

17. Any staff officer who has seen war has heard tales of disaster such as are almost always brought back by the seriously wounded and by skulkers. All reports from ground observers in the front line have a tendency to be warped by the excitement, the sights, and the sounds of the battle field. It is difficult for a staff officer to avoid being influenced by these reports. A properly utilized and properly trained Air Service can discount many false reports and can clear up most of the obscure points on the line of battle.

18. To locate troops on broken ground requires flying at altitudes of 700 feet and less, at which altitudes airplanes are extremely vulnerable to machine-gun fire from the ground.[10] It is difficult to locate the lines during an attack, as our own Infantry are then too busy to show their panels; hence, though the enemy does not greatly hinder our low-flying airplanes at such a time, the airplanes do not bring back the most valuable reports. The best time for Infantry contact patrols is usually for about one hour after the capture of an objective. During enemy counter attacks, a very heavy fire against our low-flying airplanes must be expected.

19. The aerial observer, when not in action, is generally somewhat removed from the sights and sounds of the battlefield. He is not subject to the waves of emotion that can and do run through masses of men at the front.

20. The aerial observer can not do his work intelligently unless he has had proper training. To secure reports of the greatest value, the observer should be a highly trained General Staff officer. This ideal, for obvious reasons, will rarely be attained. By the proper training of Air Service officers it can be approximated. The pilot should be a young man, the observer an older man, who has received several years on General Staff training in schools established for that purpose.

The Airplane as an Instrument of Communication.[11]

21. Once the deadlock on the western front was broken, and movement—which is the essence of war—began, the staffs of large units began to experience serious difficulties in transmitting orders and in securing information. These difficulties were almost insuperable so far as ground communication with advanced elements of ground troops was concerned; the common methods failed to function with more than a small part of their former efficiency. This was not true of the Air Service. The difficulties of communication, inherent in a war movement, are present to a much smaller extent between the staffs and the Air Service than between ground observation posts and posts of command. In future wars we may expect the Air Service to do more and more of this important work.

22. In a war of movement the Air Service will probably be the chief reliance of the G–2's of combatant units. The training for G–2 work should therefore include experience in aerial observation.

Communication.

23. To keep in touch with the front line in open warfare, only one means is reliable—the actual physical carrying of a message. Runners are slow, horses frequently impracticable, and motor cycles demand roads. Considering time and distance as important factors, the airplane is often the best carrier. Better means of communicating from the ground to the airplanes must therefore be devised. This is limited at present to a few prearranged signals which, though they may not contain all a commander desires to know, even now contain all he need know to form a sound estimate of the situation. Communication from airplanes to the ground, on the other hand, for all essential command purposes, is efficient where good training exists.[12]

10. The opening sentence of the original was dropped in the revision: "Infantry liaison flights are dangerous."

11. The original heading was: The Airplane as an Instrument of Liaison." See note 5 above.

12. In the original this is followed by a section (one paragraph) on principles of command. See addendum.

Combat.

24. Aerial fighting is difficult. Its difficulties are not appreciated by the majority of those who are not aviators.

25. The greatest difficulty of the pursuit pilot is to find the enemy. The difficulty that a man in the air experiences in seeing another airplane is hard to understand. When an airplane is seen from the ground, it is generally the noise of the engine which attracts attention to it. In the air the noise of the pilot's own engine drowns all other sounds.

"Vision of the Air."

26. With no foreground or background a pilot may look directly at an airplane and not see it, because his eye is out of focus. This difficulty is hard to explain. To seafaring men it will appeal as natural. To landsmen, all that can be said is that it does exist, and aviators try all sorts of expedients in an effort to overcome it, such as looking at struts which are at different distances from their eyes and then sweeping the horizon.

27. From above it is difficult to distinguish an airplane if the camouflage on the wings blends well with the background of the earth against which it is seen.

28. An airplane seen from below can not be attacked unless the attacker is justified in accepting a serious disadvantage of position during the combat that is to follow.

29. Two airplanes on the same approximate level present to one another very small projected areas as compared with the same two airplanes as seen from the ground, for from the ground they are seen in plan.

30. For the foregoing reasons hostile airplanes often pass one another in the air without joining in combat.[13] Also observation airplanes, like ground reconnaissance patrols ordinarily avoid combat unless they are attacked.

Fighting in the Air.

31. Fighting on the ground is in two dimensions; fighting in the air is in three. When combat is joined, an airplane moving at a speed in excess of 120 miles an hour is a gun platform from which to fight a target moving at a similar speed. The difficulties involved are sufficiently obvious to explain the fact that effective range never exceeds 400 yards and that 90 percent of the machines shot down are shot down at ranges from 100 yards to 10 feet.

32. To the average soldier at the front, and to his officers, too, the sole purpose of airplanes was apt to be regarded as the driving off of enemy machines—a function which was very poorly performed in the war, to judge by the accounts of those unfamiliar with the proper employment of an air service.[14]

Tactical Employment.

33. The proper employment of pursuit airplanes includes the destruction of enemy aircraft, the protection of our own observation airplanes, and the prevention of enemy aerial attacks on our ground troops. By our success in harassing and destroying hostile two-seaters the enemy is prevented from informing his command.[15]

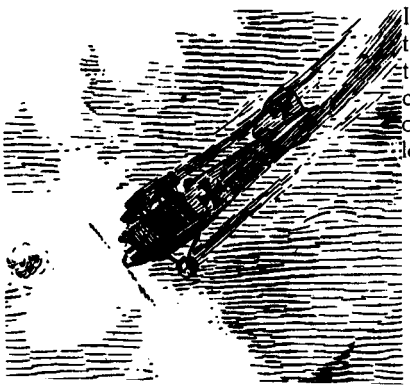
34. Experience has shown that maximum casualties can be inflicted on the enemy air service, and our own observation airplanes can be better protected, by adopting a vigorous offensive policy for our pursuit airplanes. This is the best defense. Maintaining our aerial front line far beyond the front line of our Infantry and clearing the enemy aircraft from the area in which our observation airplanes work, give better protection to our Infantry and to our

13. In the original the following sentence is inserted: "Probably the Infantry of both sides curse their respective representatives as 'yellow,' while the truth is that the pilots have never seen one another at all or else at least one of the planes was an observation plane, charged with the duty of getting information."

14. In the original the sentence ended: "... to judge by the accounts of those unfamiliar with the proper employment of an air service." The original then continued: "The function was ill-performed because the Air Service never attempted it for the reasons indicated in paragraph 38 [34 in revision]."

15. The last sentence was added in the revision.

observation airplanes than attempting to give close protection. The Infantry do not see combats far within the enemy's line, and consequently one hears frequent complaints and demands by the ground troops for the patrolling of our lines by our own pursuit airplanes. Such a disposition of forces would be analogous to placing all of our Infantry in the outpost zone and evenly distributing it from one end of the line to the other, while confining it to a strict defensive. Such tactics would of course inevitably result in defeat.[16]



Low-Flying Enemy Airplanes.

35. As a matter of fact, the only successful way to deal with low-flying airplanes is for the Infantry to have confidence in their own weapons—rifles and machine guns—and to use them. It has been explained that it is difficult to see one airplane from another in the air. The lower an airplane is flying the harder it is to see. Once seen, a low-flying airplane is hard to attack from the air. With no room to dive or maneuver, the efforts of a pursuit airplane to attack even a two-seater which is harassing our Infantry, Artillery, or columns on the road may be compared to the efforts of a hawk to attack a crow among trees. It is the duty of the Infantry to drive off the low-flying enemy airplanes.

36. The great moral effect of low-flying airplanes results from an exaggerated notion of their capabilities. An airplane that remains over the enemy lines at an altitude of 500 feet for only five minutes may safely be assumed to cover 7 miles. It will probably be seen by all the troops of one division who are in the forward zone, and experience goes to show that, no matter with what equanimity the division withstands hostile shelling, a number of its troops will believe themselves to have been in danger from such an airplane. (One of the best American divisions in France on one occasion received 3,500 enemy shells in its sector in one day without being disturbed, and yet personal questioning by General Staff officers disclosed that almost every man in the division believed himself to have been in danger from a single low-flying enemy airplane which was over its lines for about 10 minutes.)[17]

37. All ground troops must be educated to appreciate that—

(*a*) Airplanes never regulate Artillery on the front lines.

(*b*) Airplanes seldom regulate Artillery from an altitude of less than 2,000 feet.

(*c*) More or less continuous observation is essential to the regulation of Artillery fire.

(*d*) Rifles and machine guns of ground troops are the best defense, and are a thoroughly efficient defense, against low-flying airplanes.

16. The last sentence was added in the revision.

17. The original continued: "In addition, if, while an airplane is over the lines or during the ten minutes after it departs, shells fall near any part of the Division, as is almost certain to occur, in all probability the shelling will be attributed to the direct agency of the airplane. The attribution of such shelling to airplane artillery adjustment is invariably based upon complete, and to the aviator pathetic, ignorance of the functions, capabilities and limitations of the Air Service."

38. Infantrymen are loath to fire upon aircraft, because they fear to disclose their positions. Firing on aircraft by infantrymen does not tend to disclose the position of the Infantry, but rather by virtue of keeping the enemy at a higher altitude helps to conceal it. Many pilots and observers returning from flights have reported being fired upon by small arms, but if in any case a pilot or observer was able to locate the point from which the fire came with sufficient accuracy to demand Artillery fire against the hostile positions the case was a very rare one, probably unique.

39. If Infantry do not fire against low-flying hostile airplanes, the enemy's aviators will become bolder, descend to lower altitudes, and will remain much longer over the lines.

40. It can be stated unhesitatingly that the boldness of the German low-flying planes over the American Army on the western front was due to insufficient initiative by the Infantry, who frequently failed to engage hostile aircraft, or engaged them only in a half-hearted manner.

41. A word of caution in this regard is imperative. The Infantry must not engage our own airplanes. Before firing on any airplane its hostile intent should be established beyond a doubt. All combatants on both sides in the late war received numerous reports of enemy pilots' flying machines captured from the other side. So far as the allied armies are concerned no German airplanes were ever flown by the Allies near the lines. No allied pilot would have dared to fly any German plane near the lines, for the one reason, if for no other, that it would have been impossible to have notified all allied pilots when and where he would be in the air, and if all allied pilots, at least within a radius of 30 miles, had not been notified, any flier in a German airplane near the allied lines would, in all human probability, have been attacked. If the low-flying airplane has not exhibited any hostile intent, the Infantry should wait to see the hostile insignia before firing upon it. To fire when it is so far away that the insignia can not be distinguished, is not productive of results.[18]

Bombing and Machine Gunning.

42. Besides its interest in the actual fighting in the air, the G–3 staff is interested in these elements of the air service which enter directly into the battle on the ground—bombers and airplanes which attack ground objectives.

43. The developments of the late war in its later months indicate that future wars will see a further strengthening of machine-gun nests as a means of defense. The airplane gave hopes, at the end of the war, of assisting materially in overcoming these obstacles. To be of assistance in the reduction of machine guns, air service units must know their location and communication must be sufficiently good so that the cooperative action between the arms at the disposal of the Infantry and Artillery can be assured.

44. The attack of ground objectives in the zone as far back of the enemy's front lines as his divisional posts of command often yields important results. For such attacks to be of maximum effect, good targets, such as columns on the road or troops in reserve, marching up to the line of battle or retreating, must be exactly and positively located before the "ground-straffers" are dispatched. Under other circumstances good results will in all probability not be achieved.

18. The last two sentences were added in the revision.

45. Bombing and its results have heretofore been little understood. The great mobility and speed of airplanes make it possible to utilize day bombardment tactically to influence an action in progress. It is considered that as compared with the material destruction wrought—which is frequently considerable—the moral effect of either bombing or machine gunning from airplanes is as 20 to 1, and victory in battle results from the destruction of the enemy's morale.

Mutual Understanding and Personal Visits.

46. The basis of the proper operation of the combined arms is mutual understanding and a spirit of camaraderie. This is best secured by the exchange of personal visits. Infantrymen, artillerymen, and staffs must visit airdromes and watch the air service work. Aviators must be sent for tours of duty with Infantry and Artillery units.[19]

ADDENDUM from Notes on Employment of The Air Service From The General Staff View Point

. . . . . .

Principles of Command[20]

26. Nevertheless, in no case should Squadrons or Groups be under direct orders of G–2 and the role of Branch Intelligence Officer should be turned over to an Air Service Intelligence Officer. *Air Service units must be under the direct orders of Air Service officers, held responsible that the orders of the Commanding General, expressed (for intelligence) through G–2, are properly executed.* From a G–2 point of view the Air Service is to be regarded as any other combatant unit. The relationship between staffs of large units (Division, Corps and Armies) and the Air Service of the units should be analogous to that between, for example, G–2 of a Corps and the Divisions of the Corps. Each air service unit should have its own officer who is responsible for the collection and forwarding of all information of the enemy. He will cooperate with G–2 and maintain intimate liaison exactly as do the G–2s of divisions and

19. There were four additional paragraphs in the original. See the addendum.
20. See note 12.

corps. But he is under the orders of the Air Service Officer who commands the unit.

. . . . . .

51. All [21] the recriminations between the Air Service and the other line troops have not been made by the Infantry and Artillery. Aviators who have fought in the war have expressed themselves quite freely when they have been called upon by ground troops for protection against enemy aircraft at a time and a place where the only airplanes in the sky were American. Frequently American airplanes have been shot at and a few have been brought down by the machine guns and rifles of our own Infantry.

52. But to be shot at by one's own friends is one of the unavoidable incidents which occasionally occur to all arms. Recriminations were more bitter when *the Air Service met with definite refusals to cooperate on the part of the line.* When *the Chief of Staff of one Division refused even to consider holding Infantry Liaison exercises* with the Air Service, when *day after day Artillery batteries changed their locations and the Air Service was not notified,* when *the Infantry took cover and hid instead of displaying their panels when an airplane signalled asking for them,* when *P.C. after P.C. was found which was without its distinctive panel,* on these occasions it was difficult for the Air Service to maintain its high spirit and morale.

Aviation Morale

53. Much ridicule has been heaped upon the so-called "temperament" of fliers. Fliers are not per se any more temperamental than other healthy young men, and are equally anxious to live up to the best traditions of the profession of arms. Nevertheless the morale of an Air Service is a sensitive thing, certainly, at least as sensitive as that of the Infantry, and subject to much the same reactions. The giving of ill-advised orders to fliers such as sending out a squadron under atmospheric conditions that render work impossible and increase the likelihood of casualties will destroy the confidence of the pilots and observers of that squadron in their superiors, with consequent loss of morale. These conditions can only be accurately appreciated by a flier. Therefore orders to Air Service units should always proceed from Air Service commanders, held responsible that the orders of commanding General expressed through their Staffs are carried out.

The Air Service Not A Staff Service

54. *Finally it is particularly desired to impress upon all staff officers that the Air Service is not a staff service but is a combatant arm and it must be considered as such to obtain success. It is susceptible to the same tactical dispositions, in accordance with the same underlying tactical principles as are all other arms of the Service.*

21. See note 19.

Lt. Col. William C. Sherman (far right) was on hand to examine a new Vickers machine gun which fired through the propeller. Lts. V. F. Ludden (far left), C. G. Sellers (in cockpit), and Capt. G. C. Thomas collaborated in the briefing.

55. Sherman: Tentative Manual for The Employment of Air Service

1919

Lt. Col. William C. Sherman, who was Chief of Staff of the First Army Air Service in November 1918, and who produced a "Tactical History of the Air Service" at the end of the war,[1] also prepared a "Tentative Manual for the Employment of Air Service." Written in France in the early weeks of 1919, the manual reflected the experience gained during the war. A revised copy, entitled "Notes on Recent Operations," was sent to GHQ, AEF for publication, but GHQ apparently never gave its approval. On 11 April 1919, following a cabled request from the United States, a copy was sent to Washington. There it was mimeographed on 18 June 1919 by the Information Group, Air Service, under the title "Notes on Recent Operations." The following year it was published under the latter title as an *Air Service Information Circular.* The text printed below is from a copy of the original in Gorrell's History.[2]

Part I.

Chapter I.
General Principles

1. The name Air Service is, to some extent, a misnomer; the employment of Air Units is not an automatic thing, functioning as a service, but is an arm, subject to the same variety of a combination for differing tactical situations as are the other arms, and governed by the same tactical principles. It is proposed, therefore, to enumerate these principles, before going into a more detailed study of Air Service employment.

2. It is a fundamental of human nature for man to fear man more than the chance action of steel and lead. Therefore, in the future, as in the past, the final decision in war must be made by man on the ground, willing to come hand to hand with the enemy. When the infantry loses, the Army loses. It is, therefore, the role of the Air Service, as well as that of the other arms, to aid the chief combatant: the infantry. That the lack of assistance from other arms would inevitably result in the defeat of our infantry does not affect the truth of the axiom. Two important corollaries therefore follow: the Air Service must know infantry and its assistants; and general officers and their staffs cannot hope to produce the most efficient knowledge, tactical combinations, unless they have a thorough knowledge, not alone of infantry, but of its assistant arms, which include the Air Service.

3. In so far as the Army is concerned, the object of war is the defeat of the enemy's armed forces in the field. This can be done only by seeking a decision in battle. It is essential to victory,

1. Published in the first volume in this series.

2. Gorrell's History, D–1, pp 167–247. See *ibid.*, C–15, for copy of version sent to GHQ. A note in D–1, p 1, states that the manual was prepared by Sherman and corrected by Gorrell. A copy of the mimeographed version that at one time was in the library of the Field Officers' School at Langley Field, is in AFSHRC 248.211–61K. The section on corps aviation was published in *Air Service Information Circular,* Vol I, No 74, 12 Jun 20, and the entire manual in another *Circular,* Vol I, No 76, 30 Jun 20.

therefore, to assume the offensive. In war, practically never does victory come as a result of the material destruction of any large portion of the enemy's forces. Often much material destruction has resulted from victory: it has never been a prerequisite to victory. The final aim sought, therefore, is not the material destruction of the enemy, which can never in practice be even nearly complete, but the destruction of the enemy's hope of victory, of his desire to continue fighting, in a word, of his morale. This fact must be particularly borne in mind, in considering the Air Service, whose moral effect on ground troops is out of all proportion to the material destruction wrought. In the line, the most certain outward sign of that superiority of morale which insures victory, is the possession of the battlefield. No other factor is so largely destructive of the enemy's morale as this. It has been truthfully said, therefore, that to advance is to conquer, and one may conquer only by advancing. These facts, seemingly trite, must nevertheless be constantly kept in mind. Whole tactical doctrines have ignored certain of these truths, with consequent disaster. Nor were there lacking men, in the recent war, who believed that the war would end in complicated systems of trenches: A failure to appreciate the very nature itself of war. In the future, therefore, as in the past, the only true expression of war is the battle, and the battle implies and necessitates movement. The long deadlock on the Western front must be regarded as exceptional and peculiar, and lessons drawn from that carefully examined, lest a rule be deduced from what was indubitably an exception.

4. It is the battle then that is sought for, and, in the battle the destruction of the enemy's morale. It is not necessary, however, at one and the same time to attack all portions of the hostile army. The morale of an army may be compared to the human body: to destroy it, it is necessary to destroy only one of several of its component parts. The battle then resolves itself into an attempt, by a crushing blow, to destroy but a limited portion of an enemy's army, while holding over the remainder the threat of impending destruction. This demands then a certain economy of forces: to the portions of the field where the blow is to be struck must be brought the superiority of force needed. For all other portions of the field, we may regard troops there employed as detachments—either to hold limited portions of the field or to ascertain the enemy's strength.

5. Before, however, the proper economy of forces can be determined, knowledge must exist of the enemy's dispositions. In former wars, this required numerous detachments of troops. The employment of these constituted the preparatory stage of the battle, which frequently absorbed a large portion of the forces available. Great tact and coolness, a careful estimate of facts, still left often no lightening of the "fog of war." It is in this phase of the battle that the relative importance of aircraft has steadily grown. Surprise exists now and always will, but air control can eliminate a very large proportion of the unknown elements, and admit of a solution based on facts.

6. The decisive blow struck, to complete the victory requires that the fleeing enemy be given no opportunity to reorganize, and that his loss of morale be communicated to the portions of his army still unstruck. The pursuit, then, is at once organized. Too frequently, in past wars, the victor, scarcely less disorganized than the vanquished, has failed to gather in the fruits of victory. Very rarely has a thoroughly organized pursuit been possible. This will be dealt with in greater detail in a later chapter, so far as the employment of aircraft is concerned.

7. The general principles briefly outlined above apply to Air Service units, not alone active cooperation with ground troops, and their attack of the enemy's ground troops, but equally in purely aerial warfare. Before, however, discussing in detail tactical use of aircraft, certain possibilities and limitations of aircraft must be considered.

8. The extraordinary development of airplanes during the great war has brought it about that practically one natural factor alone can prevent flying today: lack of visibility. A pilot travelling at rates of speed almost always in excess of one hundred miles per hour must have a fairly wide range of vision in order to know and to maintain his course. Nor can visibility be determined from ground observations, except in extreme cases. It is highly probable that with time, this handicap will be overcome to a large extent. It must, however, be accepted as a definite limitation today. A second limitation to be borne in mind is the duration of time an airplane may remain over the enemy lines. Due to the question of fuel supply, wear and tear on comparatively delicate engines, and the great physical and mental strain of flying, where every sense is keyed up to the highest, only a small average number of hours per day per plane available can be kept up indefinitely. It is not uncommon among the uninitiated to believe that, because ten planes are available, ten may be kept over the lines all day, with short intervals for refilling fuel. Such is far from being actual service conditions.

9. From the point of view of the command, the greatest value of the Air Service to date has been in gathering information of the enemy and of our own troops. In the nature of things, this source of information should be in future wars both more nearly complete and more reliable. The observer, aloof from the battle, is less subject to its disturbing influences. He is removed from the contagion of fear and panic, so easy of transmission where men are elbow to elbow. He hears none of the reports of the wounded, nearly always breathing calamity. He receives no impressions from skulkers, "the last man left in their company," justifying their crime by reports of disaster. In short, he is physically so situated as to be able to see and report with an approach to that mathematical coolness and accuracy, that is so desirable, but so seldom secured by human beings in the thick of a fight, subject to all its disturbing reactions.

Physically, nothing is defiladed from the airplane observer's view: a situation that is rarely met with in even the best systems of terrestrial observation.

During the long period of trench warfare, elaborate methods of liaison were established, which seldom succeeded when the war of movement—which is alone really war—began. Liaison from airplane to ground, less modified, by movement because more simple and containing fewer links to be broken, should on the contrary, always be successful in open warfare, where due care is taken. Liaison from the ground to airplane, on the other hand, is still comparatively undeveloped, and constitutes one of the problems of the immediate future.

Reports from untrained observers, whether on the ground or in the air, are generally valueless. Training is essential before one can describe even the location of the most conspicuous objects. To know what things are important, and what unimportant; to know exactly what to look for, and what negative information is of value; in short from a view to secure such information as will permit an accurate estimate of the situation, requires an officer whose knowledge and intelligence fit him to be a general staff officer. In practice, this ideal will rarely be attained. Nevertheless it will be striven for, and thereby make more full and reliable the information received in future from the Air Service.

10. An employment of the Air Service, as yet in its infancy, but capable of great results, is that of actually intervening on the battlefield, not alone by bombing

[but also] by direct attack with machine guns. In estimating the value of such attacks, we must again bear in mind that an army is defeated not by destroying it, but by destroying its morale. It has been said before that man fears man more than the chance of lead or steel. The basis of the greater fear is the knowledge that man, having both intent and intelligence, can pursue his design to a fatal conclusion, and hence is more terrible than any inanimate object, directed from a distance. Much of this feeling enters into man's fear of hostile airplanes. The latter's commanding position, rendering concealment apparently useless, induces the instinctive belief in the heart of every man on the ground that he himself is being watched by hostile eyes and being made the target for bomb or bullet; and that this hostile man can pursue him intelligently and ultimately destroy him. To this is added a feeling of utter helplessness, not justified by facts, but none the less instinctive and not to be overcome wholly by reason or training. That the moral effect of attacks from the air is, as compared with attacks from the ground, out of all proportion both to the effort expended and the material damage done, is attested by many incidents. A division of first class troops, that received with equanimity four thousand shells per day in its sector, has been known to be greatly disturbed and harassed by the efforts of one persistently active day bomber. Inquiry showed that almost every man in the division believed himself to have been in danger from this plane.

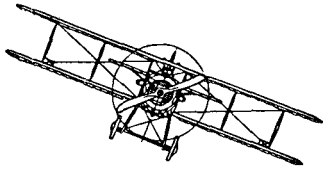
11. It is the purpose of this manual to set forth the principles governing the use of air units, and to put on record the results of experience in this war. But, two facts must be held constantly in mind: The Air Service is a combatant arm, and full training in peace can alone prevent inefficiency in war.

Chapter II. Security

1. Security in Air Service units as in all branches of the army embraces all those measures taken by a command to protect itself from observation, annoyance, or surprise by the enemy. Security of the plane in the air will be dealt with under the heading of combat, because in reality once the machines have actually left the airdrome, the general principles of combat go hand in hand and come under the province of fighting in the air. It will only be necessary, therefore, in discussing the security of Air Service Organizations to consider those measures taken by the Commanding Officer at his airdrome, that will protect him from observation, annoyance, or surprise.

2. It is essential the greatest care be exercised in selecting an airdrome, not only from the standpoint of accessibility and other general principles and shelter, but also from the standpoint of security. An airdrome, therefore, should be selected bearing these principles in mind. Airdromes, if possible, should be away from landmarks which will be visible at night; they should be away from streams; if located at the edge of a forest they should not be near a prominent portion of the forest. While it is well in selecting an airdrome to take precautions against enemy action, it is advisable to look out for natural obstacles, such as undulating ground, and high obstacles which might endanger machines landing or taking off. Every precaution should be taken that will eliminate, insofar as possible, the chances of accidents. In flying, accidents are bound to occur even at the front where pilots are supposed to be capable of flying under any conditions. After the airdrome has been located, care should be used in the location of the hangars. They should never be placed closer than 100 yards apart; in practice it has been found well to scatter them evenly around the perimeter of the field. Where there is danger of night bombing it is well to cover them with camouflage material which makes them blend with the ground, not appearing as landmarks at night. Precaution against fire must always be taken in the case of hangars, and camouflage material should not be used where airdromes are not subject to night attack, as it is always inflammable and renders the possibility of complete destruction greater. At times it is better to place hangars on good ground than to religiously distribute them evenly over the airdrome and break a lot of propellers, tail skids and machines in rough ground. After a commanding officer has located his hangars he should next look to the security of his personnel. Under normal war conditions his enlisted men and officer personnel will be scattered over the whole airdrome, but great care must be taken to keep a unit in its own area, so as to maintain proper disciplinary control. By scattering the personnel in this way danger from bombardment is minimized and protection given to the hangars and machines located at the airdrome. Often airdromes are so located that additional precautions by way of trenches and abris must be taken. If the airdrome is very close to the line great care must be taken against attack in force by enemy low flying airplanes, machine guns should be mounted and personnel properly organized for the most efficient handling of same when occasion arises. Smoke screens, if possible, should be prepared so that a dense form of smoke can be scattered over the airdrome from all directions should an attack of this nature be attempted and if under any special circumstances it is felt that the security of the airdrome is jeopardized. In this respect special guards should be maintained at all times to be ready to handle the situation.

3. Complete mobility of all units insures the safety of material when a general retreat becomes necessary. This mobility depends principally on sufficient initial transportation equipment, and its proper upkeep during the course of operation and on the maintenance of mobility in the unit at all times. Offices should be located in trailers ready to be pulled away on a moment's notice. Spare parts should be kept in trailers and in spare trucks, and movement orders should be extant at all times and revised and republished at frequent intervals.



Chapter III. Shelters

4. The maximum achievements of any Air Service organization can only be achieved when machines are properly housed against the weather and the personnel is comfortably cared for. Mobility and defense against bombardment attacks must be considered.

5. Airdrome sites should be selected on flat well drained high ground, free as far as possible from mud and dust. Good roads must lead to them and a railroad should pass in the vicinity. High grass will injure many propellers and must be removed before flying begins. Sanitation and kindred subjects will be cared for as prescribed in Field Service Regulations. See also Paragraphs 2 and 3 in Chapter 2, Part I.

Chapter IV. Orders

6. The principles laid down in Field Service Regulations for the issuance of orders apply to the issuance of orders for the Air Service.

Chapter V. Marches and Convoys

7. (a) Wings, or larger units, will move by groups.

(b) The removal of a Pursuit Group from one field to another has primarily three phases:

1. Preparation for the move.

2. The move.

3. Arrival at the new airdrome and the preparation until day of attack.

8. Preparation for the move.

(a) As accuracy is of paramount importance in any move, the Group Commanders will be given his new location and all necessary information concerning it, with instructions to make all arrangements to move—but to carry on his preparations fully with only the date, hour, and location omitted.

(b) He will, therefore, before flying to the new location immediately call a meeting of Squadron Commanders, Park Commanders, Supply, Transportation, Radio, Engineering, and any other officers who in his opinion are necessary to contribute to the working out of the operation, which must be planned with all the forethought possible. In this meeting all questions of moment will be discussed which will include:

I. Transportation.
II. Supplies—continuance of incoming.
III. Rations for at least ten days from the present railhead.
IV. Material left on the field for transport to the rear, to be placed in charge of an officer sent from the rear for that purpose.
V. Billeting to be properly adjusted with the local authorities before leaving.
VI. Pulling down of existing inter-camp lines of communication that have been installed by the group.
VII. Camp thoroughly policed before leaving, etc., etc.

(c) The Group commander will then make an aerial reconnaissance to the new airdrome with the object of returning with further particulars of importance to the move in general.

I. He will establish the route by which pilots will fly, noting the important landmarks, airdromes, gas stations, headquarters to notify if forced to land one side or the other of given points "en route."
II. He will have inspected the new field and made notes on the landing facilities.
III. The work of the construction squadron engaged in the preparation of the field and upon the construction of barracks, hangars, etc.
IV. The line of communication to outside headquarters.
V. The disposition of the hangars on the field and which squadrons will occupy them.
VI. The new Group Headquarters and the most suitable location.
VII. Men's quarters and messes.
IX. And in general an idea of the neighboring units and in which way they might be of assistance to his command in moving.

(d) Upon returning to the old field he will see that all these details are passed on to the Squadron Commanders and to those affected.

9. The Move.

(a) Moving orders will be received from the wing or the Army Air Service Commander, depending upon the tactical use to be made of the unit and will be acknowledged by notifying the Headquarters as soon as the echelons have started or are all en route.

(b) The move will be made in four echelons, by squadrons, each echelon of each squadron in charge of an officer.

I. Advance echelon.
II. Main echelon.
III. Flying echelon.
IV. Rear echelon.

10. The advance echelon will be in charge of a competent officer and will be light, consisting only of the personnel necessary to start inter-camp communication by telephone to establish squadron operations, to locate source of supply, fuel, straw, water, etc., and to set up kitchens to take care of arrivals until incoming units are settled. In regard to the above, the park commander will immediately get in touch with the Air Depot of the Army of its advanced field to insure this supply, determining at the same time the quantity of planes on hand, spare parts, etc., that may be called upon for

immediate use. Also get in touch with Parks of adjoining Armies which may be used as an auxiliary supply.

11. The main echelon will leave if possible the next day and will consist of all non-flying personnel of the Group, less the necessary personnel from squadrons and Headquarters Detachment, required to provide meals, planes, make minor repairs on those planes which may be out of commission, attend to billeting, policing, etc., etc. All material that can be taken will accompany this echelon, which will leave camp at the designated hour and will follow the route according to itinerary.

12. The following rules and regulations are to be observed on the march.

(a) All stops for meals or other reasons, other than those caused by emergency, will be regulated on schedule order issued when moving order has been received, designating time of departure and route.

(b) Speed of truck train will be between 10 and 12 miles per hour, regulated by Acting First Sergeant at head of train in side car.

(c) In towns and villages, distances between transportation will be 30 feet, every place else 200 feet.

(d) The train will never stop within a radius of one mile of any town or village.

(e) Acting First Sergeant may grant soldier permission to enter town but only for a good reason.

(f) No soldier will descend from trucks for any reason whatsoever without permission from the N.C.O. in charge of truck.

(g) Each junior N.C.O. will be in close relation with his senior N.C.O. and privates, and is directly responsible to his immediate superior for the discipline and work of his men.

(h) When train is moving, if certain trucks are lagging, put them at the head of the train.

(i) Trailers may be shifted at noon stops or at evening stops, provided that such changes will assist in maintaining schedule.

(j) Chauffeurs will work in details to which trucks are assigned and will be held responsible that their trucks have extra supply of gas each.

(k) N.C.O. in charge of each section will be responsible to the Acting First Sergeant for the loading and unloading and placing of equipment assigned to his section. He will also be responsible for the discipline of the men assigned to his section while en route and until the squadron is settled in its new quarters.

13. The flying echelon will consist of all serviceable machines, with their pilots. This party will leave the field after the advance echelon has reached its new station to receive the planes. Flight formations will be used and each pilot leaving the gound will be given the necessary information for making the trip. On arrival at the new station each pilot will report to the commander of the advance echelon.

14. The rear echelon will consist of the necessary personnel required to provide meals, start planes, make minor repairs on these planes which may be out of commission, attend the billeting, policing material left on the field for transport to the rear, empty gas containers, etc., etc., but will terminate their work as quickly as possible, making sure that the camp is thoroughly policed and in the proper shape to be taken over by the rear units or a new organization, and leaving a proper guard for the camp, should the incoming units be de-

layed or the local authorities be unable to furnish the proper protection.

15. It is most important that these echelons be properly officered to handle any emergencies that might arise and that the move be conducted according to one prescribed route with a schedule of arriving and departing times for the main stopping points "en route."

16. Officers heading these echelons will be assisted by another officer and side car who will bring up the rear and notify the head of the convoy of any breakdowns. They will also be posted on all traffic rules for convoys, see that all rules of the road are observed and in entering congested areas will make sure that no other moving units have priority of movements.

17. All drivers will be supplied with maps and an itinerary of the move in case of breakdowns.

18. Each echelon will depart with ten (10) days' ration.

19. A medical officer will accompany each echelon.

20. Arrival at the new field and preparation until the day of the attack. As soon as the Group has arrived and a hurried inspection has shown that things are progressing nicely, the Group Commander will:

(a) Report the arrival in person to the Wing or A.A.S.C. Headquarters, as the case may be.

(b) Ascertain the locations of all units with which he will be expected to keep in liaison.

(c) Dispatch the radio and searchlight officers to establish relations with the radio and searchlight P.C.'s and to get in touch with their respective liaison officers at A.A.S.C. Headquarters.

(d) Dispatch other liaison officers, calling upon Squadron Commanders, if necessary, to establish relations with anti-aircraft batteries, balloon locations, headquarters of adjoining army units, corps observation groups, in short, developing all sources of information which will materially assist in the efficient functioning of the group as well as developing relations which will include the personal touch so essential in cooperation.

(e) See that all lines from outside sources as well as the inter-communicating telephone systems are speedily installed, including radio and searchlight installations.

(f) Make sure that the operations office of the group is establishing itself with all scale maps necessary, information about existing line locations of allied and enemy airdromes, anti-aircraft batteries, balloon locations, searchlight locations, etc., and the proper housing of the radio and power equipment.

(g) Make arrangements for an aerial target, preferably a small lake at which the pilots may commence at once to test their guns.

(h) Visit personally the staff officers of the A.A.S.C. or Wing of the Army to which attached; Corps observation groups, either pursuit group with whom patrols will be made; C.O.'s of units working with the army operation on the right or left, etc., etc.

21. Separate squadrons will move as above, except that the aerial reconnaissance of the new station and other details of the Group Commander's duty will be performed by the Squadron Commander.

22. A separate flight will generally move in only three echelons: the advanced echelon, the flying echelon, and the rear echelon. The main body of the flight may travel with either the advance or rear parties, depending on circumstances. The Flight Commander will make the same arrangements as the Group or Squadron Commander in the moves discussed above.

Part II. Corps and Army Observation

Corps Observation

Introduction

1. The purpose of this Manual is to establish, on the basis of experience gained in the War with Germany, the general lines of technical procedure governing the operations of the air service assigned to Army Corps in the Field.

Chapter 1. General Principles

2. The Air Service of any Army Corps in the Field is an auxiliary arm. Primarily it is organized for the purpose of observing the dispositions and activities of the enemy during active hostilities. It further assists the artillery as a means of fire control. It partakes of the general nature of combatant arms in that its mission forces it from time to time into combat with enemy aerial forces. The Corps Air Service may accept but will not ordinarily seek combat.

3. The Air Service of an Army Corps is under the tactical and administrative control of the General Commanding the Army Corps. The troops of the Air Service of a Corps are Corps Troops. Corps Air Service troops assigned for tactical duty to Divisions within the Corps retain their identity as Corps Troops.

4. The basis of organization for the Air Service of an Army Corps is the Observation Aero Service Squadron. The basis of the Squadron is the two-seater airplane manned by a pilot and an observer. The Air Service of the Corps may number one or several squadrons.

5. When two or more squadrons are operating together in the same Corps they are organized into an Observation Group. The Observation Group is under the immediate command of a Group Commander.

6. The tactical and administrative control of the Corps Air Service vested in the Corps Commander is delegated to Corps Air Service Commander (C.A.S.C.). The C.A.S.C. is an officer of the Air Service. He is a member of the Corps Staff. Upon the original organization of the Corps he is designated by General Headquarters upon the recommendation of the Chief of Air Service. Thereafter the Corps being a part of an Army, he is designated by the Commanding General of the Army upon the recommendation of the Army Air Service Commander.

7. The Corps Air Service is dependent, for technical supply and replacement of personnel, upon the Air Service Organization of the Services of Supply operating through the medium of Air Depots, Air Parks, and Replacement Squadrons of the Air Service in the Zone of Advance.

8. The details of organization, assignment and designation of personnel, amounts and kinds of transportation and technical equipment are fixed in the Tables of Organization for the Air Service of an Army Corps, Air Service of the United States Army.

Chapter II. The Squadron

9. Tactical and administrative control of the squadron is vested in the Squadron Commander. He is responsible for the tactical, technical, and administrative efficiency of his organization. He is assisted by a staff of officers in the discharge of his duties. His prime qualification is leadership. He is the rallying point of his command. The degree of success attained by the squadron will depend very largely upon the example set by the Squadron Commander. The Squadron Commander may be either a pilot or an observer. In either case he is conversant with the essential principles of the work of both.

10. A Squadron Commander in his administrative duties is assisted by a competent Adjutant. Routine administration is supervised by the Squadron Commander but is effected by the Adjutant.

11. Routine details of squadron supply are administered by the Supply Officer. The Supply Officer will ordinarily be placed in charge of the transportation of the Squadron.

12. In the exercise of his tactical functions the Squadron Commander is assisted by an Operations Officer. This officer is ordinarily the senior observer present. A junior observer may be detailed as Operations Officer if, in the opinion of the Squadron Commander, his executive ability, practical experience, and record for devotion to duty warrant his preferment. The Operations Officer is responsible, under the Squadron Commander, for the direction of the tactical operations of the squadron. He collects, compiles, and transmits all tactical information. He assigns tactical missions to the individual pilots and observers of the squadron. He directs the establishment and maintenance of liaison. He renders, nightly, to higher authority, a detailed account of the tactical operations of the squadron for the day. He acts as tactical advisor and instructor to the pilots and observers of the squadron.

13. The Operations Officer is assisted in the discharge of his duties by an Assistant Operations Officer. The Assistant Operations Officer is an observer. The Assistant Operations Officer replaces the Operations Officer during the latter's absence.

14. The squadron is equipped with Radio Set capable of sending and receiving radio messages to and from all ground stations within a radius of fifty kilometers. The Squadron Radio Set is further equipped with an artillery spark set for receiving airplane messages on short wave-lengths. The squadron radio equipment further consists of airplane type sending sets mounted on each airplane. A detail of Radio mechanics is a part of the personnel of the squadron. The squadron Radio Section is in charge of the Radio Officer. The Radio Officer is responsible for the installation and upkeep of all radio equipment. He is further responsible for the radio liaison of the squadron. He is in personal touch with the Corps and Army Radio Officers. He is conversant with Corps and Army Radio Plans and Regulations and assures compliance with these. He assigns wave-lengths to outgoing airplanes. He is responsible for the coding and decoding of radio messages and of telegrams. He receives the test calls of airplanes leaving the airdrome unless relieved of this function by the Radio Officer of a higher unit. He investigates into the causes of airplane radio failures

and establishes liaison with radio stations of artillery and other units with which radio failures have been reported. Wherever possible he logs the messages of all airplanes of his squadron operating on the lines, with a view to determining, in case of failure, whether the faulty functioning originated aboard the airplane or elsewhere. He maintains a complete log of all radio messages received at his station. He is assisted by one or more trained radio noncommissioned officers.

15. The armament of the airplanes of the squadrons is installed, aligned, and maintained at the maximum of efficiency by the Armament Officer assisted by a staff of enlisted mechanics. The Armament Officer is responsible for the supply, calibration, and loading of machine-gun ammunition. He is further responsible for the supply of signal rockets, signal pistols, and message dropping tubes. During intensive operations he is charged with the duty of replenishing aboard each airplane, immediately the plane is announced available for flight, the stock of equipment above noted. Immediately upon taking station at an airdrome the Armament Officer establishes a machine-gun testing butt, an armament work-shop and storeroom, and erects adequate gun-racks. He assigns rear turret machine-guns to observers by number. He assures the use of rear-turret machine-guns only by the observer to whom each gun, or set of guns, is assigned.

16. The care and upkeep of airplanes and engines is the duty of the Engineer Officer. The Engineer Officer is in immediate charge of the airplane and motor mechanic personnel of the squadron. He is responsible for the instruction and efficiency of the mechanics. He is assisted by a Chief Mechanic and three Chiefs of Flight mechanics.

17. For the purpose of distribution of control the squadron is divided into three Flights. The Flight is composed of six airplanes together with the indicated proportion of pilots, observers, and mechanics. The Flight is commanded by a Flight Commander. The Flight Commander is ordinarily a senior pilot. The Flight Commander is never an observer. The Flight Commander is responsible to the Squadron Commander for mechanical and tactical efficiency of his Flight. He acts as instructor and advisor to the pilots of the Flight. When an entire Flight is detailed for a single mission the Flight Commander is the leader of the formation. The Flight Commander is ordinarily Second-in-Command of the Squadron.

18. The flight is never an administrative unit. In theory it is a tactical unit; in reality it is a technical group, furnishing a convenient sub-division for distribution of technical control. During intensive operations the operative unity of the Flight cannot be preserved. Fluctuation in the average availability of machines in the different flights, and varying qualifications of pilots, will render assignment to duty by flight roster inexpedient. Squadron Commanders will assign pilots to duty in the order of availability and according to the special qualifications of each, not Flight by Flight. During periods of comparative inactivity, however, a duty roster by Flight may be advantageously employed thus:

One Flight, Duty.
One Flight, Reserve.
One Flight, Off duty.

This arrangement is desirable in that it permits pilots one day in every three of complete rest and freedom from responsibility. It has the further advantage of permitting a thorough inspection and overhaul of airplanes every third day.

19. Where a single squadron is operating separately with a division in the field the tactical organization becomes similar to that of the observation group.

Chapter III. The Corps Observation Group

20. The Corps Observation Group consists of a Headquarters, two or more observation squadrons, and a photo section. Medical ordnance, artillery, infantry, and Intelligence personnel are attached.

21. Command of the Group is vested in the Group Commander. The administrative functions of the Group Commander are similar to those of the Commanding Officer of any Army Post.

22. The Group Commander assures the efficient execution of tactical orders received from higher authority. He is responsible for the organization and efficiency of the tactical staff assisting him in his functions. In reality he is the representative, at the airdrome, of the Corps Air Service Commander. Upon his ability to visualize the specific demands of the general situation as communicated to him from higher authority depends the success of the Group.

23. The Group Commander is assisted in his administrative work by a Group Adjutant. The Adjutant is assisted in his duties by a Headquarters Detachment of enlisted clerks and orderlies. The functions of the Adjutant are similar to those of the Adjutant of an Army Post.

24. Supplies are received by the Group for the Air Park and also the Air Park attends to certain repair of not sufficient major importance to warrant their being done at the Air Depots.

25. In the fulfillment of his tactical functions the Group Commander is assisted by an Operations Officer. The Operations Officer is an able and experienced observer. The Operations Officer is responsible, under the Group Commander, for the direction of the tactical operations of the Group. He collects, compiles, and transmits all tactical information proceeding from outside sources to the Group and all information proceeding from the Group to outside units and headquarters. He transmits orders for the execution of missions to the squadrons concerned. He actively directs and maintains at a high point of efficiency the liaison of the Group. He organizes the Group Operations Room. He prepares the schedule of missions for each day. He renders nightly to higher authority a detailed account of the tactical operations of the Group for the day. He receives and supervises the reports of all observers. He acts as tactical advisor and instructor to the flying personnel of the Group.

26. The Operations Officer is assisted in the discharge of his duties by an Assistant Operations Officer.

27. The Radio Section of the Group is exactly similar in organization to that of the squadron. The Group Radio Officer, in addition to the duties outlined for the Squadron Radio Officer, supervises the operations of the squadron Radio Sections. Where a separate Radio Section is not detailed to the Group the Group Commander may designate a squadron Radio Section in lieu thereof. The Group Radio Section maintains operators at the receivers throughout the day and night. It constitutes one of the surest means of liaison available.

28. A complete motorized photographic laboratory constitutes a part of the technical equipment of the Group. The laboratory, together with its staff of enlisted experts, is commanded by the Group Photographic Officer. Wherever possible the Photographic Officer is responsible for the installation of a photographic barrack, with complete apparatus for developing, drying, and printing in quantity production. Airplane cameras are a part of the equipment of the Group Photo Section. The installation of cameras aboard airplanes is a function of the Photo Section.

29. The Branch Intelligence Officer is a member of the Group tactical staff. He is especially trained in the subject of intelligence of the enemy. He is assisted by a staff of clerks, draftsmen, and photo interpreters. He is responsible for the collection, compilation, and distribution of all intelligence of the enemy gathered by the observers of the Group. He provides the maps for the use of the Group. He prepares a special large scale mimeographed map for use of observers in marking the location of troops. These maps are extremely useful additions to dropped messages reporting the results of infantry contact patrols. He is responsible for the interpretation, assemblage, map and file record, and distribution of aerial photographs of enemy territory secured by observers of the Group. He maintains close liaison with G–2 of the Corps.

30. The Operations Room is the tactical heart of the Observation Group. It is the center and source, for the organizations and individuals of the Group, of all tactical information. In it are conveniently displayed detailed, large scale situation maps of the organization of the Army, Corps, and Divisional areas. Other maps show enemy situation and organizations. Charts, diagrams, tabulations, orders, bulletins, reports, photographs having a technical or tactical bearing on operations are available for immediate access. Work tables, paste-pots, colored crayons for the use of observers and pilots are provided. Maps are on file for distribution to individuals. A collection of technical works for reference of flying personnel is kept at hand. The complete Operations Room is the realization of effective liaison. Before leaving on missions observers are instructed to post themselves on the latest developments and receive final instructions from the Operations Officer or his Assistant at the Operations Room. Upon returning from missions observers invariably prepare their reports here. The Operations Room is the Headquarters of their Operations Officer.

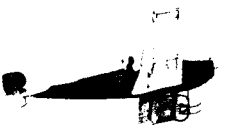
Chapter IV. The Corps Air Service Commander

31. Technical, tactical, and administrative control of all sections, units, and groupings of the Air Service of an Army Corps is vested in the Corps Air Service Commander. The C.A.S.C. is a field officer of the Air Service. He may be either a pilot or an observer. He should be thoroughly familiar with the general principles of the procedure governing the operations of the General Staff. He is a member of the Corps Staff. In addition to his administration and tactical duties, as an Air Service Commander he is the immediate advisor to the Commanding General and the Staff in all matters pertaining to the tactical employment and operations of the Air Service as a whole. He is at all

times familiar with the tactical situation and may make such dispositions to meet it as the limitations and possibilities of the arm he directs indicate, provided that such dispositions in no way conflict with instructions emanating from superior commands. He further transmits and assures compliance with orders governing the employment of the Air Service emanating from the Staff and the C.O. He is responsible for the efficiency of Air Service liaison. He is responsible for the assurance of maximum operative efficiency of the units and staffs of his Command. He is assisted in the discharge of his duties by a staff of experienced Air Service Officers. The post of the C.A.S.C. is with the Corps Staff. The office of the C.A.S.C. is a section of Corps Headquarters.

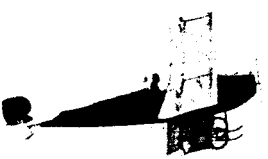
32. The C.A.S.C. is assisted in his administrative duties by an Adjutant. The Adjutant is assisted by a Headquarters Detachment of enlisted clerks and orderlies.

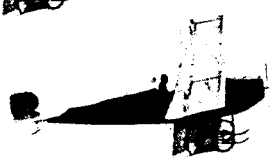
33. Adequate transportation and transportation personnel must be allotted the C.A.S.C. for the carrying out of all liaison duties and establishment of courier services. Supervision of transportation is ordinarily the duty of the Adjutant.



34. The C.A.S.C. is assigned an airplane for his personal use. It is the function of one squadron of his command to assure the care and upkeep of his airplane.

35. In discharge of his tactical duties the C.A.S.C. is assisted by an Operations Officer. The Operations Officer is an Air Service Observer of wide active experience and considerable executive ability. The Operations Officer





replaces the C.A.S.C. in his temporary absence. He is responsible, under the C.A.S.C., for the issuance and transmission of all tactical orders. He advises with the C.A.S.C. in all matters pertaining to the establishment of adequate liaison system by all sections, units, and groupings of the Corps Air Service. He collects, compiles, and transmits, in close liaison with the Corps and Divisional Staffs, all information, both outgoing and incoming. On the basis of the tactical situation as established by the day's information and orders he prepares, under the immediate supervision of the C.A.S.C. the general Operations Order governing the operations of the Groups for the following day.

36. The Operations Officer of the C.A.S.C. is assisted in the discharge of his duties by an Assistant Operations Officer.

37. Such personal liaison for the Office of the Corps Air Service as cannot be undertaken by the C.A.S.C. or his Operations and Assistant Operations Officers is assured by one or more Liaison Officers. These Officers are ordinarily Air Service Observers of considerable active experience. It is their duty to visit as often as may be necessary the Headquarters and Posts of Command of Divisions and Divisional troops and there discuss and, if possible, solve all tactical problems and collect all tactical information having a bearing on the operations of the Air Service in their relation to the commands visited. Liaison Officers render verbal and written reports on their activities to the C.A.S.C. at the close of each day.

38. It is important that all concerned recognize the Office of the Corps Air Service Commander as the sole controlling point for activities of the Corps Air Service. Ordinarily no orders emanating from Staff or Line Commanders requiring compliance by the units of the Corps Air Service will be transmitted direct to the Group or to the Squadron immediately concerned. Orders will be transmitted to the C.A.S.C. or his representative and thence will be issued to lower units. In this connection a comparison may be drawn for the tactical purposes between the regiment and the Air Service of the Corps. In the case of the regiment, orders requiring compliance by battalions or companies pass through the Regimental Commander. This practice is established by military precedent and dictated by practical considerations. In general the same precedents and considerations apply to the Air Service. Situations may and frequently do arise where it is impossible to transmit orders for the Air Service having their source in Divisions through the office of the C.A.S.C. Communications may be interrupted or extreme urgency may interfere and dictate the more direct and rapid method. In special situations of this nature it is permissible for Divisions to transmit orders direct to the Group. The C.A.S.C. in this case is informed by the Group Commander of the receipt of the order and the action taken to comply. In like manner all relations of the Group and Squadrons entered into with Line Organizations should be taken cognizance of by the

C.A.S.C. Liaison Officers proceeding to Division Headquarters and Divisional units will report in one way or another to the C.A.S.C. that visits are contemplated or have just taken place. The result of visits will likewise be reported. It is of extreme importance that the C.A.S.C. be informed up to the minute of all tactical activities of his command. Obviously, unless he is conversant with the very latest data regarding the operations of his command he cannot intelligently direct future operations nor report accurately on the accomplishment of work. Incomplete exercise of control by the C.A.S.C. will result either in duplication and the issuance of superfluous orders, or in an under estimation of the needs of the situation and a consequent failure to make adequate disposition.

Chapter V. Assignment and Functions of Squadrons

39. In assigning Squadrons the C.A.S.C., upon whom this duty devolves, will consider the tactical needs of the Corps as a unit, and the needs of the Divisions of the Corps in the line. Excepting for purposes of training, the Division in reserve will not be considered. The C.A.S.C. will ordinarily assign one Squadron to perform the missions required by the Corps as a whole and one squadron each to the Divisions on the Line.

40. The Corps Squadron has a zone of action bounded on the right and left by the Corps boundaries. The depth of the zone is ordinarily never more than ten kilometers from the enemy territory. The depth is determined in each particular case by the relative strength of enemy aerial defenses weighed against the urgency of demand for information. The Corps Squadron is charged with the duty of securing all photographs of enemy territory, whether photographs are requested by the Corps or Divisions. It is charged with such general surveillance of the course of battle across the entire Corps front as the situation may demand it. It controls and adjusts the fire of the Corps artillery and observes any preparations for enemy counter attack.

41. The Division Squadron is charged with the duty of surveillance of the Divisional Sector to the depth of flight of the Corps Squadron. It is further responsible for establishing liaison between the Divisional Commander and the troops in the front line by means of low-flying Contact Patrols. It reports the position of the enemy's advance elements and his dispositions for defense and attack. It controls and adjusts the fire of the Divisional Artillery. Observations made by Divisional planes and reported to Divisional Headquarters are repeated to Corps Headquarters.

42. All Squadrons report to headquarters of units to which they are assigned the locations of enemy batteries observed in

action and the location and density of friendly and enemy shell observed. Special reconnaissance for the location of enemy batteries in action are ordinarily carried out by airplanes of the Corps Squadrons but may be requested by Divisions of the Squadron and assigned to them.

Chapter VI. General Observation and Principles

43. The observation airplane is not designed for combat. It is charged not only with securing information *but with the duty of reporting on its observations*. Observation planes will avoid combat whenever possible, thereby increasing their chance of returning safely to report on information gained. They will avoid all danger from enemy aerial defenses whenever such action will not materially interfere with the accomplishment of the mission. In like manner the Command will carefully weigh the urgency of need for information against the risk involved in obtaining it. Where the risk overbalances the need the Air Service will not be called into action. It must be borne in mind that the Air Service is a costly, highly trained arm. Replacements of personnel and equipment are difficult and effectives must be husbanded in times of relative inactivity in order that maximum service may be counted on when greater need arises. Airplanes must never be utilized when balloons will give the results desired. As a means of liaison between the troops and the Command the Air Service should be called upon only when all other means fail or are virtually certain to fail. Never use aerial observation when terrestrial observation is sufficiently efficient. Local actions will never be deemed sufficient reason for ordering the accomplishment of contact patrols.

Chapter VII. Information

44. With the Air Service, as with all other Arms, intelligent and successful action is based upon accurate and complete tactical and technical information of the military situation. The Corps Air Service itself is fundamentally organized with the object in view of gathering information of the enemy for communication to the commands and Services concerned. The Air Service, on the other hand, is itself dependent upon outside sources for such information as will enable it to carry out its

functions in the most efficient manner. Collection and communication of information will constitute a prime preoccupation of Commanding Officers.

45. Information may be considered under two general heads, (a) Information of the Friendly Situation, (b) Information of the Enemy Situation. Information of the Friendly Situation includes (a) Situation on the ground, (b) Situation in the air, (c) Plans for future operations (1) on the ground (2) in the air, (d) Liaison plans. Information of the enemy ordinarily available includes, (a) Situation on the ground, (b) Situation in the air, (c) Plans for future operations.

46. Sources of Information of the Friendly Situation:

1. On the Ground—
Corps and Division Staffs, Commanders of Combat Units.
Field Orders: G–3, Army Corps, Division.
Daily Operations Orders: G–3, Army, Corps, Division.
Liaison Reports: G–3, Corps, Division.
Station Lists: G–3, Army, Corps, Division.
Situation Maps:
Artillery Command, Army, Corps, Division.
G–3: Army, Corps, Division.
Plans of Employment: Artillery, Corps, Division.
Observation Post Bulletins: G–3, Corps, Division.

2. In the Air—
Army and Corps Air Service Commands.
Neighboring Air Service Units.
Station Lists: Army Air Service.
Bulletins: Army Air Service.
Operations Reports: Army and Corps Air Service.
Operations Orders, Army Air Service.

3. Plans for Future Operations—
Field Orders: G–3, Army, Corps, Division.
Operations Orders: G–3, Army, Corps, Division.
Plans of Employment: Artillery, Army, Corps, Division.
Maps to Accompany Any Above: corresponding sources.
Air Service Plans: Air Service Command and Units.

4. Liaison Plans and Data—
Road Liaison: One-way Road Maps and Orders, G–1, Army Corps, Division.
Plans of Liaison to Accompany Field Orders:
Telephone.
Telegraph.
Visual Signals.
Rockets.
Panels.
Flares.
Projectors.
Radio.
Pigeons.
M.D.S.
Runner.
Airplane Dropping Grounds.
Fixed Regulations Governing All Forms Liaison: Confidential Pamphlet No. 2 (Revised) G.H.Q., A.E.F., June 1918, "*Liaison for All Arms*."
Fixed Regulations Governing the employment of Aerial Observation in Liaison With Artillery: Confidential Pamphlet No. 80 (Revised) G.H.Q., A.E.F., May 1918, "*Aerial Observation for Artillery*."
Means of Secret Liaison:
Codes: G–2, Corps.
Airplane Codes: Plan of Liaison and Fixed Regulations as Above.
Secret letter map coordinates: G–3, Corps.
Service Code: Chief Signal Officer, Corps.
Telephone Code Name Directory: Chief Signal Officer.

47. Sources of Information of the Enemy Situation:

1. On the Ground—
Field Orders: G–3.
Operations Orders: G–3.
Liaison Reports: G–3.
Observation Post Bulletins: G–2.
Summaries of Intelligence: G–2.
Interrogation of Prisoners: G–2.
Enemy Order of Battle Maps: G–2.
Aerial Photographs: G–2 and Air Service.
Air Service Reports:
Army Air Service.
Corps on Right.
Corps on Left.
Own Corps.
Balloon Observation Reports.

2. In the Air—
Enemy Airdrome Maps: G–2, Army (Thru A.A.S.C.)
Bulletins:
Army Air Service.
Corps on Right, Air Service of.
Corps on Left, Air Service of.
Operations Reports:
Army Air Service.
Air Service, Corps on Right & Left.
Neighboring Air Service Units.
Balloon Reports.
Liaison Reports: G–3.
O.P. Bulletins: G–2.
Summaries of Intelligence: G–2.
Interrogation of Prisoners: G–2.
Interrogation of Captured Aviators: Air Service, G–2.
Balloon Observation Reports.
Friendly Anti-Aircraft Artillery.
Observations of own Air Service Units.

3. Plans for Future Operations—
Summaries of Intelligence.
Interrogation of Prisoners.

48. Stress is laid upon the personal contact element in collecting information of every sort. Frequent conferences by Air Service Officers with other officers of the Aerial Army and with Staff and Unit Commanders of Corps and Divisions will often elicit special information, not available from other regular sources, which may be advantageously acted upon.

49. The Field Order embodies a résumé of the friendly and enemy situation and establishes the strategical and tactical plan of action which will be followed by the troops of Army, Corps, and Divisions over a considerable period. It includes annexes giving information regarding the activities of special arms and services. The general Plan for the employment of the Corps Air Service during the period of activity presumed is based upon the tactical provisions of the Field Order. The Field Order is communicated to the entire flying personnel of the Corps Air Service in order that pilots and observers may have a thorough understanding of, and take an intelligent interest in operations in which they are to participate.

50. The Daily Operations Order, G–3, embodies a résumé of the friendly and enemy situation at the close of the day and establishes the tactical plan of action for the following day. The activities of the Corps Air Service conform to the tactical demands for aerial cooperation with the troops as set forth day by day in the Corps Operations Order. The G–3 Operations Order is not necessarily, however, the sole basis for the planning of daily Air Service operations.

51. Liaison Reports, G–3, and Observation Post Bulletins, G–2, are hurried reports rushed from the forward areas by the most rapid means of liaison available. They ordinarily demand imme-

diate action, if any, by the Air Service. They form the basis for the ordering of specific missions, not for the formulation of extended plans of action. They frequently warn the Air Service of radical changes in the terrestrial or aerial situation requiring a reversal or readjustment of set plans, an intensification of general activity, or the adoption of additional precautionary measures. Their rapid transmission from the Office of the Corps Air Service Commander to the Group is at times of vital importance.

52. Station Lists and Situation Maps are the basis of personal liaison. They show the location of the units with which liaison is required.

53. The Plan of Employment of the Artillery is the basis of the plans for the accomplishment of Air Service artillery missions.

54. Accurate information of the strength and method of employment of neighboring friendly Air Service objectives, when checked against the reported aerial strength and aggressiveness of the enemy, permits an intelligent estimate of the lengths to which Corps Observation may be safely carried. Knowledge of the offensive and defensive Pursuit patrol schedule in the sector will permit the accomplishment of routine Corps Observation missions at those hours of the day when aerial support and protection is present on the lines. Dissemination of information regarding the operations of neighboring Observation Groups will promote interest and encourage emulation in the ranks of the flying and executive personnel.

55. Army Air Service Bulletins, Operations Reports, and Operations Orders contain information of enemy aerial strength, tactics, and equipment. Army Operations Orders ordinarily establish, by authority of the Army Air Service Commander, the broad tactical principles regulating the direction of Corps Air Service operations.

56. Personal liaison and courier runs are routed in accordance with one-way road regulations of Army, Corps, and Divisions, established in orders emanating from the G–1 Sections of various Staffs. Illustrative maps ordinarily accompany these orders.

57. The system of liaison established by the Corps Air Service is governed by the Corps Plan of Liaison and fixed regulations above noted. Secret messages are encoded and decoded by means of the codes and keys above noted. Headquarters are called by code name in accordance with the Code Telephone Directory prescribed by the C.S.O. Map coordinates are transmitted by a system of secret lettering prescribed by higher authority.

58. Possession of information of the enemy is a prime requisite to the intelligent direction of aerial operations, permitting concentration of observation on those points where the reaction of our own forces will be most effective, or on points whence enemy activity is apprehended and where such activity may be forestalled by appropriate dispositions based upon information furnished by the Air Service.

59. Information of our own or the enemy situation having its source in the Air Service is ordinarily communicated by the C.A.S.C. direct to the G–2 Section of the Corps Staff. G–2 is responsible for its transmission by the most rapid means of liaison available to those units concerned.

60. All information collected by officers of the Corps Air Service which has a bearing on the operations of the Air Services of neighboring or higher units is transmitted by the most rapid means of liaison available from Air Service to Air Service, without reference to G–2.

61. All tactical and technical information, whatever its nature, is of direct or indirect interest to all flying, technical, and executive commissioned personnel of the Air Service. Its rapid transmission and thorough dissemination is of prime importance.

Chapter VIII. Liaison

62. Effective Liaison involves the establishment of mutual understanding, rapid communication, and effective cooperation between the Air Service of the Corps, Air Services of other Corps, other branches of the Air Service, and other Branches and Arms of the Service to which the Corps Air Service stands in some tactical or technical relation. Information is gathered by means of Liaison.

63. Liaison cannot be carried too far. Its scope is limited only by the means possessed.

64. Liaison is carried out by the following means:

Frequent personal visits and conferences.

Permanent Air Service Liaison Officers stationed at important tactical centers of information.

Mechanical means of long-distance communication:

- Telephone
- Telegraph
- Radio
- Visual Signals

Motor Couriers
Airplane Couriers
Pigeons
Mounted Couriers
Runners

65. Liaison by personal contact, besides elicting information, promoted mutual understanding and sympathy between the Air Service and other Branches of the Service. It is useful in acquainting other Services with the possibilities and limitations of

military aviation. It forms the basis for the laying of specific plans, prescribing of methods, and establishment of means and methods of rapid communication. Within the Corps, personal liaison will be frequently affected to include down to Infantry Brigades and Artillery Batteries.

66. The permanent Liaison Officer is ordinarily posted with Division Headquarters and Corps Air Service Headquarters of the Corps on right and left. The permanent Liaison Officer at Division Headquarters is the representative of the Divisional Squadron and of the C.A.S.C. He collects and transmits, through the C.A.S.C., to the Group and Squadron, all tactical information available. He is in close touch with the Divisional Artillery Brigade Commander. He transmits, through the C.A.S.C., all requests for missions. He is the immediate advisor on Air Service matters of the Divisional Command and Staff. He is responsible to the C.A.S.C. for the establishment of a suitable airplane message Dropping Ground at Division Headquarters. He interprets, whenever necessary, dropped message and clears up obscurities.

67. Establishment of adequate mechnical means of long-distance communication is a duty of the C.A.S.C. He must always be furnished with a direct-line telephone circuit from his office to the office of the Group Commander. The running of telephone lines is a function of the Corps Signal Officer.

68. A special Air Service Motorcycle Courier connects the office of the C.A.S.C. with the Group. Orders, reports, bulletins, and routine administrative papers are transmitted by courier.

69. Carrier Pigeons, Airplanes, and Mounted Couriers are used as a means of liaison when other means fail. Runners are employed over short distances where road communication by motor dispatch is impracticable.

70. The Air Service system of liaison includes the establishments at Corps, Division, Brigade, Regimental, and Battalion Headquarters of suitable Dropping Grounds for the receipt of airplane written messages. Signal Officers are responsible for the establishment and maintenance of Dropping Grounds. The location of Dropping Grounds is ordinarily selected by an Air Service Offficer and, wherever possible, the Radio Station is established nearby. A detail of enlisted men is on duty at the Dropping Ground throughout the hours of daylight. The C.A.S.C. prepares a map showing locations of all Dropping Grounds in the Corps Area for the information of Pilots and observers of the Group. Distinctive panels, as prescribed in "Liaison for All Arms" (see chapter on Information) denote at the same time the locations of headquarters and the emplacements of Dropping Grounds. Dropping Ground panels are displayed by the detail on duty upon the call of the airplane. Calls are sent by signal rockets, short bursts of machine-gun fire, or radio.

71. Liaison includes the taking of any measures which serve to enlist the interest of troops in the work of the Air Service. Divisional Squadrons may display special distinctive insignia on the wings and fuselage of airplanes permitting troops to recognize planes of their own Division. The morale of troops in action is appreciably raised by the knowledge that "their own plane" is flying over them and assisting operations. Where troops constantly observe planes known to be of their own command in action a feeling of interest and camaraderie with the Air Service is developed. Cooperation of the troops during infantry contact patrols is a direct result. The dropping of newspapers and cigarettes from airplane to the troops in advance areas is likewise a means of liaison, promoting, as it

does, mutual confidence and sympathy. Visits by pilots and observers to advance positions and the front line during battle is a valuable means of promoting sympathy and understanding between the troops and the Air Service. In like manner visits from officers of combatant troops to the airdrome are encouraged. Line officers visiting the airdrome gain an intimate first-hand knowledge of the work and viewpoint of the Air Service and disseminate the information obtained upon return to their units.

72. The Corps or Division Commanders may utilize airplanes for communicating to their troops in advance areas. Orders and citations calculated to raise the morale of the forces engaged in battle may be mimeographed and dropped in quantity along the lines.

73. Airplanes communicate with the ground by radio and rocket signalling and by dropped message. Conventional rocket signals are fixed in Planes of Liaison of Armies, Corps, and Divisions. Secret Radio codes for use by airplanes are similarly prescribed. All airplane radio messages are in code.

74. Ground troops communicate with airplanes by means of signal panels, rockets, bengal flares, and electric projectors. Regulations governing the use of ground signals are published in Liaison Plans and the Pamphlet, "Liaison for All Arms."

Chapter IX. Security

75. The Chapter on Security of the Airdrome, Part I, applies in principle and detail to Corps Observation Stations.

76. During active operations over the lines, Corps Observation Planes are largely dependent for security upon the protection afforded by the Pursuit Effectives operating on the sector. Pursuit protection is of two sorts, (a) Extended Barrage, and, (b) Close Protection.

77. Pursuit barrage methods are prescribed by the Army Air Service Commander. Ordinarily formations of pursuit planes patrol the Army and Corps sectors at scheduled hours and for stated periods during each day. Certain formations are charged with the duty of clearing the air of enemy aircraft and protecting our own aircraft at low and medium altitudes. Other formations fly at higher altitudes and forbid the approaching of our lines by enemy aircraft. To assure the security of observation missions the Corps Air Service Commander prescribes the accomplishments of routine missions at those hours of the day when pursuit barrage is scheduled to operate. Close protection of Corps Observation Planes whose mission carries them deep into enemy territory is secured by personal arrangement between the Group Commanders of Corps and Pursuit Groups.

78. Where close protection from Pursuit Units is not available Corps Observation Planes detailed for deep-flying photographic or visual reconnaissance missions assure their own security and are dispatched in formations of varying numerical strength, the number of planes depending upon the reported strength and aggressiveness of enemy pursuit aviation in the sector.

79. Security of Corps Observation Planes flying within the friendly lines is further assured by the protection afforded from enemy pursuit by the Anti-aircraft Defenses of the Sector.

80. Lacking other protection the Corps Observation Plane is dependent for security upon its own armament.

81. Security decreases in direct proportion to the increase in altitude and distance from the friendly lines. Enemy pursuit

aviation rarely ventures into the friendly lines at an altitude of less than three thousand feet. Corps Planes observing from their own lines at low altitudes are relatively secure both from enemy aircraft and enemy artillery.

82. In conducting observation the intelligent Corps Observation team seek the maximum of security. Missions are carried out at the lowest altitudes and shortest flight ranges which permit of accurate observation. The enemy lines are ordinarily penetrated by the single plane only for short periods and after careful survey of the air. Repeated short sorties over enemy territory, although they prolong the total duration of the flight, decrease the danger of attack and are therefore preferable to a single extended flight at a distance from the friendly lines. Observation of Artillery fire, excepting at extreme ranges during hazy weather, can be accomplished by the experienced observer without crossing the enemy lines. Observation of artillery fire at long range is more easily accomplished from high than from low altitudes. For purposes of security it is preferable to fly high within the friendly lines than to fly low in the enemy lines, for the reason that, though the danger of encounter is increased, the plane, if attacked over its own territory, can resort to rapid manoeuvres while losing altitude and thus drop into security under cover of friendly ground machine-guns and artillery.

83. The use by observers of field-glasses is an added measure of security and is encouraged. The use of field-glasses permits accurate observation from a safe distance within the friendly lines and the rapid identification of distant airplanes. Long practice is required for the effective use of field-glasses. The ability to employ them is a rare and valuable asset among observers.

84. A sky completely overcast by even cloud strata affords added security. Sun-glare is eliminated and the area to be surveyed in watching for hostile aircraft is limited. The silhouettes of aircraft within the range of vision stand out sharply against the clouds. Broken cloud groupings decrease security. Scattered banks of clouds afford ambush to hostile pursuit. Broken cloud banks are never approached by the single plane where it is possible to avoid them.

Security from surprise attack is dependent upon the constant vigilance of pilot and observer and upon ability of airplane teams to distinguish enemy aircraft from friendly by the silhouette. Pamphlets showing the silhouettes of enemy and friendly types of planes are published by the Air Service Intelligence Section from time to time. These are made available to all flying personnel and are carefully studied and learned.

86. Security from enemy anti-aircraft artillery and machine-gun fire is afforded by effecting slight changes in course and altitude at short intervals. Where artillery fire is so dense as to assume the aspect of a barrage a long steep dive is resorted to, the dive being continued until the lowest bursts observed have passed overhead. The plane then climbs rapidly changing course at the same time.

Chapter X. Orders and Reports

87. The Corps Air Service Operations Order is based upon the tactical situation as set forth in information gathered by the C.A.S.C., through liaison channels. The Operations Order is issued by the C.A.S.C. at the close of each day and prescribes the general and specific lines of activity of the Observation Group for the following day. It contains:

a. Friendly tactical situation and plan.
b. Enemy tactical situation and presumed purposes.
c. General mission of the Corps Squadron.
d. General mission of the Divisional Squadrons.
e. Specific missions.
f. Special information affecting operations.
g. Any admonitions, advice, encouragement.

88. The Operations Order is forwarded to the Group by M.D.S. If there is doubt that it will arrive at Group Headquarters in ample time it is communicated in advance by telephone.

89. In preparing the Operations Order the C.A.S.C. will advise with the Corps Chief of Staff and the Assistant Chiefs of Staff, G–2 and G–3.

90. Distribution of the Operations Order:

Group Headquarters.
Army Air Service Commander.
C.A.S.C., Corps on right and left.
Corps C. of S.
Corps G–2 and G–3.
Commanding Generals, Divisions of own Corps.

91. Operations Reports are prepared for the C.A.S.C. by the Group Operations Officer under the supervision of the Group Commander. They contain a narrative of the salient features of each day's aerial operations. They contain a statistical tabulation of each day's operations, by squadron, showing number and kinds of flights accomplished; number of flying hours; number of photographs secured; number of forced landings; number of planes crashed; number of combats; number of casualties; planes and personnel available for the following day's operations. Totals for the entire Group follow squadron statistics. For distribution see Par. 90.

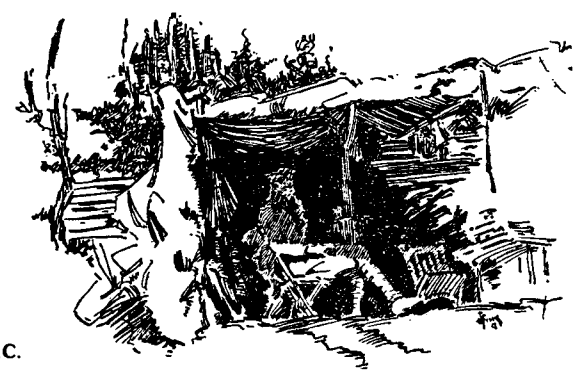
92. A written report of each visual reconnaissance mission accomplished is furnished by each observer (a) in a dropped message to the P.C. of the Division for which the flight is made, and to the Corps P.C. in every case, and (b) in a carefully detailed narrative, prepared after landing, under the supervision of the Group Operations Officer.

93. The dropped message report is complete but concise. Skeleton phrasing is permitted. All information secured, both positive and negative, dealing with the friendly and enemy situation, is included. The tendency of the inexperienced observer is to omit in the dropped message minor details of time and place. All details will be included, no matter how insignificant they may appear to the observer. Locations will be accurately described by coordinates or filled in on an attached map. The message, if dropped at the Corps P.C. by a Divisional Plane, will state in conclusion whether or not a similar message has been dropped at the Division, this in order to assure G–2 of the Corps that transmission of the information in the body of the message is or is not necessary. In preparing forms for the writing of dropped messages observers will duplicate, and thus save time, by the use of carbon paper firmly fixed between two or more message blanks, attached by means of rubber bands, thumb tacks, or tape, to a stiff backing. Photographic and artillery missions are not reported by dropped message. Their results are reported by telephone liaison from the Group.

94. The full narrative observer's report prepared at the Group tells the entire story of the mission, including information of route followed; visibility; and duration of flight; enemy road and railway activity observed; enemy aircraft observed; with description of types or silhouettes and distinctive markings; enemy balloons in ascension, giving location; enemy and friendly artillery activity, locations of enemy batteries in action; density and location of friendly and enemy shell observed; locations and activities of friendly and enemy troops; general aspect of enemy sector, carefully calling attention to any lack of activity where activity might have been expected; fires and explosions in friendly and enemy territory. Where conclusions are drawn they are carefully labelled as such and are not stated as absolute fact. Observers are encouraged to draw conclusions.

95. Inexperienced observers often omit the following essential data in reporting on missions:

Negative Information of Enemy Sector.
Exact time of observations.
Exact locations by coordinates.
Direction taken by Enemy Troops and Train movements.
Approximate strength of columns observed on roads.
Direction of flight of enemy aircraft.



An open-air P.C.

Careful supervision by Corps Air Service and Group Commanders and their Operations Officers is the sole means of training observers in the careful and complete preparation of reports.

96. Report of artillery adjustments is made by the observer at the Group. The usual flight narrative describing general conditions under which the flight was accomplished is followed by a report of number of rounds fired and number of bursts observed and by an estimate of the result obtained. Failures are carefully reported, stating reasons.

97. The photographic reconnaissance report includes the usual narrative with a statement of number of plates exposed and estimate of area covered. Failures and reasons thereof are reported.

98. Report of encounters and combats with enemy aircraft is made, by pilot and observer in conference, on a special Combat Report Form prescribed by the Army Air Service Commander. Report includes narrative of the incidents of combat; states the approximate number of rounds fired by the pilot and observer; states effect of fire on the enemy and effect of enemy fire. Time, locality, and altitude are carefully noted. Number and type of enemy planes encountered, a description of their characteristic markings, and comments on the tactics employed are embodied in the report.

99. The Observer's Report is the sum and substance of Air Service Information. Its contents are transmitted to all concerned by the most rapid means of liaison available.

100. General principles governing the composition and issuance of Orders and Reports for the Army promulgated in Field Service Regulations apply to Orders and Reports of the Air Service.

Chapter XI. Marches and Convoys

101. The principles governing the conduct and regulation of Marches and Convoys for all Air Service units and Groupings are treated in Chapter V, Part I of this Manual.

102. The Corps Air Service Commander and his Staff move with Corps Headquarters.

Chapter XII. Participation in Combat Observation

103. During the inactive periods in trench or stabilized warfare the Air Service of the Corps is charged with the following missions:

a. To photograph to a depth of ten kilometers the enemy's position.

b. To locate by the flash the exact emplacements of enemy batteries.

c. To adjust the fire of our own artillery on sensitive points and calibrate our guns.

d. To maintain surveillance of the enemy and assure protection of increased activity indicating preparation for hostile attack.

104. During a friendly offensive the Air Service of the Corps is charged with the following missions:

a, b, and c, as in paragraph 103.

d. To maintain surveillance of the enemy at low altitudes, reporting on concentrations of troops for local stands and reactions.

e. To observe enemy road movements for indications of the bringing up of extensive reinforcements.

f. To find and report to the Command and the artillery the location of the friendly front lines by means of low-flying infantry contact patrols.

g. To control the friendly barrage.

h. To seek and report on all indications of a general enemy retreat.

i. To seek fugitive targets, i.e. massed enemy troops, convoys on roads, and to adjust rapid zone fire on such targets.

105. During a general retreat of the enemy and pursuit by friendly forces the Air Service of the Corps is charged with the following missions:

a. To seek and report on the location of the enemy's rear guard, notifying the heads of the friendly pursuing columns as well as the Command.

b. To discover the enemy's main axes of withdrawal.

c. To report on the position of the friendly advance elements at frequent intervals.

d. To report to the heads of friendly pursuing columns any concentration of enemy troops for local stands or reactions.

e. To discover the enemy's main line of resistance.

f. To photograph the enemy's main line of resistance.

106. During an enemy offensive met by stubborn friendly resistance the Air Service of the Corps is charged with the following missions:

a, b, c, as in paragraph 103.

d. To maintain constant low-flying surveillance of the enemy and report in advance his preparation for each successive effort to break through the friendly lines.

e. To observe enemy road movement for indications of the bringing up of extensive reinforcements.

f. To locate enemy cantonments, camps, dumps, axial roads, and other suitable targets for the destructive and harrassing fire of the friendly artillery.

g. To find and report to the Command and Artillery the location of the friendly front line during and after each enemy effort to break through.

h. To control the friendly barrage.

i. To adjust rapid zone fire on fugitive targets and concentrations of enemy troops preparing for assault on the friendly positions.

106. During a general friendly retreat and pursuit by hostile forces the Air Service of the Corps is charged with the following missions:

a. To report on the position of the friendly rear guard and the general road aspect of the friendly retreat.

b. To report to the friendly rear guard and to the Command the position of the advance guard and main body of the pursuing hostile forces.

c. To effect liaison between the Command and the right and left flanks.

107. Under all conditions the Corps Air Service holds one, two, or three airplanes at the disposal of the Corps Commander for the accomplishment of special missions demanded by developments in the tactical situation.

108. Photographic missions are requested as need arises by G–2, G–3, or the Artillery Command. During stable trench warfare tactical maps are based on data furnished by Corps and Army aerial photographs of the enemy's territory. Photographs during war of movement are of little value in studying the enemy organization but serve to acquaint the Command with details of terrain. Oblique photographs of the enemy's front-line defenses in either stable or open warfare are extremely useful. They are distributed down to include commanders of infantry platoons and serve to acquaint the Command and troops with the nature of the terrain and

defenses immediately confronting them. During stable trench warfare photographic missions are a matter of daily routine to be accomplished by the Corps Air Service upon every day of favorable weather. During open warfare photographic missions are only occasional and are requested to clear up map obscurities or most other specific demands for information. The preparation of the photographic mission involves communication to pilot and observer, by C.A.S.C., of the limits of territory to be covered. The work is carried out by formations. The usual altitude from which Corps photographs are secured is 3000 meters. It is sometimes impracticable to send formations of planes on photographic missions. In this case the mission is carried out by a single plane flying at great altitude, 5000 to 5500 meters. The security of the plane is increased by its inconspicuousness at extreme altitudes and the rapidity with which it can cover an extended area from great heights. In the case of certain types of planes (examples of which are the French Salmson and Breguet) which retain their qualities of speed, climb, and manoeuverability at extreme altitudes, security is further afforded by the ability of the plane, relying on its qualities of speed and climb, to out-distance attacking enemy pursuit. During periods of unsettled weather photographic missions are ready to take the air from early morning. Instant advantage is taken of any break in the clouds. Under these conditions Pursuit protection will not be counted upon owing to the loss of time involved in meeting the protection at the rendezvous. During midsummer, sunlight is sufficient for the securing of photographs between 8 and 16 o'clock. Photographic missions during the spring and autumn months are ordinarily executed between 10 and 14 o'clock. In winter good photographs are secured only between 11:30 and 12:30 o'clock.

109. Location of enemy batteries in action by the flash is a routine mission of Corps Observation Units during all situations excepting that of general friendly retreat. Battery flashes are best observed just after day-break and just before night-fall. They are rarely picked up, even by the vigilant observer, in broad daylight. Where it is known or suspected that a concentration of enemy batteries has been effected within certain specific limits bounding a very restricted area a single reconnaissance plane charged with the sole mission of locating exactly the flashes of batteries in that area will ordinarily meet with success. Surveillance planes searching the sector for miscellaneous information are only moderately effective in locating batteries. The plane seeking to locate batteries in action should fly at the lowest altitude permitting observation and should remain as far behind the friendly lines as the work will permit. Once the plane's presence is detected by the enemy, batteries will ordinarily cease fire. Information of enemy batteries in action is communicated to the Divisional and Corps Commands immediately by radio and later confirmed by dropped message. Enemy batteries in action may be effectively counter-batteried by the assistance of the airplane reporting them. For this purpose the artillery assigns suitable counter-batteries. Liaison with these batteries is then effected. When

arrangements are completed between the batteries and the Air Service the counter-batteries are prepared to receive radio calls from all planes of the Corps during the hours of daylight and to adjust fire on targets reported, without delay. It is a function of the C.A.S.C. to assure wherever possible the assignment of such counter-batteries and to provide for adequate liaison in order that the minimum of failures may result. Counter-batteries thus arranged for become, during active periods, fugitive-target batteries. Theoretically, all batteries are ready to receive airplane calls and adjust at all times. Practically, better results are obtained by assigning only a few batteries for this type of work and carefully perfecting liaison arrangements. All Corps and Divisional observers are supplied with the necessary information for calling counter-batteries and conducting adjustments, in accordance with the arrangements effected.

110. Detailed instructions for adjustment of artillery fire by means of airplane observation are contained in Confidential Pamphlet No. 80 (Revised) G.H.Q., A.E.F., May 1918, "Aerial Observation for Artillery": Successful adjustment of artillery is largely dependent upon carefully accomplished liaison. The best work is achieved after a visit by the observer to the battery with which he is to conduct fire. The adjustment should be arranged by conference between the observer and the battery commander, details of method, time, panel and radio signaling, being thoroughly discussed and a complete understanding and agreement reached. Before leaving on the mission the observer notifies the battery by telephone or radio that he is about to start. In preparing the mission the observer equips himself with a large-scale map bearing coordinates in secret letters and showing the location of the target. If an aerial photograph of the target is available this will be attached to the map, properly oriented and squared off to scale. The photograph renders exact location of bursts observed extremely easy. Batteries which do not respond to the radio call of the plane may be called by dropped message. In like manner batteries whose calls are not known to the observer may be notified that an adjustment is required and all necessary data for opening fire and establishing radio liaison may be included in the written message. The battery replies by panel signals whether or not the work requested can be undertaken and what method of fire will be used (see "Aerial Observation for Artillery"). Liaison between the airplane and artillery is at all times complex and difficult of perfection. The conditions governing its effective establishment change with the tactical situation and cannot be laid down by any rule which will cover all cases. Corps Air Service Commanders will be called upon to use great energy and ingenuity in assuring effective cooperation between the Air Service and the

Artillery. This will be particularly true during active periods in war of movement.

111. Surveillance of the enemy is a routine mission of Corps and Divisional Squadrons during all tactical situations. The Corps Squadron patrols the entire Corps Front reporting on the general activity of the entire sector to a depth varying from five to ten kilometers. The Divisional Squadron patrols within the boundaries of the Divisional Sector reporting in detail on all activity observed. Effective sector surveillance implies an accurate knowledge of the terrain by the observer. The observer should be familiar with the latest information on the tactical situation in order to concentrate his attention on those points which are of most interest to the Command. Sector reconnaissances are increased in frequency as combat activity or preparation for activity increases. During actual offensive or defensive operations they may overlap, establishing an unbroken watch on the movements of the enemy. Surveillance planes are fitted with radio equipment and are prepared to call the artillery into action whenever need arises.

112. Control of the friendly barrage may be advantageously conducted by airplane. Where the barrage extends across the entire Corps front and is participated in by both Corps and Divisional Artillery, the Corps Artillery is observed by a plane from the Corps Squadron; the Divisional Artillery is observed by planes from the Divisional Squadrons. Observers controlling barrages are provided in advance with maps showing the barrage schedule, minute by minute. Control consists in reporting by radio to the Corps and Divisional Artillery Brigade Headquarters any failure of the barrage to play accurately and on schedule time, giving approx-

imate location, density, and caliber of bursts observed to be inaccurately placed or off schedule. Close adjustment of the barrage is not undertaken.

113. The general principles and specific regulations governing the conduct of infantry contact patrols for the purpose of staking the friendly front line are established in "Liaison for All Arms." The contact patrol is a mission of the Divisional Squadron. The contact patrol is most effectively carried out at an altitude ranging between 25 and 100 meters. Troops frequently disregard the call of the plane to display panels. From these altitudes troops can be plainly distinguished and identified by the color of the uniform. Where troops do not show panels observers will not report the location of the "front line." They will report the location of the "most advanced friendly elements observed." The Infantry panel is the only guarantee of the exact location of the front line. Where troops are seen but no panels are displayed upon the call of the plane, there is room to suppose the actual front line is still further advanced. Even though the observer can locate no friendly troops beyond a certain point he will not report the location of the "front line" until panels are shown. The infantry contact plane will never proceed directly from the airdrome to the point which the advance of the friendly troops is presumed, by schedule, to have reached. It will proceed to that point where the most advanced elements were last definitely reported. Having reached this point the plane will assure itself by observation of movement of troops on the ground that the advance has continued. It will then gradually extend its observations farther and farther to the front, working back and forth across the sector, until the observer can distinguish no friendly troops beyond. The line is called at this point. If no panels are shown the plane will carry observations somewhat deeper but with extreme caution. When satisfied that the limit of the friendly advance has been reached and noted the observer will immediately report to Division and Corps Headquarters by dropped message. The contact patrol observer will bear always in mind the possibility of enemy counter-attacks and will constantly watch for enemy troop concentrations. Where counter-attacks appear imminent the observer will drop a message to that effect to the front line elements most nearly concerned. He will then call the fugitive target battery and adjust neutralizing zone fire over the terrain where concentration has been observed. Contact patrols frequently locate enemy machine-gun nests. Where hostile machine-guns are observed the front line troops are notified of the danger by dropped message. Contact patrol planes may assist the advance of friendly troops by opening fire on enemy machine-guns, silencing them until they can be captured.

114. In directing the operations of the Air Service the C.A.S.C. maintains liaison with the Corps and Divisional Balloons. He is assisted in this function by the Corps Balloon Group Commander. The C.A.S.C. will assure himself at all times that

Observer watching infantry movements below.

airplane missions do not duplicate the work accomplished, or in course, by the Balloons. He will establish as a principle that work which Balloons can accomplish will not be undertaken by airplanes. This will usually apply to the accomplishment of artillery missions. Certain areas in enemy territory are obscured to Balloon Observers by inequalities in the terrain. The areas not defiladed by the Balloons decrease in number and extent with the increase in altitude. Those areas closed to Balloon Observation at varying altitudes will be sketched in on a map for the use of the Corps Air Service and Group Commanders in determining what missions properly fall within the province of the Balloons during varying conditions of visibility. A copy of the Balloon defilade map is posted for the information of flying personnel in the Group Operations Room.

Chapter XIII. Shelter

115. The principles governing shelter of troops in the field, established in Army Field Service Regulations, apply to the troops of the Corps Air Service.

Army Observation

Introduction

116. The Army Observation units function as an organ of the high command. They are placed at the disposal of the General Staff of the Army and their activities conform to the orders issued by the General Staff. The Chief function of the Army Observation units is to keep under constant surveillance the dispositions and movements of enemy forces. This consists of the reconnaissance, both visual and photographic, in depth, of the entire Army sector. Their prime object being the gathering of information, it is necessary that they operate in spite of enemy aerial opposition. However, engaging the enemy's air forces in combat must be avoided as far as possible except when the nature of the mission demands and the chances of gain are commensurate with the risk involved.

Chapter XIV. Information

117. Information of the enemy and our ground forces is essential to the proper tactical operation of any observation unit whether it be an independent squadron, a group, or a larger organization.

118. The collection, preparation, and circulation to the smaller units of the command of this information is the duty of the Army Air Service Commander. Every Commander of a large unit, wing, or group will see that all essential information which he receives is circulated to the component elements of his command. It is the duty of all Commanders at all times to act on the principle that the collection of information without its circulation is useless. Information properly circulated to Observation Units has an important moral effect upon the flying personnel. It is to be remembered that except when actually in the air, aviators are removed from the sights and sounds of the battlefield and only by a thorough information system can the various possibilities of the military situation be brought home to them. Unless these possibilities are made clear it is impossible to obtain the maximum efforts from the personnel.

119. The Operations Officers of the various units (separate squadron, group, or wing) are responsible for the supply of

their respective units with:

(a) Maps of 1/20,000 scale covering the entire sector. This map should be colored so that the prominent topographical features are easily referred to.

(b) Maps of 1/50,000 scale covering the entire sector for use by observers. It is of paramount importance that these maps be colored so as to make reference easier.

x (c) Maps of 1/20,000 scale covering the entire sector showing, by means of conventional symbols, all the important artillery objectives. These maps are printed at frequent periodic intervals by the second section of the General Staff (G–2).

(d) Maps of 1/200,000 scale covering the entire sector for use by pilots and observers.

x (e) Maps showing the organization and occupation of the sector by ground troops. This map shows the location of the different friendly divisions in line.

(f) Daily enemy Order of Battle map showing the location, both known and probable, of all enemy divisions both in line and reserve.

x (g) A map showing the location of all known enemy airdromes. This map should indicate, by conventional symbol, whether the airdrome is occupied or unoccupied.

x (h) A map showing the location of all enemy balloons.

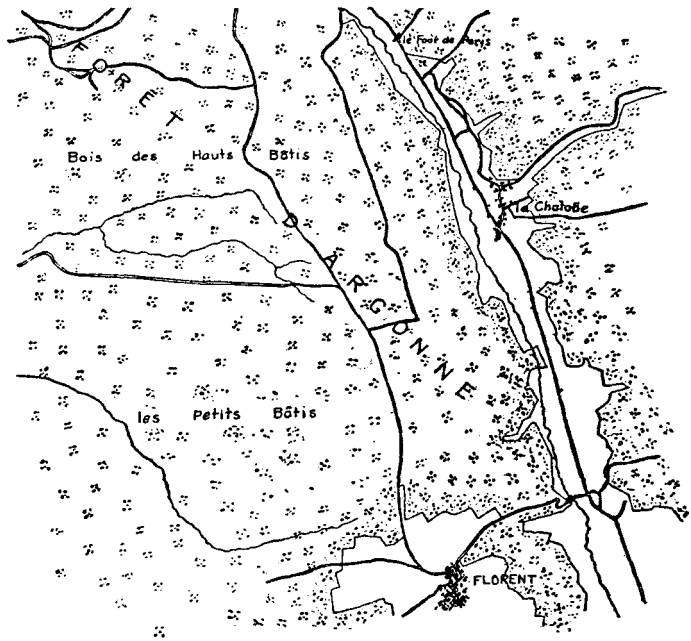
x (i) A map showing the precise location of all the known enemy antiaircraft batteries and their calibre.

(j) A map showing the enemy areas that are defiladed from the different friendly balloons. This is valuable in that the Aeroplane observers can pay particular attention to those areas that are protected from observation by balloons.

x (k) A map showing enemy's system of railroads and the railheads.

x (l) A map showing the main roads over which traffic is heaviest. These are indispensable to observers so as to know beforehand where to look for traffic.

(m) A map showing the location of all friendly airdromes in the sector of the Army Air Service Commander. The pilots and observers should be familiar with the location of all these airdromes so that in case of a forced landing if they should become lost the breaking of a plane might be avoided.



x (n) Silhouettes, photographs, and tables of performance of all known types of enemy airplanes will be prepared or secured. These are essentials and must be studied carefully by the flying personnel.

(o) Charts showing the lighting systems of enemy airdromes and signals for planes at night.

(p) All photographs available of the enemy airdromes, dumps, towns, etc. It is well to arrange these in alphabetical order in books so that easy reference can be made to them and when new photographs are taken they can be compared. Also, it is necessary that these be at all times kept at the disposal of the pilots and observers for study, as it enables them to recognize them when flying over enemy territory. Stereoscopic views of all these points should be prepared and placed at the disposal of the pilots and observers for study.

Items marked x are prepared and distributed at frequent periodic intervals.

120. Charts, diagrams, and maps should be supplemented by:

(a) Army Summaries of Intelligence, prepared by the second section of the General Staff (G–2). It is of paramount importance that these be supplied to the squadrons and there be at the disposal of the pilots and observers as it is difficult to prevent these officers from suffering a feeling of the other arms of the service unless these summaries are furnished to them.

(b) Air Service summaries of Intelligence will be prepared in the Headquarters of the Army Air Service Commander to supplement the Army Summaries of Intelligence. These should cover all subjects relating to the enemy Air Service and especially deal with the types of planes and of using them as learned from all different sources, such as: reports from agents, statements of prisoners and captured orders and documents of all sorts.

(c) The Army Air Service Operations Orders prepared in the Headquarters of the Army Air Service Commander, showing the activities of all Air Service Units under his command.

(d) All available documents and pamphlets concerning the enemy's forces, paying particular attention to the information concerning the enemy's aerial forces.

It is one of the duties of the Operations Officer of all observation units to attend to the details of the circulation of information within the command. It is imperative that the observations and experiences over the lines of every pilot and observer be made accessible to every other pilot and observer in the organization in the most inviting manner, without delay.

Chapter XV. Liaison

121. Owing to the absolute necessity for cooperation between the various Air Service units under the command of the Army Air Service Commander, and also the various arms of the Service, great importance must be attached to the preparation of means of communication for receiving and transmitting information and orders. A rapid and complete comprehension of the entire situation has decided influence upon the success of the operations. For mutual comprehension of plans, possibilities, and limitations nothing can be substituted for personal contact.

122. The exchange of personal visits between pilots and observers and officers of other arms stationed nearer to the front will be encouraged as much as possible. All Air Service Commanders in the field will exchange personal visits with officers of corresponding rank and will see that their subordinates of all ranks come into close personal contact with officers of corresponding rank in the divisions in the line and in reserve, in the anti-aircraft artillery, both machine-gunners and heavier gunners, in Field and Heavy Artillery, with balloon observers and all other Air Service units, both bombardment and pursuit as well as observation.

123. In order that a maximum return may be assured from the observation units, it is necessary

that the best possible means of communication be established, as follows:

(a) By direct telephonic installations to the Headquarters of the Army Air Service Commander.

(b) By telephonic liaison with all the Air Service Units under the command of the Army Air Service Commander.

(c) By liaison by radio with the station established at Headquarters, Army Air Service Commander.

(d) By dropping messages from aeroplanes on the dropping ground established near the Headquarters Army Air Service Commander.

124. Liaison by aircraft is still to be developed as a means of reporting promptly the information obtained concerning the progress of the battle but with the development of wireless telephones for communication between planes and between planes and the ground the utilization of aircraft as a means of communication will be more and more emphasized.

125. Every observation group will be equipped with sufficient supply of telephones and wire to insure the establishment of its internal liaison, the Group Operations Officer and Headquarters being directly connected with the several squadron Headquarters and Operations Offices. The establishment of telephonic liaison from the Wing Headquarters to the Group Headquarters and from the Headquarters of the Army Air Service Commander to the Wings and separate groups of his command is the duty of the Army Air Service Commander. He will arrange with the Chief Signal Officer of the Army in the field for the installation of these telephone lines before ordering those units to their new stations.

126. In order to insure close cooperation between pursuit and observation planes while in the air it is necessary for the Group Operations Officer of the Observation Group to inform the Operations Officer of the Pursuit Groups as to the time of departure of the missions, the number of planes in the formation, the altitude at which they are going to work, the probable time of crossing and recrossing the lines and the route to be covered in order that the pursuit patrols separating over the same area at the same time may be notified and pay particular attention to the safety of these formations.

127. The Operations Officers of the various units are responsible for the interrogation of all pilots and observers immediately upon their return from missions and for securing a full, accurate and intelligible report of all observations of interest to the General Staff. This report should be transmitted by him by telephone, if possible, direct to the Headquarters of the Army Air Service Commander.

Chapter XVI. Combat

General Principles

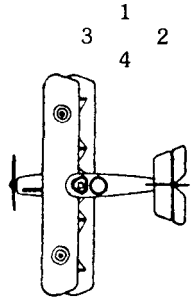
128. The object of tactics, as employed by Army Observation planes, is to avoid combat with enemy planes, to allow the observers to obtain the desired information and return to the airdrome with it. The Army Observation planes do not accept combat otherwise than as a defensive measure. Definite tactics to be employed by formations of biplace observation planes have not been adopted. It depends entirely upon the ability and initiative of the Flight Commander, the pilots comprising the flight and the conditions. Owing to the fact that the Army Observation unit operates far beyond the line of friendly pursuit patrols, it is necessary that they depend largely upon their own means of defense. However, even though formations of biplace observation planes are employed the co-operation between pursuit patrols and observation informations when the latter are operating within range of the pursuit patrols should be as close as possible. The numerical strength of a formation depends entirely upon the depth to which it must penetrate the enemy's territory and the known aggressiveness and numerical strength of the enemy's air forces. Missions must never be attempted by individual planes except when the weather conditions are such that formations flying is rendered impossible.

Formations

129. During the hours of daylight, the weather conditions permitting, the missions assigned to the Army Observations Squadrons will invariably be carried out by formations. These formations should not be too large. A formation of 4 planes, flying in diamond formation, has been found very effective as it is easily controlled by the leader and it is very flexible. All formations must have the following characteristics:

(a) Simplicity.
(b) Manoeuverability.
(c) No dead angles.
(d) Concentration of fire to the rear.
(e) Compactness.
(f) Each pilot must be able to see the leader.

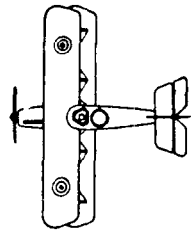
130. Airplanes in formation are numbered as follows:

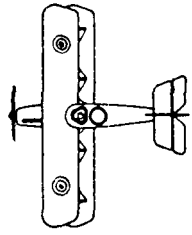


3. The copy contains a typographical error, a parenthesis for what evidently was to be a second digit. This perhaps was a zero, but *Circular* 76, p 29, gives 25, which fits with the other distances in the formation.

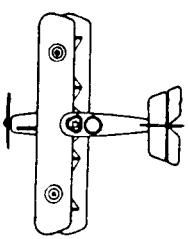
Number 1 is the leader and flies at the lowest altitude, numbers 2 and 3 fly at the same altitude, about 25 meters higher, 25 meters to the rear, and 25 meters to the right and left, of number 1, respectively, while number 4 closes the diamond, as it were, flying about 25 [?] meters[3] above numbers 2 and 3 and about 25 meters behind, keeping directly behind number 1.

131. In the event that the formation is attacked, the formation must be kept as compact as possible. The maximum security will





be maintained by keeping the closest possible formation—15 to 20 meters between planes. In this manner the blind angles of one plane are covered by the other planes of the formation, thereby preventing the enemy planes from closing in to short ranges without exposure to concentrations of fire from the different planes. The usual tactics employed by the enemy pursuit planes against formations of biplace planes is to remain at long ranges and firing short bursts to confuse the pilots and observers so that they will break up the formation. It is fatal for any plane to become detached from its formation as it will then be subjected to the concentrated efforts of the enemy pursuit pilots and will be easy prey for them.



132. In order that there be mutual understanding between the pilots and observers of the flight it is necessary that they know the following:

(a) The various signals for communication between planes.

(b) The mission to be accomplished.

(c) The territory to be covered.

(d) The altitude at which they will fly.

(e) Their relative positions in the formations.

133. The Flight Commander being responsible for the tactical employment of the formation while in the air must take all necessary precautions to prevent the formation from being surprised by enemy planes. He will pay particular attention to the sun and to the clouds that are above the level of the formation, behind which enemy planes may be lurking.

Single Planes

134. Missions are carried out by single planes only when the atmospheric conditions such as low hanging clouds and mist prevent the employment of formations, and the early reconnaissance, when darkness forbids the employment of formations. When single planes are operating under or above the clouds it is an easy matter for the plane to enter the clouds, which afford excellent protection, in the event of being attacked by enemy planes. However, operating at such low altitudes, far beyond the enemy lines, under and in the clouds, requires the employment of pilots and observers of exceptional ability. They must know:

(a) The terrain, thoroughly.

(b) The direction and speed of the wind at the different altitudes.

(c) How to navigate, in the clouds, by compass.

Part III. Pursuit

Introduction

1. Pursuit Aviation has for its object the destruction of the enemy air service and the protection of our own observation aviation. When opportunity offers it will take part in the battle on the ground, inflicting maximum casualties upon and weakening the morale of the enemy's ground troops. Whatever later developments may appear, up to the present time the basis of the Air Service has proved to be that portion devoted to observation. But observation aviation's very existence depends upon a powerful, well trained and aggressive pursuit aviation. That our own observation airplanes and balloons may be [protected] and may feel and see that they are protected, while the enemy's observation aviation is destroyed and driven back from the line of battle, pursuit aviation is employed.

Chapter I. Information

2. Information of the enemy and our ground forces is essential to the proper tactical operation of any pursuit unit, whether it be a separate flight, an independent squadron, a group or a larger organization.

3. The collection, preparation and circulation to the smaller units of the command of this information is the duty of the Army Air Service Commander. Every Commander of a large unit, wing or group, will see that all essential information which he receives is circulated to the component elements of his command. It is the duty of all commanders at all times to act on the principle that the collection of information without its circulation is useless. Information properly circulated to Pursuit Units has an important moral effect upon the combatant personnel. It is to be remembered that except when actually in the air aviators are removed from the sights and sounds of the battlefield and only by a thorough information system can the various possibilities of the military situation be brought home to them. Unless these possibilities are made clear it is impossible to obtain the maximum efforts from the pilots.

4. Every Wing, Group and Squadron Headquarters, including the Headquarters of the squadrons which comprise the Groups and Wings under his command, will be supplied by the Army Air Service Commander with:

(a) A map giving the location of all enemy airdromes. This map should indicate by symbols whether or not the airdromes are occupied and should bear upon its face an easily read key so that the quality and kind of enemy air service can be taken in at a glance.

(b) A map showing the precise location of all enemy anti-aircraft artillery units, showing their kind. This map and all others should be issued at frequent periodic intervals and never allowed to get out of date.

(c) A map showing the locations, both known and probable, of all enemy divisions both in line and in reserve. This map will be prepared by the Second Section of the General Staff (G–2) and its circulation down to Groups and independent squadrons is important on account of its moral effect in bringing the flying personnel into touch with the military situation.

(d) Silhouettes and photographs of all known types of enemy airplanes will be prepared or secured by the Army Air Service Commander. These should be in such form that they can be pasted or tacked on bulletin boards. They cannot be too profusely circulated and can be posted to advantage in all officer's messes and in their quarters.

(e) A map showing the location of all airdromes in the sector of the Army Air Service Commander, the Corps and Divisional sector boundaries of all units in line, the location of our antiaircraft units, balloons and other Air Service organization.

(f) A diagram or chart of telephonic liaisions within the Army area.

5. The charts, diagrams and maps should be supplemented by:

(a) Army Summaries of Intelligence, prepared by G–2. It is of the utmost importance that these be circulated down to include Groups and whenever possible should be circulated to include squadrons as it is difficult to prevent the pilots from suffering a feeling of detachment and isolation from the operations of the other combatant arms unless these summaries are furnished to them.

(b) Air Service summaries of Intelligence will be prepared in the Headquarters of the Army Air Service Commander to supplement the Army Summaries of Intelligence. These should cover all subjects relating to the enemy air service and especially deal with the types and quantities of his airplanes and his methods of using them as learned from prisoners, captured orders and documents of all sorts.

It is one of the duties of the Operations Officer of all pursuit units, under the Commanding Officer, to attend to the details of the circulation of information within the command. It is imperative that the observations and experience over the lines of every patrol leader and every pilot be made accessible to every other pilot in the organization without delay.

Chapter II. Liaison

6. Owing to the rapidity of movement of pursuit airplanes and the influence that they can exercise both in the battle for supremacy of the air and the fighting on the ground, great importance must attach to the preparation of means of communications for the transmission of information and orders. A rapid comprehension of the entire situation has a decided influence upon the success of the operations.

7. For mutual comprehension of plans, difficulties and limitations nothing can be substituted for personal contact. The exchange of personal visits between Air Service pilots and all elements stationed closer to the front will be encouraged as much as possible. All Air Service Commanders in the field will exchange personal visits and will see that their subordinates of all ranks come into close personal contact with officers of corresponding ranks in the Headquarters and the Divisions in line and in reserve, in the antiaircraft artillery, both machine-gunners and heavier gunners, with balloon observers and with all air service units, both bombardment and observation as well as pursuit.

8. In order that a maximum return may be secured from our pursuit aviation, and in order that the enemy may not throw an overmastering force of pursuit airplanes on the line at certain hours of the day, it is all important that close liaison be maintained with the front at all times. This liaison should be perfected so that every Group Commander can be informed without delay of the number, type, altitude and direction of flight of all enemy airplanes and formations approaching our front lines in the sector for which his group is responsible. This liaison may be established:

(a) By direct telephonic installations to forward observing posts established at intervals on or near the front lines, in charge of Air Service officers.

(b) By telephonic liaison with the anti-aircraft artillery observation posts. Messages relative to enemy aircraft activity from the anti-aircraft artillery to a pursuit group should have priority over the army telephone lines, because Air Service Units practically alone can be utilized to influence an action in progress.

(c) By liaison by wire with the radio-goniometric[4] stations.

(d) By liaison by radio either with forward observing posts established by the Air Service or with radio equipped forward observing posts of the anti-aircraft artillery.

9. Liaison by aircraft is still to be developed as a means of reporting promptly upon the progress of fighting in the air. With the prospective development of wireless telephones for communication between formations and between airplanes and the ground the utilization of aircraft as a means of communication will be more and more emphasized.

10. In addition to immediate reports upon the number, type, altitude and direction of flight of enemy airplanes, daily reports should be made to the Group Commander upon the size, altitude and methods of operation of all elements of the enemy air service. These reports must be prepared by Air Service officers detailed by their Group Commanders to keep watch from the ground upon the enemy air service from advance observation posts.

11. Every Pursuit Group will be equipped with a sufficient supply of telephones and wire to insure the establishment of its internal liaisons, the Group Operations office and the several squadron operations offices being directly connected. The establishment of telephonic liaison from the Wing Headquarters to the Groups and from the Headquarters of the Army Air Service Commander to the Wings and independent Groups of his command is the duty of the Army Air Service Commander. He will arrange with the Chief Signal Officer of the Army in the field for the installation of these telephone lines before ordering these several Headquarters to new stations.

12. In order that our pursuit aviation may make safe the work of our observation aviation, close liaison must be maintained with all elements of the observation air service, and the pursuit group commander should have at all times as complete a knowledge as possible of the number, altitude and route of all observation airplanes working in the sector for which his group is responsible. This liaison will also be helpful in keeping track of the movement of our advanced infantry and cavalry elements and in the selection of targets for ground straffing.

4. Direction finding.

13. While the prime duty of pursuit aviation is fighting in the air, pursuit pilots will occasionally be called upon for special reconnaissances and will make valuable observations from time to time in the course of their patrols. This will not be allowed to interfere with their combatant operations.

14. The squadron operations officers are responsible for the interrogation of all pilots upon their return from flights and for securing a full accurate and intelligible report of all observations of interest to the higher command. This report should be submitted immediately by telephone, if possible, through channels to the Army Air Service Commander, who will transmit it to the Second Section, General Staff (G–2).

Chapter III. Combat

I. *General Principles:*[5]

5. The guiding principle in Pursuit Tactics is to seek out and destroy enemy airplanes. Contact is made with the enemy by chains of formations, formations and by individual machines. Before passing on to study the tactics used by each, it is to be remembered that the primary object of the aerial force working with an Army is to keep the enemy under observation. It performs what was once the chief function of the Cavalry, and preventing the enemy observing our dispositions and maneuvers, seeks to keep him under surveillance at all times. The eyes of the Air Service are observation airplanes and balloons. But the arms and weapons are the pursuit airplanes and without the latter two-seaters would be blinded by the enemy air forces to such an extent that their missions would fail and they would have to resort to fighting tactics.

6. The pursuit elements of the Air Service have as their prime function to keep an area equal in depth to the distance over the enemy lines which is allotted to the Corps and Divisional Observation squadrons clear of enemy machines. In other words the aerial front line must be maintained, at minimum, as much in advance of the line of battle on the ground as the range of the Corps Artillery. Pursuit machines, therefore, specialize on the fighting, and of necessity have to adopt certain tactics, varying with the type of machine used, with the activity of the sector and with the altitude at which they are working, but certain principles are universally applicable.

7. The flight formation, limited in size by the number of machines that can be maneuvered by a single leader, at present five or six, is the tactical unit of pursuit aviation. When more than one flight is to be used for any given purpose, emphasis is to be laid upon the value, from the point of view of esprit, of using the flights of a squadron echeloned together in a chain of formations.

5. There was an error made in numbering the seven paragraphs which follow. The correct numbering resumes with paragraph 23.

II. *Tactics of Single Machine.*

(a) The unit of the formation.

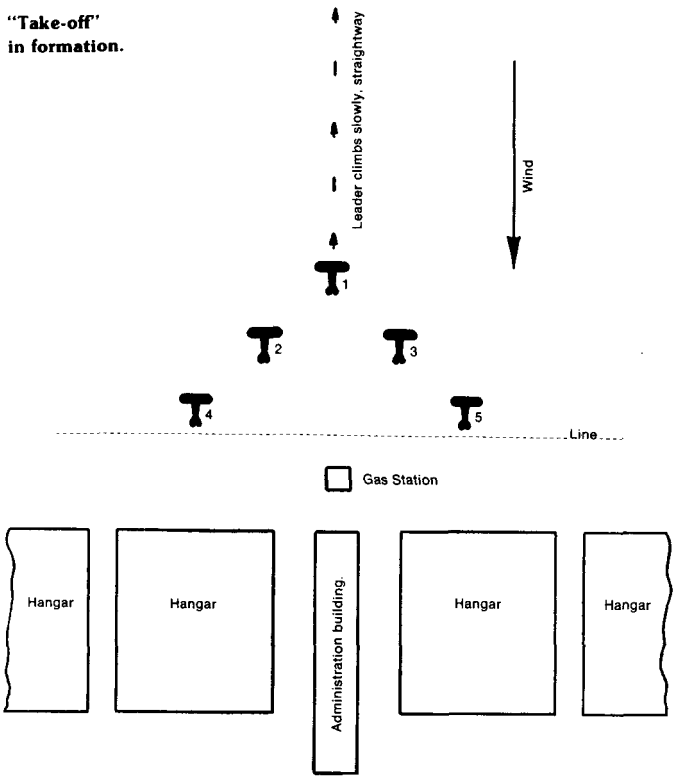
8. A great deal of attention has to be given to the tactics of the single machine and it might be argued that this amounts to nothing more than tactics of the individual pilot. This is indeed a fact except that a great deal depends on the make of the machine in use, but there are many principles in individual aerial combat tactics that apply to all pursuit planes, which must closely be followed.

9. The individual pilot in a formation must be a disciplined subordinate officer with confidence in his leaders. A single machine must be part of the team. The team must be the unit to engage the enemy. It must be remembered that the pursuit machine has no defense after a surprise other than its maneuverability and for this reason only pilots of the longest experience and the greatest ability should be permitted to engage in individual patrols and then only on rare occasions. Up to the point where the pursuit machine is attacked its defense consists of the eyes of the pilot plus its speed. It is quite possible for a single machine to get out of very awkward predicaments provided they are seen by the pilot in time and proper tactics are employed. When once attacked the pursuit pilot depends upon his ability to shoot and maneuver for success. The only safe protection from attack the single-seater has besides the eyes of the pilot is altitude, but the higher the pursuit machine gets the less likely its pilot is to see any enemy machines below him and the fewer machines will be encountered. The object of the attack of a formation is to break up the enemy group and resort to single combat without losing the chain of responsibility, so that throughout the combat the mental unity of the flight is not lost. When this stage is reached the individual pilot must close in and at close range deliver accurate and effective fire. Under no circumstances must he be drawn away from the rest of his flight, no matter what the results of his fire have been. He must carefully avoid being drifted over by the wind farther into enemy territory, or pulled away by any ruse whatsoever. If he is separated from his formation he must fight constantly, relying on being able to fly back home at low altitude if necessary, remembering that it is fatal to dive straight away. Even in case of engine failure the aggressive spirit must be maintained until the ground is reached.

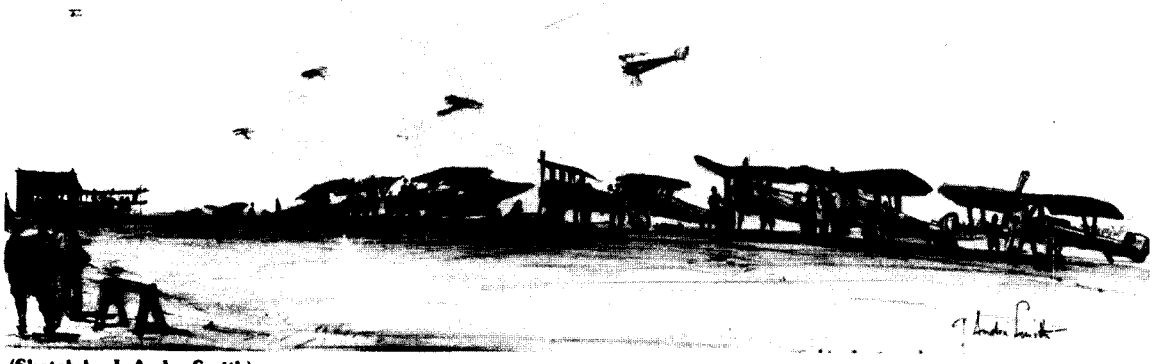
(b) When Single Machine Permissible.

10. At times opportunity presents itself for individual pilots to perform a mission. On days when the weather is very bad, for instance, it sometimes becomes necessary for individual machines to cross the lines at extremely low altitude and penetrate to certain objectives for the purpose of gaining information of great value. At other times the enemy will seize the opportunity afforded by very bad weather and use especially designed armored machines for straffing the infantry at a very low altitude. On misty days it is sometimes impossible to attack these enemy airplanes except [by] individual machines, flying as before, at an extremely low altitude and in this case all the elements of success called into

"Take-off" in formation.



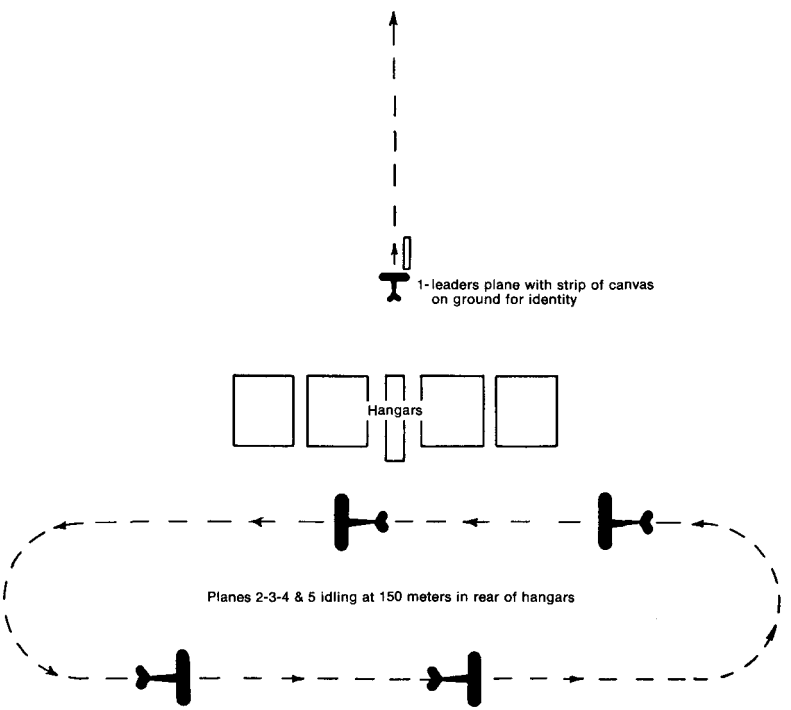
service by formation leader must be employed. Surprise being the greatest asset, the pilot should, if possible, close in on the enemy machine by flying through the clouds a portion of the time, making allowance for speed of enemy machine and other possibilities so that the surprise will be complete and the personnel destroyed by a heavy cone of well directed fire at short range. Another occasion when it is permissible for a single machine to be sent on a mission is when a single enemy airplane penetrates far behind our lines and must be destroyed at any cost. At such a time it is well to attack the enemy with individual machines rather than wait to dispatch a formation and run the risk of the enemy machine getting back home safely with the information gained.



(Sketch by J. Andre Smith)

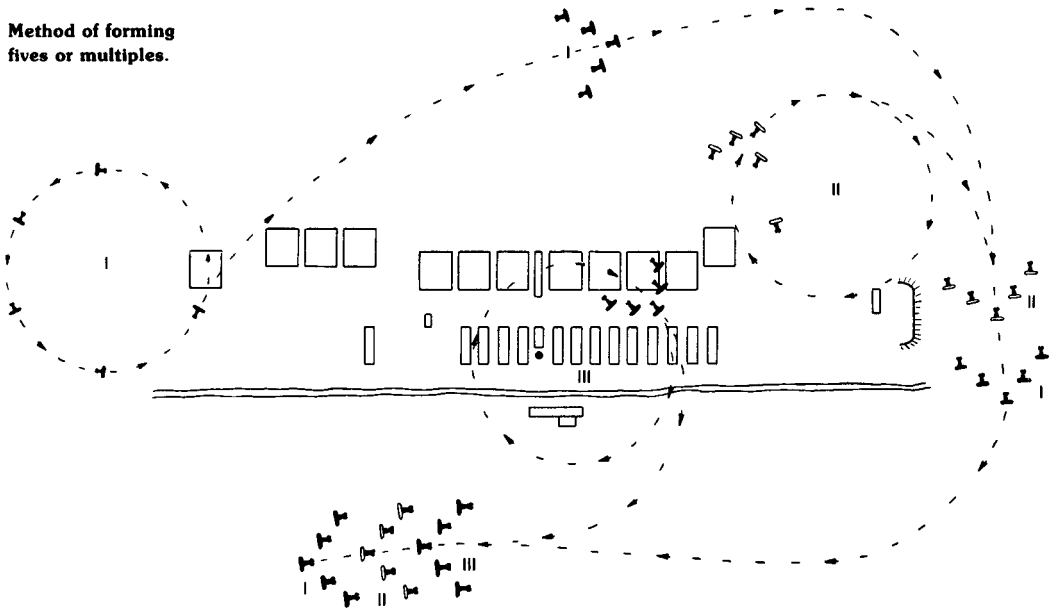
(c) Single-seater vs Single-seater.

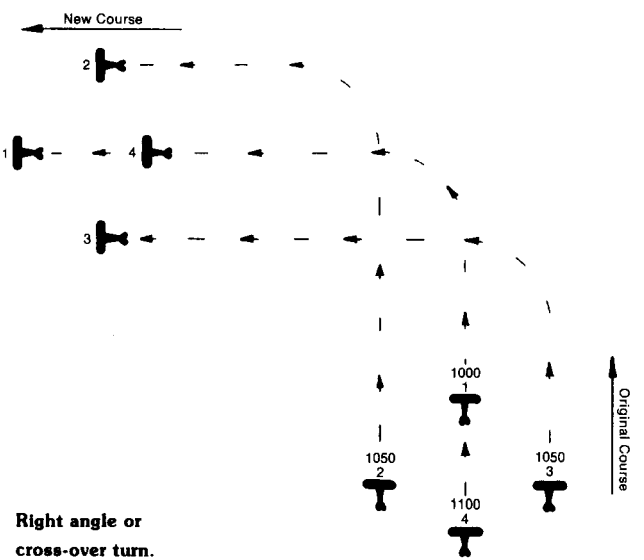
11. When a single-seater attacks a single-seater, his ideal objective is to get directly behind his opponent's tail at very close range where tanks, engine and pilot are in line and where no care has to be taken as to deflection in aim. If the element of surprise has not been effected the only manner of getting this advantageous position is by making the enemy dive away. A good pilot, however, will never dive away and the fight resolves itself into a battle to gain the higher position. A pilot must never allow his machine to lose altitude or fall into a spin. This calls for perfect flying so that just the right moment of rudder is used at the proper time and so that the fight can be moved at will toward supports or away from enemy reinforcements, as the case may be. Above all, a pilot's attack must be vigorous and if he should be so unfortunate as to be outnumbered greatly, he must maneuver cooly but in a very erratic course until he can damage or destroy one of the enemy machines without himself being trapped. He must do his best to keep all enemy machines in sight and never permit an enemy pilot to align the axis of his machine in his direction. It is quite possible for one good single-seater to engage as many as three, four or even more enemy pursuit machines



Another method of forming.

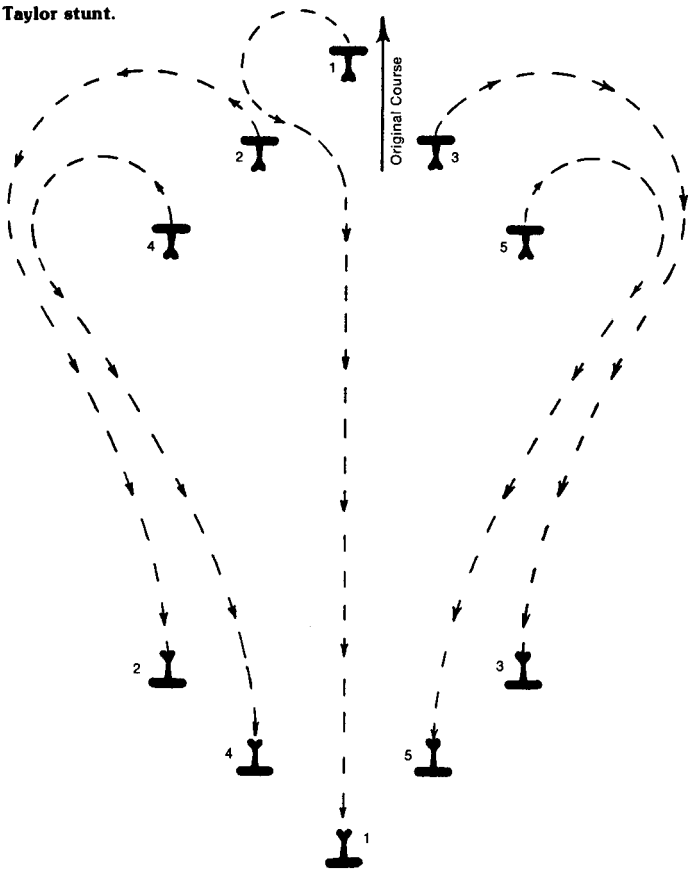
Method of forming fives or multiples.





Right angle or cross-over turn.

Taylor stunt.



for 20 minutes and get back safely to his lines. To a certain extent the type of airplanes will govern the particular maneuvers employed.

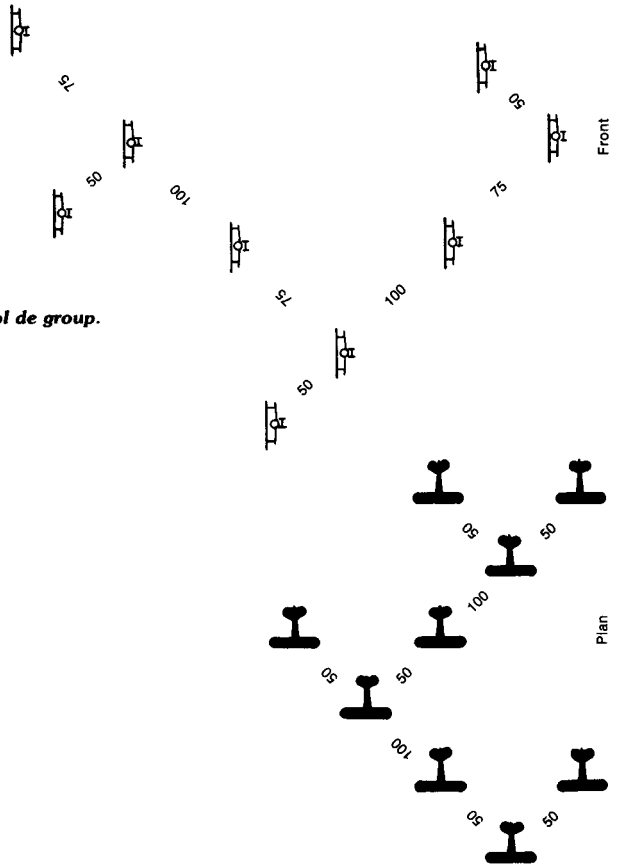
(d) Single-seater vs two-seater.

12. Attack by a single-seater on a two-seater machine is, of course, very much more difficult. It should be made in cooperation with another machine, but when this is not possible, the pilot should aim at closing in to short range, delivering his first burst before the observer is able to reply. When two or more machines attack a single-seater it is necessary by zigzag courses, relying on the extra speed, to close in despite the observers fire and at close range deliver hot bursts. When close in under the enemy's tail, make it a practice to turn opposite to the way he does. In this way it is practically impossible for the enemy observer to train his gun on you.

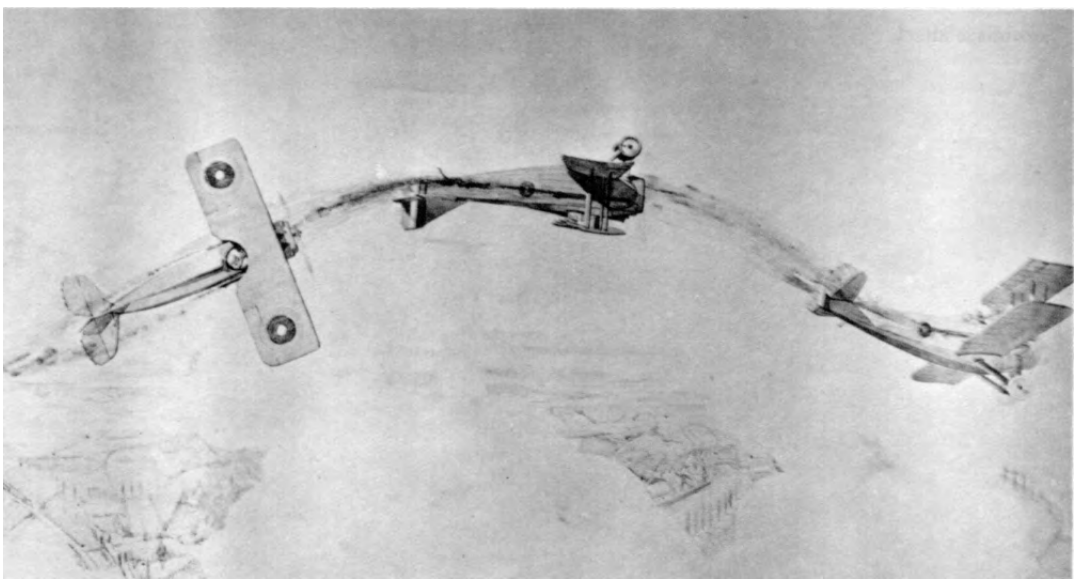
(e) Decoy work by the Single-seater.

23. There is another case when individual flying can be resorted to and this is in decoy tactics. Usually a machine goes out alone but in the sight of a larger formation. Sometimes it meets at a predetermined point at a given altitude and time, and there the formation conforms to the movements of the decoy. The best advice for a decoy machine under these circumstances is to follow an erratic

course. It should never fly straight at all. The pilots should be scouring the sky systematically and thoroughly at all times and use his head to obtain the greatest results by decoying the enemy down on him or attracting the enemy's attention from the higher friendly formation above. It is essential in decoying tactics that the utmost co-operation and confidence exist between the leader of the patrol and the decoy so that there will be no chance of them getting out of touch.



English *vol de group*.



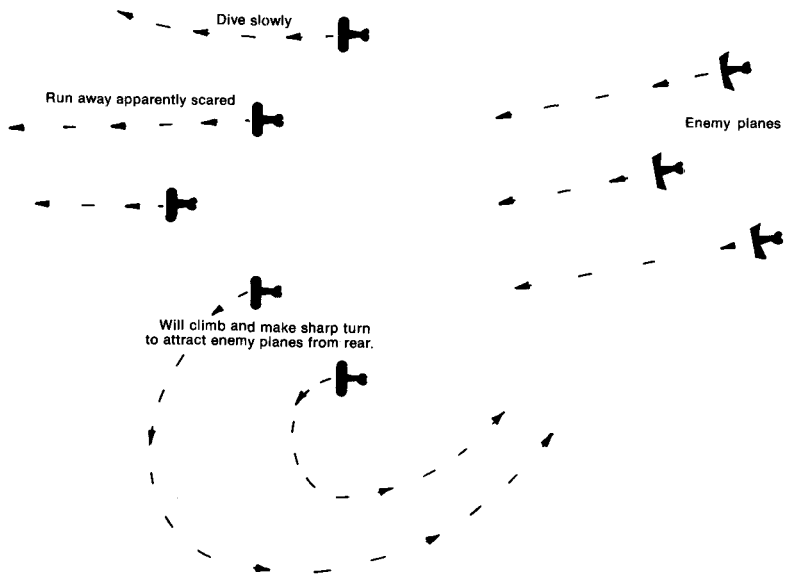
III. *The Single Formation*

(a) General.

24. Good formation flying is the greatest essential in pursuit work. The greatest results cannot be obtained by units that do not do good formation flying. A unit with this asset is certain of success and will attain the greatest point of efficiency. The first essential is to get a good leader; the second, is to maintain the relative positions of the machines; the third, is liaison and cooperation between machines of the formation and last but not least is the chain of responsibility in the flight.

25. The normal formation should comprise a double echelon in depth and in altitude, the planes at the rear being highest up so that they can take advantage of their altitude to close in on the patrol leader by diving, in case of necessity. The normal formation is that of an inverted "V", the patrol leader at the head, number two and number four on his left rear, number three and number five on his right rear. Number two and

Camouflage attack.



number three should be between 100 and 200 yards apart and about fifty yards above and behind number one. Number four and number five should be between two and four hundred yards apart. The shape of the inverted "V", whether the angle is to be acute or obtuse, will depend upon the visibility from the particular type of airplane in use. When several flights are used as a chain the same principle is employed. The guide for the chain of formations flies at the head of the leading flight, one flight behind, above and to his left, the other behind, above and to his right. Where chains of more than three flights are employed each echelon of three flights will use a similar formation and while guiding on the leader will also maintain its own formation.

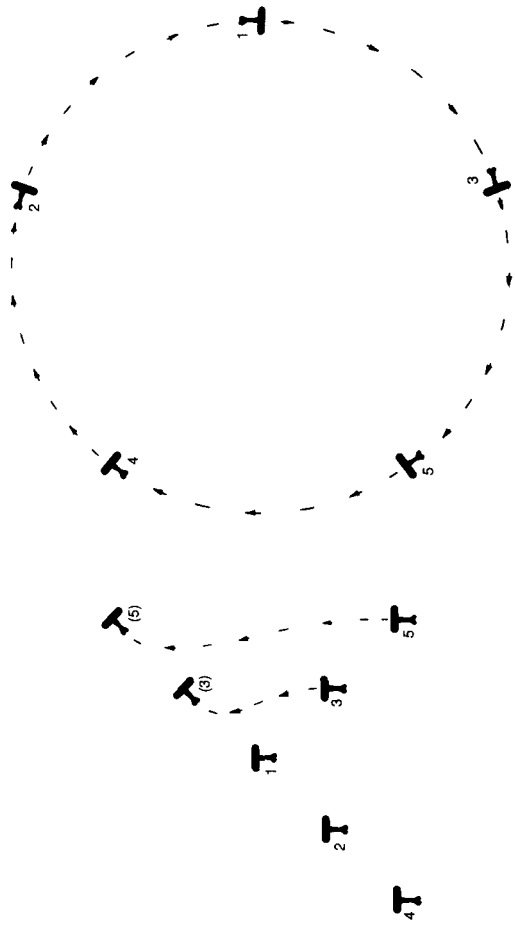
(b) The leader and his responsibilities.

26. A successful patrol leader must possess the complete confidence of his flight, and all that that entails. While the leader is under definite orders always, a great deal depends on his ability to engage the enemy at the most opportune moment, retaining his disposition of machines and launching his attack or maneuvering his formation as occasion demands. He will be well advised to allocate certain positions to pilots and then maintain them on successive patrols insofar as possible. Communication between machines must be simple but certain, and he can obtain this by signals with his wings or by firing Very Lights. The prospective development of the wireless telephone will be of great assistance in increasing the efficiency of patrol leading. Each machine in itself must be in a position to signal to the leader. In short there must be a chain of responsibility running from the leader through the deputy leader to each successive machine of the formation to the last man so that positions and liaison may be maintained under a competent leader, no matter what circumstances arise or what disaster befalls the unit. After much practice, that state of proficiency will be reached where a formation can be worn down to two machines but it still maintains its unity as a formation with its leader and the second machine working in cooperation ready for combined effort.

(c) Fighting tactics.

27. The actual fighting methods of the formation are much the same as for the chain of formations, with the exception that the leader, in attacking and meeting the attacking line of machines, usually breaks off his individual attack and climbs to support the rear machines or to hold himself in readiness to get his formation together again in a hurry. It is essential to demand this of the leader in spite of the temptation he will have to close in on his adversary. He will often be under the necessity of sacrificing a personal victory to the better judgment indicated. In an attack by a formation every effort should be made to obtain unity to the last. For this purpose it is well to attack the highest and rearmost enemy machines, if attacking from above, of if from below, the straggler should be selected for concentration. Each man of the formation should be able to surmise the attentions of the leader and in this way concentrated effort is more apt to be attained. In order that a perfect understanding may prevail

Lufbery show.



among the pilots of every flight they will live together on the ground and will be encouraged to talk over at all times the situation which have been or are likely to be encountered in the air. If it is impossible to close in on a formation owing to its superior speed or altitude, the next best alternative is to wait until the formation endeavors to make a turn and then launch the attack with great vigour. The enemy can be broken up much more easily at this point than if he is flying straight away [and] has advantage of the height and speed. Great care in the attack must be exercised by all leaders to see that the formation itself does not straggle, because on going down on the attack altitude is lost so quickly by the front line the supports often get out of touch, with disastrous results, amounting, as it does, to a split in the attacking formation. It is found in practice that it is easier to keep a formation of pursuit machines intact in a combat than larger two-seater machines provided the pilots are sufficiently well trained. This is due undoubtedly to their superior maneuverability.

(d) On the type of machine.

28. Formation flying depends so much on the machines in use that it would be unwise to pass on without calling attention to the fact that the tactics must, of necessity, alter with the type of machine employed. The ideal machine for this work of course is one that is maneuverable, and

that can be throttled down,[6] and at the same time made to fly level at any speed by means of an adjustable tail or other contrivance.[7] With a machine of this nature, formation flying is very simple, as one can fly slowly until the actual combat or until necessity arises when by opening out the throttle the necessary speed is obtained to launch the attack. Some machines, however, have motors that cannot be throttled and tails that cannot be adjusted so formation flying becomes a greater problem.

IV. *Chains of Formations.*

(a) The simple chain.

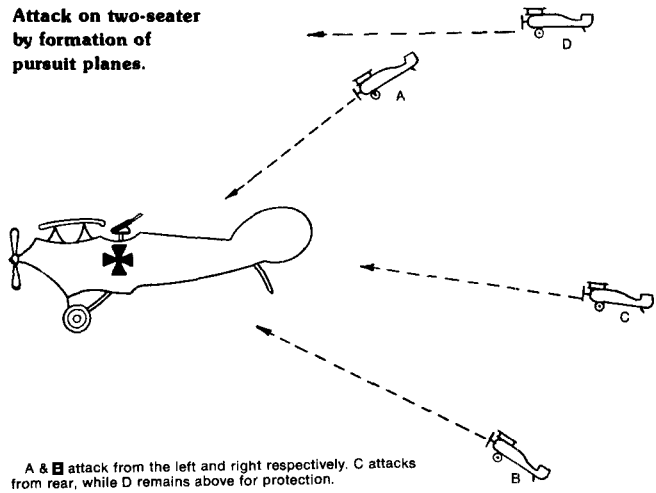
29. Aerial fighting has developed to that stage where it is necessary to send out formations and chains of formations for the accomplishment of missions. Mutual cooperation and support is essential. It has become necessary, therefore, to adopt a unit formation. The size of this unit varies and is determined by the simple fact that a flight leader cannot control more than a limited number of machines in the air at one time with the greatest efficiency. It has become necessary therefore, to send out chains of formations. Sometimes this chain consists merely of two formations of three machines as a minimum, working in touch with one another; the front and lower formation guides and may be called the front line; the rear formation conforms its movements to the lower and supports the lower in its attack according to the requirements. They maintain their respective positions throughout the whole of an offensive patrol and are often given definite patrols when it is necessary to cover a large amount of territory with a limited supply of machines. In such cases a patrol will be ordered to cover certain points at certain altitudes and at given times and the two formations or echelons perform their mission, retaining their respective positions and relationship at all times.

30. It is interesting to compare this simple combination to a patrol on the ground. On the ground one would find advance and flank guards, but in the air these are unnecessary and the work is accomplished by a top guard. The strength of this top guard has to be considerable as this is the most vulnerable point of the formation, and great care has to be taken that it does not get too far in the rear of the main or guiding unit.

(b) Larger chains.

31. This simple chain can be augmented as circumstances require by increasing the number of each echelon or by adding

Attack on two-seater by formation of pursuit planes.



A & B attack from the left and right respectively. C attacks from rear, while D remains above for protection.

6. The rotary motors used in some planes had no throttles and were controlled mainly by turning the motor on and off by means of an ignition switch on the control stick. Some degree of regulation, however, was provided by a mixture valve.

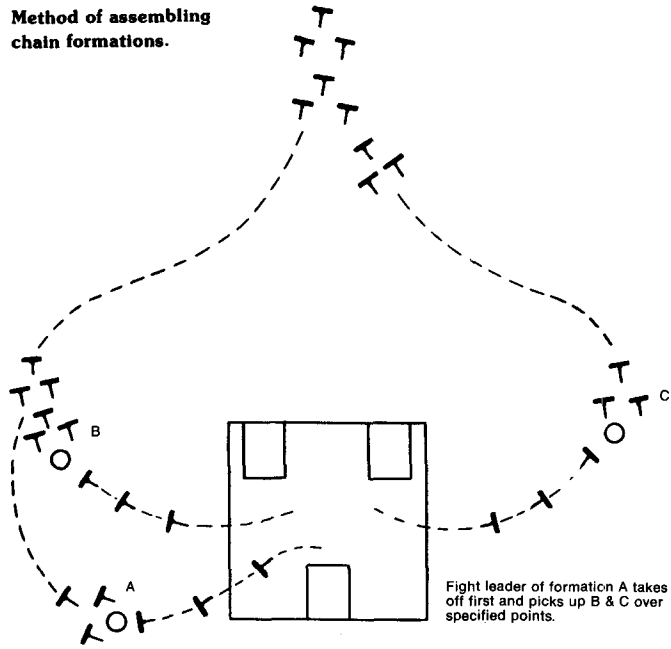
7. The reference may be to an adjustable horizontal stabilizer such as had been incorporated in the Sopwith 1½ Strutter and some other planes, or some similar means for trimming the aircraft in flight.

one or more formations to the chain. The positions of these added formations are maintained throughout the operation and they have clearly defined functions to perform for each particular occasion that arises. For example, if three formations are patrolling, it is well to have them proceed in a triangular chain, the right rear formation serves as a support to the main body while the left rear remains above in reserve to give protection during the combat and to deal with enemy machines that detach themselves and climb with the intention of counter-attacking.

(c) Chains at a distance from the airdromes.

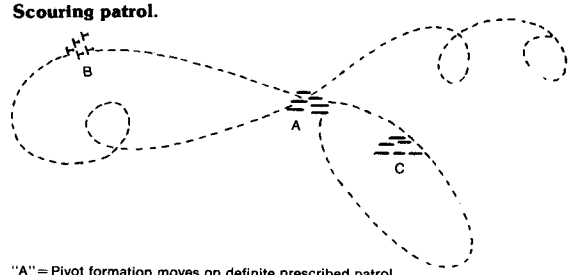
32. This simple combination of formations is not the only kind of chain flying that has been developed. Sometimes individual formations are dispatched and they maintain their individuality and their independence until a given point is reached at an appointed time, when they take up their positions with respect to the previously designated leading flight and proceed as in the simple chain. The advantages of these tactics for use against balloons or other localities of known enemy aerial activity,

Method of assembling chain formations.



Fight leader of formation A takes off first and picks up B & C over specified points.

Scouring patrol.



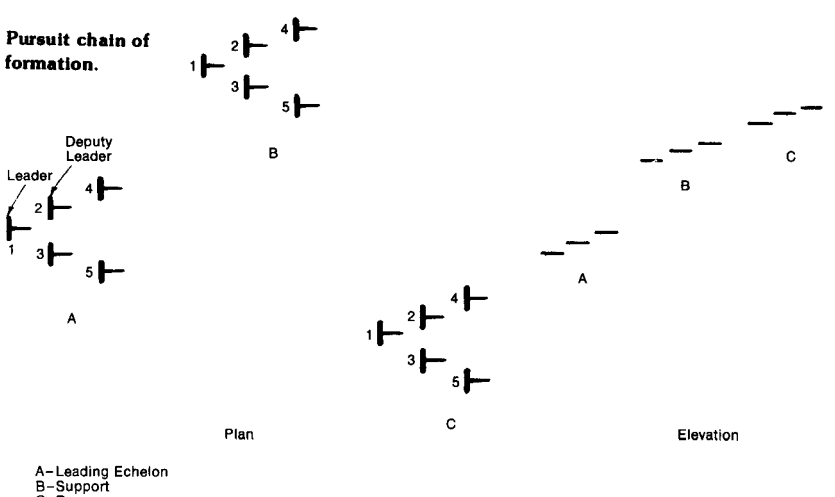
"A" = Pivot formation moves on definite prescribed patrol
"B" & "C" Keep in touch at all times with "A"

such as the rendezvous of a day bombardment formation, is obvious. It is well to point out in this particular form of tactics by chains of formations that the greatest care must be exercised by each leader of a formation. He must not give battle to any enemy aircraft before he reaches his objective and must sacrifice everything to being at his objective at the given instant. The importance of this cannot be over emphasized, as failure on the part of even one formation leader might prove extremely disastrous.

(d) Chain.

33. These tactics can be employed at any altitude but for low work prove especially valuable. These tactics have in mind at least three formations, one acting as the pivot. Each formation leaves the airdrome at a given time and proceeds over a prescribed route to a rendezvous. No time is lost in getting to the rendezvous but each formation is independent until it connects with its pivot formation at that point. On arriving there the leader of the pivotal formation flies in an erratic course but on a definite bearing offensive. The other formations, flying erratically, keep in touch but practically out of sight of the pivot in the hope that the enemy may be encountered. Should one of these formations encounter enemy machines, a signal is given to summon the whole chain to its support. A chain of this kind is not liable to surprise as the whole sky is under observation practically all the time and it becomes impossible for enemy formations to approach without being seen by someone. On the other hand, enemy aerial activity is almost bound to be observed by someone and by signals the hostile machines can be encountered and destroyed.

Pursuit chain of formation.



A–Leading Echelon
B–Support
C–Reserve

(e) Barrage chain.

34. These three formations of chain flying are used for offensive purposes. Pursuit aviation, however, is used a great deal for protection of reconnaissance and artillery observation machines. One of the simplest and most effective means of accomplishing this is by means of chains of formations. Each formation works individually, patrolling a given beat and connecting up at the beat with its adjacent patrol. Each patrol in itself is irregular in that it does not patrol the whole beat religiously but proceeds erratically. In this way the aerial front line is maintained in advance of the line of battle and friendly observation machines are permitted to carry out their important work of surveillance and observation unmolested. The utilization of permanent barrage chains is wearing on pilots and is opposed to the principle of economy of forces as it results in using up our available resources without permitting us to undertake those strong offensive expeditions in force which alone can cause maximum casualties to the enemy and give us a definite moral superiority. It therefore should only be undertaken at times of intense preparation for attack.

(f) Fighting tactics of the different chains.

35. The fighting tactics employed by the chains in actual combat have certain fundamental principles in common. In the attack the leaders, having done their utmost to surprise their adversary, sweep down deliberately on their opponent, relying on the support to lend necessary assistance. The latter at the same time acts as a reserve or top guard to deal with reinforcements which may arrive to assist the enemy. The primary object of the attack is to split up the enemy formation and enable the pilots of the patrol, maintaining superior altitude to destroy the enemy in single combat. So much depends on the factor of surprise that its value cannot be overestimated. Probably the best feature of a surprise attack is that the offensive formation maintains its unity or at most, if it does lose it temporarily, regains more quickly to great advantage in the ensuing combat which is bound to follow. Provision is always made for a rendezvous in case a formation is broken up. In practice it has been found that the center of the fight and the shortest line to our own side of the lines is the best rendezvous area. This not only enables a formation to get back quickly but often insures machines supporting one another on their return journey.

(g) Fighting tactics continued.

36. Fighting tactics in the chain depend a great deal on the machine, on the direction of the wind, and on the locality, but certain principles prevail in all combats which must be adhered to at all costs. First, the leader controls the situation. Every machine must conform to his movement and support him. Second, attempts must be made to fight outwards at all times, the idea being to have your formation intact at the end of the fight, with the enemy scattered on the outskirts. Thirdly, under no circumstances must a pilot or formation attempt to dive away from a fight. It is better for a pilot when his machine is shot to keep fighting and circling and be forced down in enemy territory than to attempt to break away and dive for home. By staying with the fight he lends support to his comrades and may cause the enemy to retire and enable himself and comrades to reach safety after destroying enemy machines, whereas by diving for home he is practically certain to be shot down himself.

(h) Principles.

37. Certain principles in the fighting tactics must be forgotten in the chain of formations. First, each formation must lend sup-

port to the other. Second, if given a mission to perform, a rendezvous or patrol, it must be carried out at all costs, as the success of the chain of formation depends so much on the carrying out of the mission by each individual formation. Third, each formation is subservient to the leading formation of the chain. The successful performance of the mission assigned to the chain is of a great deal more importance than any other that might be successfully accomplished by the single formation at the cost of the greater mission.

Chapter IV. Attacks on Ground Targets

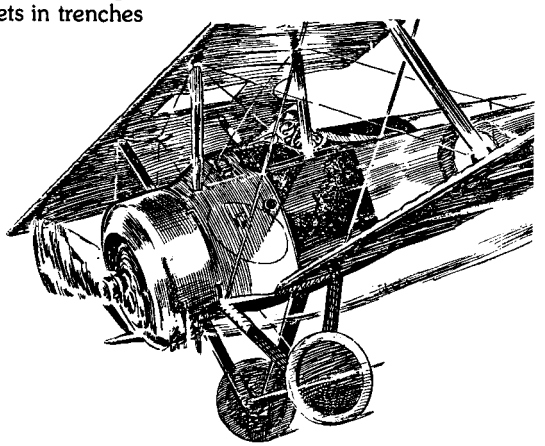
38. Bombing and machine gunning of ground targets can only be carried out when air supremacy is attained. This supremacy does not have to be permanent but must be temporary at least. Unless this supremacy is held at the time low flying is to be done there will be a greater loss in machines than damage done to the enemy. Ground straffs may be carried out in force by placing over the lines at a certain period sufficient number of pursuit machines to establish the line of equal safety for machines as far over as the straffing is to be done. A single pilot of experience, however, may go over the enemy lines and ground straffs when the enemy hold air supremacy, but the amount of possible damage he may do does not equal the risk for loss taken.

39. The discussion for low bombing and machine gunning can be combined because where it is possible to accomplish one it is, as a rule, possible to accomplish the other. Low bombing, however, is more effective on troops. Bombing can be done from a greater height than effective machine gunning. Bombing is more effective on places of shelter. However, machines doing low straffing should be capable of both and in most cases a good target for low bombing is a good target for machine gunning.

40. Low straffing of ground targets is only used when large targets are available for attack. A target must be large enough to be an easy mark and important enough for its destruction to

Strafing a machine-gun battery.

warrant risking the loss of a machine. Only in time of great activity on the ground by either of the combatant forces are ground targets sufficiently large to warrant their being attacked from the air. In the ordinary course of war when no offensive is being launched a good target such as a staff car, or a convoy or a battery may very occassionally present itself, and the pilot of a separate machine or a patrol leader of a formation may use his judgement as to whether the situation demands that he make an attack on that target. Although ground straffing is commonly spoken of as trench straffing, the term trench straffing is a misnomer. Targets in trenches are not large enough to straff from a height and are protected; and for a machine to go down to within 25 or 30 feet from the ground where many machine guns can be directed against it, the chance of that machine doing damage is too small to offset the chance of being brought down. When an offensive is under way large bodies of troops, cavalry and transport are being brought up to the line. These targets are large enough to spot from some distance in the air. Fire can be directed on the group and a great amount of material damage as well as moral damage to the enemy can be done. Targets which admit of attacks from the air are any groups of men or horses or transport of the enemy large enough to be easy of mark, and materials or any sort which are of military value and which can be destroyed by aerial attack.



41. The locality of effective ground straffing varies. As troops and transports approach the front line there is a point where large movement cannot be made. Back of that point is the beginning of the effective zone of ground straffing. The farther back of the line one goes the larger are the bodies encountered. But after a certain distance the frequency of encounter will diminish. The zone for the best targets for ground straffing is that place where large enough targets to be easy of mark are found frequently. Besides the location of the target, the factor of comparative safety in distance of penetration enters the question. This factor is determined by the air superiority held, both permanent and temporary, upon weather conditions, the type of machine used, and the condition of enemy ground defenses.

42. In conducting a ground straffe the command has to consider the disposition of its forces and the method of their dispatch and orders. The disposition of forces depends upon the force available and the state of the attack. The dispatch and orders depends upon whether the target is predetermined and designated when the straffing machines leave the ground; or whether the target is to be found, the area in which targets are likely to appear being designated.

43. The problem of available force is one of the number of machines for ground straffing and the number for protective patrols. Whenever straffing is to be done there should be sufficient protective force above to make the low flying machines safe from attack by enemy aircraft. If the protective force is insufficient a ground straffing machine will be easy prey for the enemy because a pilot doing ground straffing has his attention centered on the ground and not in the air. Also formations of machines on this mission become scattered in most cases. The greater the confidence of the pilot of the low machine in the pilots protecting him, the better the job of ground straffing will be. Cooperation between the protecting machines and the straffing machines is very important. The feeling of personal relationship brings about the best cooperation, and patrols should be arranged to take advantage of that fact whenever possible. In case the number of machines for protection is small it will be necessary to concentrate the protecting force during certain hours and send out all ground straffing machines during those hours. If the number of machines available for protection is large a barrage of machines may be kept up to serve as a protection at all times. It is more difficult to secure cooperation between the low flying machines and the protecting machines where the protecting barrage of machines is used all during the day than where forces are concentrated during limited periods. The number of machines available to do ground straffing does not affect their disposition so much as the number of the protecting force. The use of a ground straffing force, whether large or small, may be concentrated or extended according to the protective force available and the ground conditions.

44. The conditions on the ground which effect the dispatch of machines are whether the attack is just beginning or is in steady slow progress. When the attack is in its first stages machines should be sent over in great numbers and force should be concentrated on that period when greatest assistance can be rendered the ground troops. When the attack has slowed in progress ground straffing may be extended for several days and a constant stream of machines kept over the enemy to harass his reserves coming up. The number over the lines at any time need not however be so great as when the attack is advancing rapidly. The reason for putting a large number of straffing machines over when an attack is in its first stages is more a moral than a destructive reason. The sight of our machines straffing ground targets strengthens the morale of the friendly troops, and weakens the morale of the enemy at a psychological moment. If an attack is slow in progress and ground straffing has been carried out day after day, the enemy must cease day movement of large bodies and transport must move in small groups with some distance between groups. If it is found that insufficient ground targets are presented it is well to concentrate on a certain period, and extend straffing farther back into enemy territory where large targets can be found. Also, the central control should know what cities and towns the enemy is using for concentration points

and may designate special straffs on those centers at an unexpected time.

45. When machines are sent out for the purpose of attacking ground targets, the target may have been previously designated, and information concerning its nature and its place given. Such a target is usually one of fleeting opportunity. In such a case it is necessary for the machines which are to make the attack to arrive at the place of the target upon very short notice. For the purpose of performing missions of this sort certain squadrons should be moved to within the closest possible distance of the line previous to an attack. A certain number of pilots and machines must be kept on alert constantly, ready to leave the ground at a moment's notice after information is received concerning a target. The machine used must be one which does not require warming, such as a rotary motored machine, in order that it may leave the ground immediately. Machines for this work can not go over the line farther than their protection takes them. If a protective barrage is up the mission can be dispatched without special escort. If there is not protective force on the lines a special escort must be provided.

46. A definite target, however, may be given which is not one of fleeting opportunity, such as a town where concentration is taking place, an important railhead, etc. Machines which are to perform the mission need not be from an advanced airdrome. Targets of this nature are often given after a ground attack has been in progress for some time and when few moving targets worth while present themselves. However, the central control should know what centers are used for concentration points at all times and should direct attacks on them. These centers are usually too far over the line for a low attack from the air to be carried out unless sufficient force is sent out as an escort to provide temporary air supremacy over the target. An enemy aerodrome presents a target of almost the same nature. Any target may be straffed from a low altitude provided air superiority can be insured at the particular time and place.

47. Machines are also dispatched without particular targets being designated. The pilots may only be instructed as to the locality in which targets are likely to be found. This is particularly true during the beginning of an attack by ground troops on the enemy. In such a case the central control should know the hour of attack, the lines of halting, the final objective, and the zone of exploitation. The pilots to do ground straffing should be informed of these various lines, and orders should be issued, that up to a certain time targets will be attacked in a given zone; that after another definite time targets will be attacked in a definite zone farther in enemy territory. Unless this method is followed pilots will not always be certain of whether targets are enemy or their own. But even if the progress is not so rapid the central control must know the zone in which targets are likely to be found and instruct pilots to look for them in that area. The more complete the information the better will be results, for pilots should not have to spend much time looking for targets.

48. Whether machines are sent out singly, in pairs, or in a formation will depend entirely upon the situation. A small formation of three or five machines will bring best results in straffing most targets because there will be a leader of some experience to find the target and to keep a lookout for enemy aircraft. Also the formation will scatter the enemy fire from the ground. The formation cannot be large because of the danger of collision in getting at the target. Machines of a small number can take turns at attacking a target but the number cannot be large because attack must be quick and machines must not have to wait for each other any length of time. If the target is surprised fire from the ground will not be severe, but if time is given for the preparation the chance of the loss of machines will be greater. The number of machines sent to attack the same target is, therefore, limited.

49. The pilots who are to do the ground straffing must possess very definite information as to where enemy troops are located and where friendly troops are located. Uncertainty, even to a limited extent, will ruin the efficiency of the work. In case the push is rapid and the line uncertain the central control must inform the pilots of limits of the zones in which straffing is to be done. That limit should not be several miles within the enemy side of the line, for while attempting to make it safe for friendly troops, the situation is made more unsafe than necessary for the pilots. Pilots should always be informed as to the latest line reports, and, if the line is a moving one, the pilot should know the line the infantry is supposed to hold at the precise moment attack is to be made from the air. Pilots after having this information should know their maps so well that reference to them is almost unnecessary. It is impracticable for pilots to determine whether troops are enemy or their own by uniforms, etc., before the attack from the air is made. To do this will do away with suddenness of attack, besides, in most cases, placing the pilot in unnecessary danger. There will, of course be exceptional cases where the pilot cannot tell by position whether troops are enemy, in which case they should make certain by uniforms and observation of various indicating facts before making an attack.

50. The method of actually straffing the target cannot be prescribed. The closer a machine is to the ground, down to 100 feet, the more accurate will be the bombing and shooting; also the more accurate the fire from the enemy. Effective bombing and shooting can be done from 2000 feet. The height from which work will be done will depend upon the development in types of machines, and armament, and in the effectiveness of the fire from the enemy.

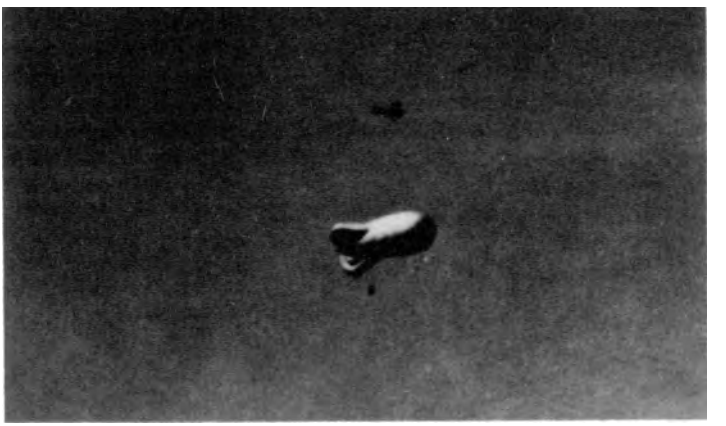
51. Formations in an attack usually become very dispersed. If the nature of the target permits attack in formation, airplanes of the formation should attack one after the other. In case the formation becomes completely scattered, pilots of inexperience should not remain over enemy territory a great length of time, for they are very subject to attack. The leader should, whenever possible, prescribe when withdrawal to the line is to be

made by signal to other machines. Otherwise, the machines should not linger over enemy territory but a few moments. In case of complete dispersion each machine is to make its way back in the shortest line. If dispersion is only partial it is best to pick up the formation while withdrawing.

52. Weather conditions effect ground straffing fundamentally. Clouds may prohibit protective patrols. In this case ground straffing machines cannot work in formations far over enemy territory, the distance depending, however, upon height and nature of clouds, and visibility of atmospheres. A single machine may do effective ground straffing when clouds are under 2000 feet, going to or returning from his target in the clouds. This is best accomplished when visibility is very poor, when there can be practically no enemy machines about. The most effective ground straffing done by single machines can be accomplished in weather of this sort with very little danger of loss of the machine. The pilots must, however, be of experience.

53. The most difficult situations, however, arise when clouds exist at altitudes about 2000 feet, not rendering a protective patrol useless, but changing very greatly the cooperation between the protective patrol and the ground straffers, and rendering the [possibility of protection] against attack from enemy aircraft much more difficult than where there are no clouds. If it is possible for machines to work above the low clouds, it is necessary to have part of the protective patrol above the clouds and part directly in touch with the ground straffers beneath the clouds. [If] it is impossible for machines to work above clouds the protective patrol cannot penetrate far into enemy territory, the distance depending upon the height of the clouds. The ground straffing machines, being lower, can work a little farther into enemy territory than the protective patrol is working.

54. Machines used in ground straffing can be combatted from the ground and from the air. The greatest source of destruction, however, comes from the ground because of the greater possibilities of fire from that source, both with respect to accuracy, and as to amount and kind. Also the sources of fire on the ground are difficult to observe, and cannot easily be combatted by the low flying machine. It is necessary to perfect devices for fire from the ground and to provide machines, which are to do low flying, with a means of protection from enemy ground fire. When ground straffing is being done it must also be combatted from the air by low flying machines with overhead protection.



Airplane attacks captive balloon (left). Minutes later the balloon becomes engulfed in flames (right).

55. The type of machine which is best adapted to ground straffing is necessarily an armoured machine. As weight is increased maneuverability, speed and climb will be decreased. The best machine will be the one with adequate armouring and with least decrease in maneuverability, speed and climb, and with greatest reliability of engine. The reliability of the engine is more important in a ground straffing machine than in other types, because that machine usually works in a place where a forced landing means the loss of a machine and pilot The least vulnerable engine to bullets is an air cooled engine. Rotary motors can be shot through and still run. It is at present considered that the best type of machine for ground straffing is a single seater, rotary motored, armoured machine with two fields of fire—one in front and one below.

Chapter V. Balloon Attacks

56. Balloon attacks may be divided into two general headings, one the individual unpremeditated attack made merely because the pilot finds himself in position for such an attack after an engagement or some special mission, and secondly the scientific attacks made with cooperation in various forms.

57. The first type is usually made with the utmost danger to the pilot as he is open to attack by enemy aircraft from above and has no efficient method of stopping attack from the ground defenses. These attacks should be discouraged save in very exceptional circumstances when they should consist only of a single dive, a long burst of machine gun fire continuing to an extremely short range, and then an immediate but cautious return to the lines. Organized balloon attacks often yield important results. They will almost always be undertaken just before or during an assault. In all balloon attacks it is most essential that the gas bag be perforated in order that the gas may mix with the atmosphere and the incendiary ammunition ignite the resulting combustible mixture. It has been found satisfactory to use ordinary ammunition for the perforation of the bag while a short burst of the incendiary fired at extremely short range, 25 to 50 yards, will in the majority of cases ignite the gas.

58. There are several methods of attacking a balloon. It should be kept clear in the mind of all pilots making such attacks that only approximately the front $^2/_3$rds of the bag has gas in it, the back $^1/_3$ being filled largely with air. Because of this, a vertical dive is not recommended. On the other hand the pilot's machine should be gotten into such position that he will be firing parallel to the fore and aft axis of the balloon. This guarantees that the bullets will puncture the bag where the gas is located.

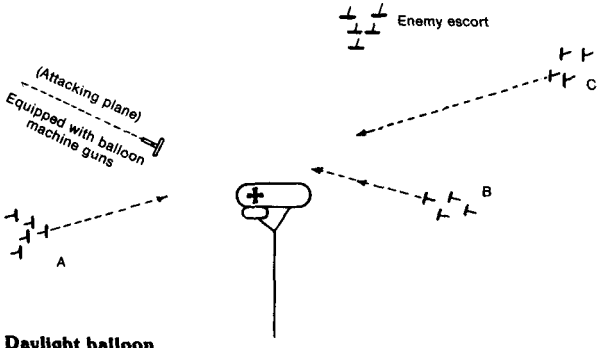
59. In a premeditated attack one of the elemental principles is to silence ground defenses in the shape of machine guns, "flaming onions" batteries (incendiary anti-aircraft) and anti-aircraft guns of greater caliber. This may either be done by our batteries or by aircraft accompanying the pilot who is to destroy the balloon. Both of these methods have proven very satisfactory in practice. In the first case the battery commander makes arrangements for his barrage to be directed at the winch and for a considerable radius surrounding the balloon. This barrage is usually laid down two or three minutes before the attack by our aircraft.

60. In the second case the machine which is to destroy the balloon is accompanied by four or five other pursuit machines, fitted with bomb racks carrying light bombs. These bombs are dropped on the emplacements of the anti-aircraft defenses and as close as possible to the winch. Immediately after this and at the same time that the single machine attacks the balloon, machine gun fire is also directed at these ground defenses and it has been found that the enemy in a considerable number of cases leaves his balloon up and takes cover.

61. Attacks on balloons should have as much of the element of surprise in their favor as conditions permit in order to prevent the enemy from drawing his balloons to the ground before the attack is made. In case there are clouds in the sky such cover as they afford should be utilized. On clear days great skill in maneuvering is necessary to make the balloon companies believe that the patrol has some other mission than destruction of the balloon. Very often a long, gentle glide to the enemy side of the balloon and considerably above it, followed by a steep, rapid dive and attack, will be successful. At other times it becomes necessary to follow the balloon as it is drawn to within a very short distance of the ground.

62. When more than one balloon is to be destroyed it is much more satisfactory, whenever possible, to assign separate patrols for the destruction of each target. In this way the element of surprise is maintained to a considerable degree. It is perfectly apparent that in the case of attacking by one patrol of a number of balloons, that the successful destruction of one will warn those to be attacked later of their danger, and will give them an opportunity to draw down the balloon and prepare for an intensive defense.

63. The element of surprise may be very valuably increased by making balloon attacks just at dawn or very late in the evening. Attack at this time also removes to a very large extent the danger of interference by hostile aircraft. The effect of an evening attack on a balloon line has really very little tactical or strategical value as each balloon destroyed will be replaced in time for ascension the following morning, but there is undoubtedly a considerable effect on morale, particularly insofar as observers are concerned.



Daylight balloon attack.

Attack at O hour. Formation A, B & C rendezvous over balloon at O hour + 1 mi. to protect attacking plane

64. It is exceedingly important that observers making successful descents in parachutes should be attacked as they are extremely dangerous to our troops on the ground because of their training.[8] Here again the question of morale arises and if observers are attacked as they are descending in their parachutes it is believed a considerable increase will be noted in the number of unnecessary descents made.

65. It has been found much more satisfactory to utilize the 11 millimeter balloon gun than the ordinary caliber machine gun. Something on the order of the one-pounder, firing a very delicately fused contact shell, would be even more successful for the destruction of enemy balloons. The use of bombs containing sulphur or other incendiary material did not prove satisfactory.

66. Whenever possible balloon attacks should be made with an escort of considerable strength, in order to allow the attacking machines to perform their mission without interruption by enemy aircraft. This protection should be flying in the close vicinity of the balloon at the time of the attack, but at a higher altitude, and should be very careful not to communicate to the enemy by its actions prior to the attack information that the attack is to be made.

67. A considerable proportion of the balloon attacks made by the Allies during the recent war failed in the destruction of the balloon because the pilot did not have a true appreciation of his distance from the balloon. This realization of distance may be gained by practice with balloons behind our lines during the course of which pilots will become familiar with the appearance of the bag in the sight and will then be able to deliver their burst of incendiary ammunition at a range short enough to be efficient.

68. It should be the attempt of pursuit squadrons on any front to keep the enemy balloons in their sector down as much of the time as possible. Balloon observation is extremely valuable for the regulation of artillery fire and for reconnaissance of back areas. It is even suggested that in the future night pursuit will be equipped with searchlights or other means for locating and destroying enemy balloons during darkness.

Chapter VI. Night Pursuit

69. With the development of the Air Service, the problem of night flying and more particularly night pursuit has to be faced and solved.

70. 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.

71. 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.

72. 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 pursuit pilots will be required under certain circumstances to go out to predetermined objectives for the purpose of dropping a flare at a given important cross road to ascertain movements of troops or for the purpose of confirming a suspected withdrawal or concentration. At first, night reconnaissance by pursuit 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

8. The shooting of parachutists abandoning disabled aircraft was then, and is yet, a difficult and controversial area of international law.

work will be done in all favorable weather at night. Concentrations will be located and bombs will be carried, enabling the pursuit machines to descend and harrass same from very low altitudes with extremely great accuracy. Balloon straffing at dawn and in the dusk of evening will be almost entirely the functions of the night pursuit machine and this practice may in time blind the enemy insofar as balloons are concerned. Straffing enemy troops by machine gun fire, owing to the case with which a surprise and get away can be effected at night, will be a very safe and effective work of the night pursuit, and its possibilities are limited only by the weather conditions.

73. 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 Service, 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.

74. 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 searchlight, his planes show up for a very great distance, and experience proves that sometimes machines can be held in the beam ten minutes. Sometimes he can be seen, not in the beam itself, but in the twilight formed in the air by the searchlights and fights have taken place without the beam picking him up or without the knowledge of the operators of the light.

75. 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 seen first by the pursuit pilot.

76. One of the great problems of night flying is equipment. These necessities include first-class searchlights, airplanes, airdrome lighting plants, lighthouses, motors and signals.

77. For night flying to be a success in the operations of an army it is absolutely essential that it have the proper cooperation and liaison with the neighboring arms. The searchlights are operated by the Engineers Corps. A liaison officer must be placed 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 very closest liaison must be maintained with the anti-aircraft artillery. The Chief of Air Service must have a liaison officer from

this branch on his staff, and the guns must be located and operated on his advice and with his cooperation. In addition, official observation posts are to be established in all units on the lines, each in touch with a Post of Command where there will be located a wireless transmitting station, in order that the Chief of all wireless stations in the rear will be kept familiar with indications and locations of enemy aerial activity and likewise advised of its cessation, so that he can most efficiently make his tactical decisions.

78. Defended areas—that is territory over which it is forbidden to fly at night—should be reduced to a minimum if not dispensed with entirely. Arrangements can 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.

79. It is very essential to obtain the proper kind of machine for night work. In the first place the engine must be reliable, simple, and if possible, one that starts up easily and instantly. Any reliable rotary or radial motor seems best adapted for night pursuit. The machine itself must be light, maneuverable and possess great flexibility of speed, owing to the tactical necessity after overtaking a twin-engine machine for a pilot to reduce the 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 landed in a very small area, a feature that will always be essential in night forced landing. It is well to strengthen the center section struts and take similar precautions so that in case of a turn over the pilot can be sure of getting out and it is 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 dive into the ground or stall on coming into the airdrome when one's attention is often diverted to landing light instruments or ground lights. With regard to fuel, it is advisable to have as much gasoline as possible. Although a patrol should not be for more than 1¼ hours, pilots frequently get lost returning and have to fly around a long time before they get their bearings.

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

81. The instrument board is an important feature. All instruments must be lighted and in addition luminous in themselves, and two movable [flash-lights must be provided, the whole electrical equipment being run][9] from two separate storage batteries which, in themselves, should be very accessible, yet substantially fixed. A good air speed indicator and a good altimeter are even more essential in night flying than in day, and the compass, too, must be of the very best. A machine will carry wing tip flares. A navigation light on the outer struts, and a signalling light on the bottom of the fuselage with at least one emergency parachute landing flare.

9. The words in brackets, inserted to fill an obvious omission, are from *Circular* 76, p. 44.

Normally the dangerous wing tip flares will not be used but in the case of forced landings these will be lighted, sufficiently high above the ground to insure their being burned out by the time the ground is reached. These must be examined very frequently and under no circumstances should they be used later than the date stamped thereon. There is no such word as economy in connection with the use of flares. They must not be opened until they are actually going to be placed on the machine. First-class parachute flares should be the only parachute flares carried. The signal-light beneath the fuselage must be operated by a tapper key and a permanent switch be opened interchangeably, at will and instantly.

82. Two kinds of airdrome equipment must be recognized and provided. First, that in vogue on the fields of the other night squadrons operating which must be most reliable and if necessary elaborate; secondly, the emergency landing set, which should be at hand on these fields but in addition should be placed on every airdrome in the army area so that a pilot lost in a fog may with safety call and land at any field. The arrangements of the main fields must be worked out as circumstances require, but it is essential that a good generating unit be at hand and that the bounds of the field be clearly defined. For an emergency lighting outfit, three small concentrated beam throwing lights, with power furnished by a fifteen volt storage battery placed on a trolley are recommended. These are quite inexpensive and will on every field justify their existence many times over.

83. The army area as a whole must [be] lit up with Mortars and Lighthouses, and a 36" Sperry light at the main airdrome for purpose of defense as well as for the purpose of directing machines home is essential.

84. Certain rules must be inaugurated for landing at an airdrome at night. These must be formulated not forgetting the possibility of the enemy bombing and must consist of a signal for recognition and on the main field 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 blocks the field, proper signals or a beam of light must be flashed to him. In this connection it will be essential to instruct and hold responsible one man at least on every field in the best methods of placing the 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.

85. Probably the greatest difficulty to be encountered is 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 pilot in the day time 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 intuitively 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 the spirit of determination first of all to develop this branch of aviation. He should be steady, sober, keen and industrious and so fond of flying that he sees every opportunity to get up in the air, day and night.

86. In flying a pursuit machine at night a pilot who has mastered his machine thoroughly should have no difficulty in mastering the art, whether pursuit or bomber, but it is useless for him to attempt the work until this is the case. In all armies there have been regretable accidents in this connection which have tended to bring night flying into disfavor with the pilots. It is a fact that any good day pilot will make a good night pilot provided his vision is normal. In addition to being a good pilot, the night flyer must have a thorough knowledge of the country, particularly of the landmarks. He must be skilled in the location of possible fields, airdromes, forests, rivers, bad ground, etc., and when he has first enlisted into the service of a night squadron, he should utilize every opportunity that presents itself in 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 must never let the ground get out of sight. If necessary he should make a forced landing rather than attempt to get home at night by flying through the mist, unless of course he is flying high and is sure of the weather.

87. After a pilot becomes competent he will practice forced landing on his own airdromes on moonlight nights, and practice combat fighting with two-seaters at night cooperating with the searchlights. Rehearsals of forced landings by means of parachute flares are practicable, the pilot using the engine if he discovers that the field sought is liable to cause him to turn over.

88. The location of instruments and the method of using them in the dark must become a matter of second nature to the night pilot, so that this will in no way distract his attention from more important things. Patrols will often be monotonous because they will cover short beats over important points. Enemy night bombers are certain to follow permanent land marks, such as rivers or forests. This means that a pilot on patrol must stay over this spot patiently and await his opportunity. He will do well to have patience and not to be distracted by neighboring lights from his particular mission. Pilots must never attempt to fly under 200 meters at night as the risk involved is too great, and on his first flights he must arise over his airdrome at a height of at least 1000 meters and take his time coming in. The morale of pilots in all branches of the Air Service must be carefully preserved, but this is even more marked in the case of night pilots. Day flying should be performed and should only be permitted between certain definite flying hours of daylight. Otherwise pilots will never feel that they are off duty and in a few weeks will become tired and disgusted with their work, and lose all their keenness.

89. The main duties in the operations of night pursuit is the defensive barrage. Patrols will be 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 lines and more particularly over permanent land marks. They will not last more than one and one

fourth hours and vary in altitude from 2000 to 4000 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, and so on. Balloons may be utilized for this purpose as they can render valuable assistance.

90. 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 searchlights beams. He will "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 times 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 assistance of a pilot on patrol and solve many of his difficulties.

91. When a pilot sights an enemy machine, his simple tactics will be to get under his tail, closing in to a 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 slide-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 must endeavor to keep his eye on the enemy by observing his instrument board, his exhaust or the explosive tracers from his machine guns. After a short time the enemy will steady down and probably attempt to dive for home, when it will be safe for the pursuit machine to close on him again. It is easier on a clear night to see machines 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.

92. 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 cross roads, 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 will be possible to take photographs at night. The same machines will be able to carry light bombs and shutting off their motors, glide down to a very low altitude and with great precision and accuracy drop them, insuring good results.

93. Other duties, however, besides these will be required of night pursuit squadrons. They will be required to attack balloons suspended in the air or lying on their beds late in the dusk of evening after all the

enemy airplanes have landed, enabling the pilot to come back unmolested and in safety to his 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 efficiency of balloons will in this way be reduced.

94. Airdrome straffing in the late evening and in the early dawn is one of the chief functions of night pursuit and airdromes may be so far back that the whole situation will be changed. Hangars probably will have to be underground and mechanics will have to live in dug-outs. On fine nights single machines will harrass enemy airdromes many times over and on [some] nights large offensive operations will be able to put machines out of action. Before and during an offensive enemy concentrations will be straffed and machine-gunned at night from a low altitude. The Commanding Officer of a Night Pursuit unit must be ready to develop the possibilities of his command to the utmost.

95. A great deal of the success of night pursuit will depend on the location of the airdrome. The ideal place is in the center of the line of searchlights. This enables pilots to stand on their airdromes ready to take off and reduce the duration of their patrols. With an airdrome in this location, pilots are able to go up and take short flights, making many sorties per night if necessary. Many devices, such as dummy airdromes, must be used to enable the location of this advanced field to be kept secret and to prevent its being bombed. Machines will not be brought up until the night of an anticipated raid, the actual location of the squadron being well in the rear. As a matter of general principal, it is very much better, however, to have squadron work from the field where its headquarters, hangars, machine shop, etc., are located, as advanced fields are never entirely satisfactory, and if at all practicable this should be the case. The location of this field near the searchlights, in addition to the usual advantages, keeps a possible landing ground within gliding distance of the pilot at all times and greatly increases his confidence and efficiency.

96. While it is important to have the airdrome located centrally, the proper location of the searchlights is more essential and two methods prevail. First, the concentration of searchlights around important bombing objectives from the enemy standpoint of view and, second, the location of a continuous line of lights along the whole front. There are many points in favor of both, the ideal, of course, being 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. Searchlights will be placed in units of three lights in triangular formation, the sides of the triangle being roughly [300 yards].[10] All the lights will be

10. The bracketed phrase, supplying a number that was omitted, and correcting a word that was misspelled, is from *Circular* 76, p 46.

under the control of one P.C. and where possible this will 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" field. Every search light, where possible, will be placed on a possible emergency landing field and instructions given to the operators that upon a distress signal from the plane all lights so located will concentrate on their respective emergency field. In locating these searchlights and instructing the operators, care will be taken that operators understand that a plane lands best up hill and into the wind, not forgetting to point out that it is next to impossible at night to land over high obstacles.

97. Anti-aircraft guns should be located so as to fire in zones and the best rule is to have them fire only towards enemy territory and over the enemy lines. In this way they serve as a signal for a pilot who may be in the air and at the same time there is less likelihood of a friendly pilot being hit. Enemy bombers prefer to penetrate an anti-aircraft barrage than searchlights where there are pursuit machines about. With this in view tactical distribution of the guns will be made to suit occasions and special circumstances.

Part IV. Day Bombardment

Introduction

Object of Day Bombardment

1. The primary object of bombing operations is the destruction of the material, personnel and morale of the enemy. The secondary object is reconnaissance of enemy movements in the air and on the ground. The effect of destroying the enemy's materiel and personnel is not commensurate with the effect gained by day bombardment in weakening the morale of troops and civilians in the bombed areas. The ratio of the effect and lowering the enemy's morale over that of destruction is estimated as about twenty to one.

Chapter I. Information

2. Information of the enemy and our own ground forces is essential to the proper tactical operations of a day bombardment unit. The collection and preparation of this information for distribution to the smaller units of his command is the duty of the Air Service commander. Information properly circulated to bombardment units has an important effect upon the morale of the personnel. This is the only method by which units far from the battlefield can have brought to them the actual situations at the front. Unless the possibilities of day bombardment are made

clear it is impossible to get the maximum efficiency from the pilots and observers.

3. Every unit headquarters will be supplied by the Army Air Service Commander with:

(a) A map showing the location of all enemy airdromes. This map will indicate whether or not the airdromes are occupied, and will show the quantity and kind of air forces present.

(b) A map showing the location and kind of all enemy antiaircraft artillery, which will be kept as near up to date as possible.

(c) A map showing the existing and probably locations of all enemy divisions, both in the line and reserve. The map will be prepared from information furnished by the second section of the General Staff (G–2).

(d) A map showing the location of all airdromes in the sector of the Army Air Service Commander, the corps and divisional sector boundaries of all units in line, the location of our antiaircraft artillery units, balloons and other air service units.

(e) Silhouettes and photographs of all known types of enemy airplanes. These should be posted in the operations rooms, and in the mess hall and quarters of the flying personnel.

(f) A diagram of telephonic liaison in the army area.

(g) A map showing the location of heavy and railroad artillery units and their targets.

5. The charts, diagrams, and maps will be supplemented with:

(a) Army summaries of intelligence prepared by G–2. These will be circulated to be accessible to every pilot and observer.

(b) Air Service summaries of intelligence prepared in the headquarters of the A.S.C. These will cover all subjects relating to the enemy air service, especially the quantities and types of his airplanes, and his methods of employing them in aerial warfare. It is the duty of every operations officer to make known to his flying personnel all the experiences that other pilots and observers have had over the lines.

Chapter II. Liaison

5. Success of day bombardment depends in a large measure, upon a system of well established liaison. The liaison must be such that it guarantees a rapid transmission of information and orders. A comprehension of the entire situation at the moment has a decided effect upon the success of bombardment operations. In order that bombing raids may be made most effective, and with a minimum of losses, a close Liaison with the front must be maintained. Accurate knowledge of the enemy's aerial activity at the time is the most important factor in deciding upon the tactics to be employed in executing the raids, the route to be followed, and the altitude from which the objective will be bombed. The Liaison should be so perfected that each group commander can be informed without delay of the location, number, altitude, direction of flight and types of enemy airplanes approaching our front lines. This liaison will be established:

(a) By direct telephonic communications with anti-aircraft artillery observation posts.

(b) By wire with the radiogoniometric stations.

(c) By wire with the line of observation balloons.

6. The telephone communications from group to wing, and to the Army Air Service should be direct. The internal liaison from group headquarters to the several squadrons should be perfect. The group operations officer should be able to communicate without delay with all squadrons operations officers and with the flying field and alert tents.

7. Too much emphasis cannot be placed upon the importance of the exchange of visits between the commanding officers of the air service units. This applies especially to the day bombardment and pursuit aviation. Without these exchanges of visits it is impossible to arrive at that close cooperation so necessary between these two branches. Personal visits between officers of all branches of aviation and the officers of infantry, artillery, anti-aircraft artillery, and balloon sections are the best means of establishing a feeling of understanding and sympathy between the various arms of the service. This understanding is necessary to perfect an efficient system of liaison upon the battle field.

Chapter III. Security

8. Security embraces all measures taken by a command to protect itself from annoyance, observation, surprise and attack by the enemy. The protection of day bombardment naturally falls under combat, and will be treated under that head. Under security will be discussed only those measures taken by the commanding officer for the protection of his airdrome.

9. The selection of an airdrome depends upon several circumstances, such as accessability, distance from the front, size, security and shelter. In day bombardment it is essential to select a large field. Airplanes loaded with bombs require a long runway to take off. As they climb slowly they must have considerable distance in which to attain sufficient altitude to clear the natural obstacles which generally surround a field. The necessity, especially during an offensive, to take off on short notice, and to take up formation quickly, requires the squadrons to leave the ground together. Therefore, a large airdrome is absolutely essential for the efficiency of the group.

10. Day bombardment airdromes as a general rule are situated at 35 kilometers from the front lines that the airplanes may attain their bombing altitude without making unnecessary detours before crossing the lines. Working within the limits above laid down the selection of an airdrome, as regards security, should be made with a consideration of the following principles:

It should be away from all landmarks which are visible at night, such as streams, intersecting highways, and large cities. An airdrome situated alongside a forest affords great security, as the hangars and buildings can be concealed among the trees. Care should be taken to place the hangars on a well defended edge of the forest. The day bombardment fields at Amanty and Maulan were good examples of forest security. On many occasions enemy night bombers could be heard circling the forest, but the airdromes were never hit by even stray bombs. These airdromes were also good examples of camouflaging material. The colors of the hangars, and buildings, blended so well with the colors of the forests that it was difficult to locate either airdrome even in daylight, especially if the clouds were low and the known landmarks in the vicinity hidden. The hangars should be spaced at least 100 meters apart so that the maximum effect of one bomb would be one hangar. All hangars and buildings should be camouflaged to blend with the surrounding color. As most night raiders carry incendiary bombs great care

must be taken in choosing camouflage material and in the disposition of inflamables. The gasoline stores must be placed a safe distance from the hangars or other likely targets.

12. The distance of day bombardment airdromes from the front usually is a sufficient safeguard against daylight raids. But it is always well to organize a system of defense against low flying enemy airplanes. This defense usually consists of machine gun emplacements around the airdrome so placed that the enemy airplanes will have to pass through a barrage before reaching a bombing position over the hangars. At times the exigencies of the service make it necessary for day bombardment airdromes to be placed close to the front, as for example, when operating in a constricted area. When airdromes are close to the front, earthworks and bombproof shelters must be erected around quarters as protection for the personnel against air raids and shell fire.

13. Each group should be mobile, and should have ample transportation facilities to move all its material in case of a general advance or retreat. Lack of transportation has occasioned great losses in material. Units operating near the lines should have their supplies or spare parts packed in boxes with hinged doors, to be loaded on trucks at the first alarm. The offices should be in trailers so that all the records can be carried away. Orders covering emergencies should be prepared in advance and understood by those responsible for carrying them into effect.

Chapter VI.[11] Group Organization

16. Group Commander.
Group Operations officer.
Group Adjutant.
Group Armament Officer.
Group Supply Officer.
Group Instrument officer.
Group Radio officer.
Group Photographic Officer.
Group Officer in charge of flying field.
Group Police officer.
Group Surgeon.
Group Transportation officer.

17. The efficiency of a group depends primarily upon the organization of its commissioned personnel. The principal duties of the group officers are here designated in order of importance.

11. The index in Gorrell's History, D–1, p 165, lists Chapter IV, Orders, and Chapter V, Marches and Convoys, which are omitted from the text, D–1, p 236. Those two chapters are included in *Circular* 76 by reference to the pertinent chapters of Part I.

Group Commander

18. The group commander has all the administrative duties of a post commander. He is also responsible for the operations of his group, the orders for which he receives from the G–3 Army through the Army Air Service Commander. In compliance with these operation orders he issues orders to his squadron commanders for the execution of the designated missions. Unless specifically covered in orders from higher authority the group commander's orders cover the following essentials:

(a) The number of formations and the number of airplanes in each.

(b) The types and weights of projectiles to be used.

(c) The time of departure, the order of departure of each formation, the route, altitude, and time of arrival at objective.

The duties of the group commander should be so coordinated that the minimum amount of time will be spent in the office. It is essential for him to keep in personal touch with all his squadron commanders, and to create a feeling of sympathy with all his flying personnel. Flight commanders and leading observers should feel at liberty to make suggestions to him regarding changes in the execution of raids, which is possible only if he adopts an attitude of sympathy toward the elements of his command. He must make frequent visits to group commanders of the other branches of aviation, especially those of pursuit groups, as such conferences are the surest means of acquiring cooperation in aviation as a whole, and of putting into effect in his group the best methods used by all the others. It is his duty to instruct his squadron commanders fully regarding the parts their respective squadrons will take in the raids. He must be a flying officer, and should participate in such raids as his duties will permit. It is absolutely essential for him to participate in enough over-the-lines duty to become familiar with the actual execution of raids. With the development of the wireless telephone he will be able to direct the execution of a bombing raid from a point of vantage impossible to a formation leader.

Operations Officer

19. The operations officer will carry out the will of the group commander much the same as an adjutant does that of a post commander. He should be chosen for his executive ability, preferably a leading observer who has had considerable experience over the lines. He will have immediate supervision of group operations. It is his duty:

(a) To compile and keep available for the group commander and flying personnel all information of value in the preparation of bombing raids.

(b) To keep an indexed file of photographs, and a supply of maps for the pilots and observers. He will post in the operations room a map of the sector (1 to 80,000, or 1 to 50,000 scales) in which the group is operating, also a map (1 to 200,000) showing the lines of the entire front with the changes as they occur. For the instruction of the flying personnel he will post maps upon which are indicated the location of all anti-aircraft batteries, airdromes, artillery positions, hospitals and balloons, both our own and those of the enemy.

(c) To post on a bulletin board all orders and communications, and all bulletins of the Army, Army corps and divisions, which may be of interest to pilots and observers of the group.

(d) To transmit all information obtained from squadron operations officers to the Army Air Service Commander, and to file the raid reports of each squadron with the records of the group.

(e) To supervise the work of the group photographic officer, to see that all possible photographs of the raids are taken and proper distribution of the prints made.

(f) To supervise the work of group pilot and observer detailed to instruct new pilots and observers in the theory and practice of bombing.

(g) To instruct selected officers in the duties of the operations office, to supply operations officers to new squadrons.

(h) To post silhouettes of all types of our own and enemy airplanes in places where they can be studied by all pilots and observers.

(i) To keep in touch with the meteorological station, and to post at least twice daily the reports of weather and air conditions.

The group operations officer should keep intelligence charts showing all the bombing objectives, and mark daily on duplicate copies the bombardments effected. He should keep up to date all information of the number and types of enemy aircraft in the sector, their air tactics, and the best methods to combat them. He is responsible for the correct interpretations of the photographs taken by the group, and for utilizing the information thus obtained. He is further responsible for the establishing and maintenance of internal liaison, liaison with G-2 Army, A.A.S.C., and all the pursuit wings and other groups.

Armament Officer.

20. The duties of the group armament officer are:

(a) To exercise general supervision over the entire armament of the group.

(b) To advise the group commander on the best types of bombs available for a particular purpose.

(c) To maintain a close liaison with the ordnance department that the squadrons may obtain, at the earliest date, any improvements in bombs, ammunition, guns or armor.

(d) To maintain a personal liaison with the armament officers of all aviation units, and to take advantage of the improvements evolved by them.

(e) To advise the supply officer of the needs of the group in armament, and see that requisitions are made out to supply them.

The duties of the armament officer are very important in the group. He is responsible for the storing and care of explosives, and for the protection of the airplanes against incendiary bullets in combat. He should be an officer of great initiative as most of the improvements in armament will be developed from suggestions made by him to the ordnance department. Nearly all real and effective improvements result from experience gained at the front.

Supply Officer

21. The main duty of the group supply officer is to keep on hand an adequate but not an over supply of spare parts. Enough spare parts is necessary to permit the group to operate at maximum efficiency; an over supply decreases the mobility of the unit when ordered to move. It requires a constant study of the spare parts used by the group to estimate the amount necessary. To prevent an over accumulation of spare parts the group supply officer must supervise the work of the squadron officers and issue spare parts to

the squadron only when actually needed for particular repairs. By personal visits to the parks one can learn what supplies are on hand, and what expected, and thus avoid submitting many useless requisitions.

Instrument Officer.

22. The duties of the instrument officer are:

(a) To keep in adjustment all delicate instruments used in bombing.

(b) To keep up to date information on the manufacture and improvement of such instruments.

(c) To recommend improvements in the instruments and requisition new and improved types.

Radio Officer.

23. The duties of the Group Radio officer are:

(a) To supervise the installation and testing of all radio equipment.

(b) To install and test all wireless telephones.

(c) To operate the radio station.

(d) To carry out orders from the group operations officer in establishing liaison with all other radio stations at the front.

Photographic Officer

24. The duties of the group photographic officer are:

(a) To command the photographic section.

(b) To supervise the care and installation in the airplanes of all the cameras.

(c) To see that all plates are properly developed and prints made.

(d) To see that all prints are properly marked.

(e) To make the correct interpretations of the photographs.

(f) To see that the observers are efficient in the manipulation of the camera.

(g) To collect all the cameras after a raid, and to assume responsibility for the plates exposed by the observers.

Officer in Charge of Flying Field.

25. The officer in charge of the flying field is responsible for discipline on the field. His duties include the following:

(a) That pilots comply strictly with the rules for taking off and landing, and for piloting while in the air.

(b) That the sleeves are properly placed and working all the time.

(c) That the landing T is always out in the day time to indicate exactly the direction of the wind.

(d) That flares and landing flights are ready and properly placed to aid airplanes landing after night has fallen.

(e) That all wrecked airplanes are removed from the airdrome without delay.

(f) To superintend the maintenance of the terrain of the airdrome that the field be in the best possible condition for airplanes to take off and land.

(g) To see that airplanes parked outside the hangars are properly aligned.

The officer in charge of the flying field has a very important bearing on the proper functioning of the group. His discipline must be very strict. Many infractions of the field rules are made by pilots returning from a raid in which the airplanes have suffered from anti-aircraft or enemy

airplane attacks. The officer in charge of the flying field must report every breach of discipline to the group commander. There is a tendency for the group commander to overlook breaches of discipline when there has been a severe combat, but the field officer must enforce the flying rules to safeguard against accidents. The officer in charge of the flying field also assumes command of the ground targets for aerial gunners. He should see that the targets are properly placed, and danger flags sent up during practice.

Police Officers.

26. The police officer can be given the odd jobs which do not seem important, but which must be done for the proper maintenance of the group, when operating against the enemy. It is his duty:

(a) To see that the camp is kept clean.

(b) To see that all oil, gasoline drums and other material which cannot be sheltered are properly placed and neatly arranged.

(c) To see that necessary walks are laid out and maintained.

(d) To take proper precautions to protect the camp against fire, and to see that fire fighting facilities are maintained.

(e) To see that the enlisted personnel use the latrines ordered by the surgeon, and when a group occupies an airdrome temporarily it is difficult to make the enlisted personnel observe the above regulation.

(f) To see that an airdrome when evacuated is left in proper condition.

Surgeon.

27. The surgeon cares for the health and sanitation of the group. Close supervision of the group surgeon by the group commander is necessary. He should have a comfortable building as a hospital in which to treat flying personnel suffering from only temporary ailments. There is a tendency on the part of most group surgeons to evacuate pilots and observers for a month or more for slight indispositions which could be cured in three days at the group hospital.

The group surgeon will see that a medical officer is on duty during flying hours, and an ambulance with a driver on the field.

Group Transportation Officer.

28. The principal duty of the group transportation officer is the care of all transportation.

(a) He will make requisition on the group supply officer for

all transportation and spare parts needed.

(b) He will supervise the employment of the transportation in all marches and convoys.

(c) He will see that his chauffeurs are properly instructed in all traffic regulations.

(d) He will see that his enlisted personnel is properly instructed in the care and upkeep of all motor vehicles.

(e) He will see that no transportation is driven from the park that is not in proper condition.

(f) He will be directly under the supervision of the group commander, and will assign no transportation without his consent.

Group Adjutant.

29. The group adjutant will carry out the administrative duties of the group, and will bear the same relation to the group commander that the adjutant of a post does to the post commander.

Chapter VII. The Squadron

30. Squadron commander.
Adjutant.
Operations officer.
Ordnance officer.
Engineer officer.
Supply officer.

31. The squadron commander is responsible for the operations of his squadron. He should be a natural leader of men. His squadron will have no more initiative than he personally shows, nor will the morale of his command be higher than his own. He must be a flying officer and must so perfect his organization as to have time to lead frequent raids. His adjutant must be capable of looking after the preparation of raids. Squadron commanders should be chosen from the best flight leaders gifted with executive ability. His more specific duties are:

(a) To issue orders necessary for the execution of missions.

(b) To give special instruction to his flight leaders on points not covered by the Operations officer.

(c) To give personal instruction to his flying personnel on the tactics employed in the execution of missions.

(d) To acquire sufficient intimacy with his flying officers to enable him to judiciously select pilots and observers for special missions.

Adjutant.

32. To the adjutant fall the administrative duties of the squadron.

Operations Officer.

33. The duties of the operations officer include:

(a) To compile and keep available for the squadron commander and flying personnel all information of value in the preparation of bombing raids.

(b) To keep an indexed file of photographs, and a supply of maps for the pilots and observers. He will post in the operations room a map of the sector (1 to 80,000, or 1 to 50,000) in which the squadron is operating, also a map (1 to 200,000) showing the lines of the entire front with the changes as they occur. For the instruction of the flying personnel he will post maps upon which are indicated the location of all anti-aircraft batteries, airdromes, artillery positions, hospitals and balloons, both our own and those of the enemy.

(c) To post on a bulletin board all orders and communications, and all bulletins of the Army, army corps or divisions, which may be of interest to pilots and observers of the squadron.

(d) To post silhouettes of all types of our own and enemy airplanes in places where they can be studied by pilots and observers.

(e) To instruct selected officers in the duties of the squadron operations officer.

(f) To make proper preparations for all the raids.

(g) To compile all information submitted by pilots and observers returning from a raid and make written report of same to group operations officer.

(h) To see that the orders of the squadron commander are transmitted to the flying personnel.

(i) To maintain an operations room similar to that of the group operations officer.

Ordnance Officer.

34. The ordnance officer is under the supervision of the group armament officer, and is responsible for the armament of the squadron. His duties are:

(a) To test and calibrate all ammunition.

(b) To supervise the care of all machine guns.

(c) To synchronize all machine guns mounted to shoot through the propeller, and to adjust all sights.

(d) To supervise placing the bombs on all airplanes scheduled for raids.

(e) To see that all bomb sights and bomb racks function properly.

(f) To test all pyrotechnics.

(g) To care for all the explosives in the squadron.

(h) To see that all machine guns mounted for a raid function properly.

Engineer Officer.

35. The engineer officer has supervision of all the airplanes, spare parts and the E. & R. shops. His duties are:

(a) To supervise the overhauling of all motors and the aligning of all airplanes, and to make all necessary repairs.

Supply Officer

36. The duties of the squadron supply officer are:

(a) To take charge of squadron stores and supplies.

(b) To make necessary requisitions to the group supply officer for supplies needed in the operations of the squadron.

Chapter VIII. Preliminary Training at the Front

37. No matter how thorough the course of training given at the instruction centers, no bombardment unit is prepared to begin actual operations against the enemy when it arrives at the front. The knowledge that the enemy is but twenty minutes away brings home to the pilots and observers the realities of war. Flying behind the lines, and a short review of the things they have learned at training schools, soon impress them with these realities, and lead to rapid and real preparation for work over the lines.

38. The pilots and observers will be given a review of their theoretical course of instruction to ascertain their fitness for further service. If their previous training is found to be sufficient they will be taught from maps the exact location of the lines, and all the topographical features of the sector. Special attention will be directed to prominent landmarks. They will acquaint themselves with the position of all our troops, anti-aircraft batteries, as well as those of the enemy. They must learn the location of all bombing objectives and be able to identify them from photographs. They must be able to identify at a glance silhouettes of all our own and enemy airplanes. They will be given instruction in the enemy methods of attack and our

tactics for defense. Formation flights will be made every day, approaching nearer to the lines. Pilots and observers who are paired off in teams will always fly together when possible. They should live together in the same quarters, and know each other intimately. On the practice flights the pilots will be given an objective, and the time will be fixed for leaving the ground and bombing the target. The formation will pass over the flying field at a given altitude for inspection by the commanding officer.

39. When the flight returns to the airdrome the signal to break formation will be given by the leading observer. The pilots will obey the rules of the flying field, landing with the T, and in rotation. This practice will be continued until the pilots and observers know the sector perfectly and can adhere to the time schedule while flying tight formation with a full load of bombs. The observers will make observations, practice signals with Very pistols, take photographs, and submit raid reports to the operations officer immediately after landing.

During this period the pilots and observers will be given instruction in aerial gunnery with shooting practice at ground targets. The Observers must become expert machine gunners to be successful in combat with hostile aircraft. This training will give the squadron commander an opportunity to select his flight leaders, and the observers who are to specialize in photography, reconnaissance and protection.

40. Leading observers will be chosen from those making the best records at the bombing schools. After operations have begun other observers will be given an opportunity to qualify in leading. Some observers make excellent records in training centers, but fail in duty over the lines, and vice versa. After this training the squadron will be ready to begin real operations. Large targets which are close to the lines and easy to hit should be chosen as objectives for the first raids.

Chapter IX. Preparation for a Raid

41. Day bombardment objectives will be designated by G–3 of the Army, and transmitted through the Army Air Service Commander to the commander of the group. Upon receipt of those orders he will decide upon the following:

(a) The number of formations and the number of airplanes in each.

(b) The types and weights of projectiles to be carried.

(c) The route, altitude, and time of departure and arrival over objective of each formation.

(d) The method of pursuit cooperation.

The pilots and observers must be allowed ample time to acquaint themselves with all available information regarding the objective, both primary and secondary, the route, and the region to be observed and photographed. The squadron commanders will designate the pilots and observers who are to participate in the raid, and are responsible for their preparation for the execution of the mission. They will designate their flight leaders, and deputy flight leaders, and will assign positions in the formation to the rest of the teams scheduled for the raid. The squadron operations officers will then prepare the operation order, a copy of which will be sent to the group operations officer.

The Formations

42. Day bombardment squadrons will invariably work in formation. The formation should be large, as many as eighteen airplanes being easily controlled by a leader when working at high altitude. For low flying formations in bad weather, eight is the maximum that can be employed. All formations must have the following characteristics:

(a) Simplicity.
(b) No dead angles.
(c) Concentration of fire to the rear.
(d) Concentration of fire below the center of the formation.
(e) Compactness.
(f) Each airplane must be able to see the leader.

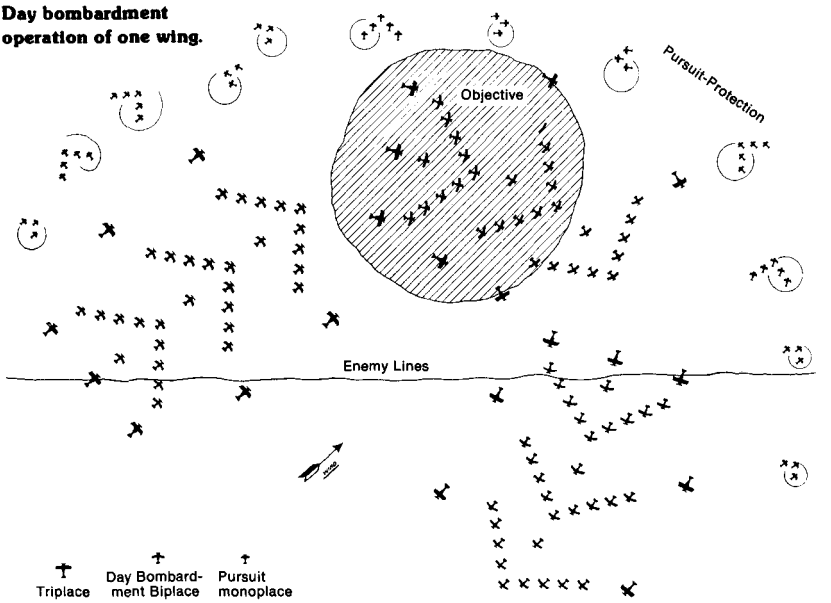
All formations, whatever the number, should fly in a "V" formation with the rear of the V closed. Formations of more than ten should have one airplane in the center of the V at the average altitude of the V. Airplanes in formation should be numbered as follows:

```
        1
      3   2
    5   12   4
  7            6
9   11    10    8
```

Number 1 is the leader and flies at the lowest altitude, Numbers 2, and 3, 4 and 5, and similarly placed pairs should fly at the same altitude, numbers 2 and 3 about fifty meters higher than number 1, and about thirty meters to the right and left of number 1, respectively. Number 4 takes the same position relative to number 2 and number 2 with reference to number 1; and number 6 takes the same position with relation to number 3.

Formations should be as compact as possible, especially when dropping projectiles; during a combat, formations should close

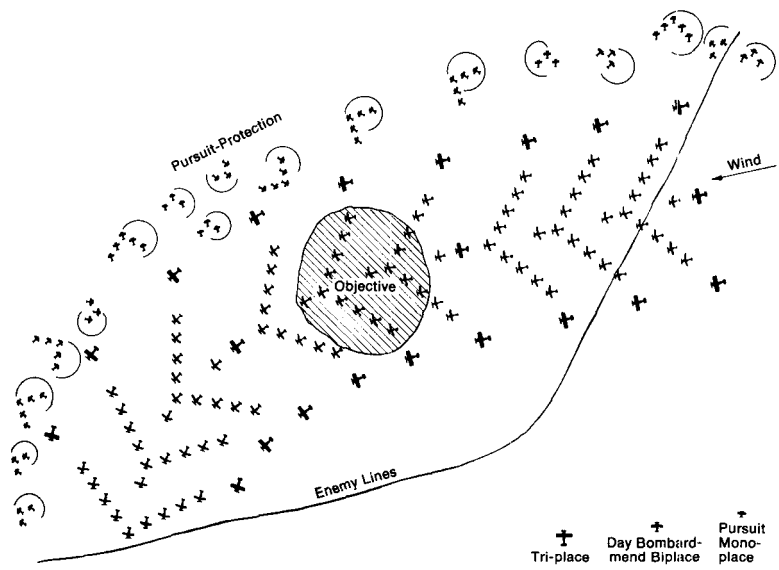
Day bombardment operation of one wing.



up. Too much emphasis cannot be laid upon the training of day bombardment pilots in formation flying. If the pilots maintain a regular echelonment in height, in case of emergency they can close up quickly upon the leader by diving. The leader should never open his throttle wide, and observers should always warn their pilots whenever their own or any other airplane appears to be getting out of formation. It is fatal for an airplane to leave the formation, and the formation should not be broken up to protect an airplane which has dropped out.

The Take Off

43. The pilots and observers should be in readiness on the field at least thirty minutes before the formation is scheduled to leave the ground, reporting to the respective operations officers. This will give the operations officers time to place any unavailable pilots or observers. The pilots will utilize this time to make a thorough inspection of their airplanes and test their motors, and the observers to arrange their maps, Very pistols, ammunition drums and to inspect their machine guns. If the flying field is sufficiently large the formation will be assembled on the ground. The flight leader and pilots 2 and 3 leave the ground simultaneously; 4 and 5 will start as soon as the wheels of 2 and 3 are in the air, and so on until the whole formation is in flight. The leader will throttle down as soon as he has attained sufficient altitude to do so with safety. When all the airplanes are in position the flight leader may make up traveling speed in climbing, but never full speed. The only practicable formation maneuver is a figure 8 on a wide circuit of about five kilometers.



Day bombardment operation of one wing.

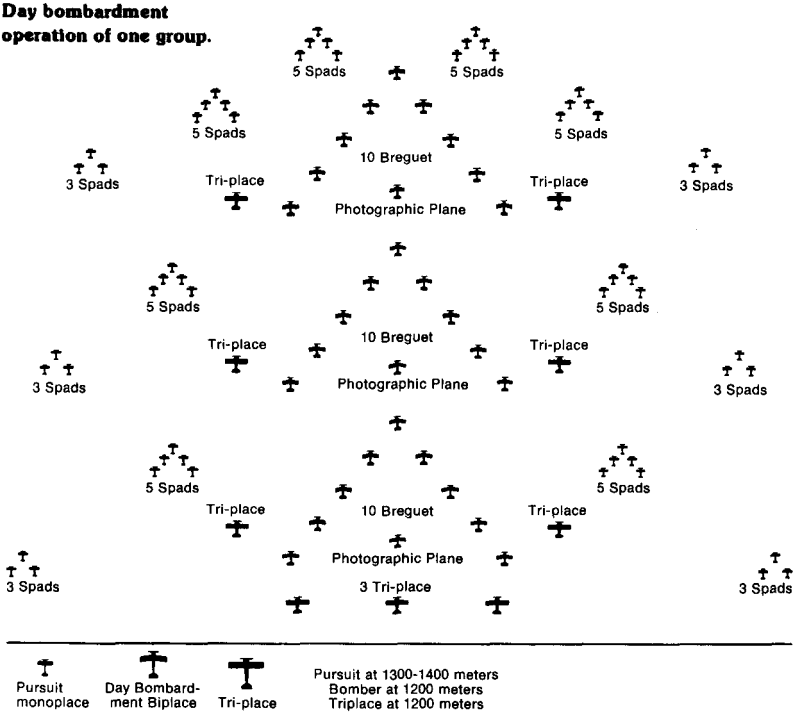
Flight to the Objective

44. The formation will attain an altitude of about 1000 meters in the vicinity of the airdrome, and then upon the signal of one white star from the leading airplane, follow the prescribed course to the lines. The bombing altitude, generally 4,000 meters or higher, must be attained before the formation is within five kilometers of the lines, in order that the leading observer may make the calculations necessary for the adjustments of his sight without being molested by anti-aircraft fire or enemy airplanes. The target may be approached either up or down wind. The formation should be tight upon crossing the lines. Any airplane which cannot hold its position in the formation must return to the airdrome.

Bombing the Objective

45. When nearing the objective the leading observer will steer his pilots by means of reins attached to the pilot's arms. This is necessary because the pilot has a limited visibility of objects directly under his airplane. The leading observer should recheck his calculations, and then fire the "Prepare to Bomb" signal of six green stars. When the image of the target appears at the black line in the bomb sight he will pull the bomb dropping lever. All other observers, or pilots as the case may be, will release their

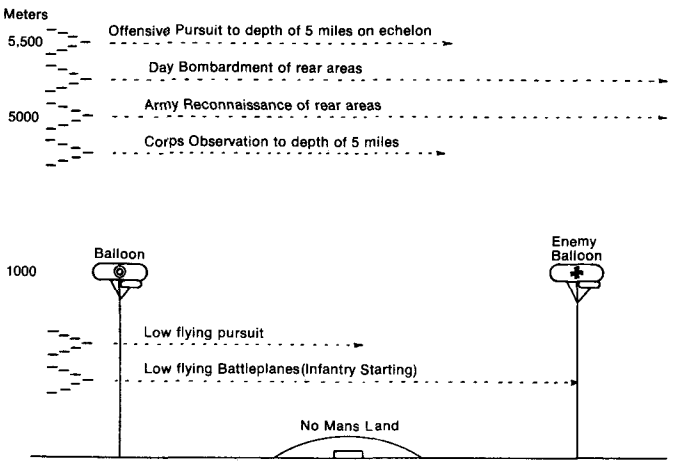
Day bombardment operation of one group.



bombs the moment those of the leading airplane are seen to leave the racks. Great accuracy has been obtained by using this method of bombing. Precision bombing over the lines is an art in which only a few observers excel. Such observers should be chosen for leading or deputy positions. Bomb sighting requires cool judgment and intensive observation of the target. Excitement causes inaccuracies. If but one observer does the sighting he knows that all the others are acting as protection, and his excitement is thus lessened.

46. When several formations are sent to bomb the same objective they should bomb at thirty second intervals. Upon leaving the objective they should all turn in the same direction. In the performance of a day bombardment mission it is essential that the formations reach the objectives exactly on time in order that successful cooperation with the pursuit units designated may be assured. With successful pursuit cooperation great damage can be inflicted upon the enemy with the minimum losses to both day bombardment and pursuit.

Chart Showing Functions of Different Branches of Air Service.



An observer and pilot demonstrate steering the pilot to the objective by reins.

During the Argonne-Meuse offensive the cooperation between day bombardment and pursuit was responsible for seventy-five per cent of the enemy airplanes brought down by the 1st Pursuit Wing.

The Return Route

47. To spend the minimum amount of time over hostile territory is the aim of every formation leader. The route from the objective back to the lines must be chosen with consideration of the direction of the wind, the position of the sun, the location of cloud banks, the most accurate enemy anti-aircraft batteries, and the probable direction of attack by enemy aircraft. If the presence of hostile aircraft does not make it inadvisable the formation leader should always take the advantage of the wind to regain the lines. It is sometimes advisable to fly toward the sun, and thus put the enemy under the disadvantage of facing the strong light. The leader should avoid passing under clouds which offer concealment to hostile airplanes. Clouds under the formation or at the same level, may be utilized for protection. Frequent changes of direction should be made, but they should be made slowly. Rapid changes of direction may cause a rear airplane to lag, which usually results in its destruction. Speed does not enter very much into the safe return of the formation. The formation should be formed to afford no vulnerable point of attack, as its safety depends upon its fire superiority.

Breaking Formation and Landing

48. Having recrossed the lines, beyond which enemy pursuit airplanes seldom venture, the formation leader begins a long glide toward the airdrome. When nearing the landing field the leading observer fires a green rocket as a signal to break formation. The airplanes circle the airdrome and land according to number in formation, Number 1 first, followed by Number 2, and so on. All airplanes land into the wind, as indicated by the T. The landing rules must be strictly observed. The observers and pilots report immediately to their respective operations officers on the field, and submit written raid reports, which include results of the bombardment, observations of enemy movements on the ground and in the air, the number of enemy airplanes brought down, and our own losses.

Low Bombing Raids

49. At the beginning of an advance, or during an offensive, by either friendly or hostile troops, there are occasions when day bombardment must resort to low bombing. Such conditions arise when the weather conditions are such that altitude cannot be attained to carry out the imperative bombardments. Other occasions are when certain bridges must be destroyed, but the topographical features around the objective make it impossible for artillery fire to accomplish that destruction. Day

bombardment must be used at low altitudes against such objectives.

50. The time element often prevents the accomplishment of such missions. The day bombardment airdromes are at considerable distance from the front lines, and time is required for transmitting the information, and for warming up the high powered engines. Often the conditions have changed before the bombers arrive at the objective. A heavily loaded bombing airplane is slow in climbing and maneuvers, and therefore unsuited for this kind of work. The best type of airplane for low bombing is one that can climb and maneuver quickly. The rotary engine, which is air cooled, and can be started very readily, and which continues to run after being hit by enemy bullets, would, therefore be better than the fixed motor for low bombing. The accuracy and volume of ground fire causes so many losses that low bombing is extremely costly, even if our forces have supremacy of the air.

51. When orders are received for a low bombing mission the group commander decides the number of airplanes to be sent in formation, never more than six. Great care should be taken in selecting the leader. He should be daring and know the terrain perfectly, and the exact location of our own troops. The pilots should be chosen for their skill and daring, as there is always danger of collisions when the bombers operate at very low altitudes. When descending to bomb the pilots should "strafe" the objective, to demoralize the enemy and prevent accurate fire from the ground. The observers use their machine guns before and after they have released the bombs.

Chapter X. Combat

52. *General Principles.* The three general tactical principles in order of their importance are:

(a) The effective bombing of the objective.

(b) The reduction of our losses to a minimum.

(c) The inflicting of the greatest losses to enemy aviation. Tactics of day bombardment in combat are, therefore, defensive.

53. Due to the size of a bombing formation, and the slow maneuvers necessary, quick changes of direction and steep dives are impracticable. The bombers must depend upon the nature of their formation, which should be such as to give them fire superiority. The formation should have symmetry, simplicity and compactness, with no dead angles, and should permit a concentration of fire to the rear and below the center. Each pilot must be able to see the leader. A formation so formed, with well trained pilots and observers, can defend itself against superior numbers of the enemy.

54. The formation is limited to the number of airplanes which can be maneuvered by a formation leader. The importance of the objective determines the number of airplanes to be employed in a particular raid. When the number required is greater than can be used in one formation the mission passes from squadron size to that of the

group. The plan of group bombing is analogous to the chain formation employed by pursuit aviation. The several flight leaders are subordinate to the leader of the leading formation, and must make their tactics correspond to his. It is a governing principle that the chain of responsibility must never be broken, from airplane to airplane in the squadron, and from formation to formation in the group. This leads to the question of formation leaders, upon whom the success or failure of operations very largely depends.

Formation Leader

55. A formation leader to be successful must have the absolute confidence of his pilots and observers. Under definite orders at all times, much depends upon his quick decisions and accurate estimates of tactical situations. The tactical situation often changes his plans. The appearance of cloud banks, a change in the direction of the wind, a sudden burst of sunlight, or new methods of attack by the enemy, make it imperative for him to think and act quickly to carry out his mission in the face of altered conditions. He must know just what reliance can be placed on each pilot. He must so arrange his pilots, and the chain of responsibility in the formation, that no matter how great the losses incurred the formation will preserve its units. He must be a model of discipline, and enforce the same from his pilots. Though tempting aircraft targets often appear he must remember that the safety of the formation depends upon its unity, and neither he nor any other pilot should break formation to attack individually. He must sacrifice chances for personal glory in combat to the object of his mission, which is to reach and bomb the objective and return without loss.

Enemy Methods of Attack

56. The deciding element in aerial combat is usually surprise. The enemy will employ all means at his disposal to conceal his approach. His most usual methods are to climb into the sun, and approach from that direction with the advantage of light and altitude. When the enemy gets between a formation and the sun he often escapes detection until he actually opens fire. He will also take advantage of cloud banks to screen his approach. Sometimes when operating as a chain one flight of enemy pursuit airplanes will follow the bombers to attract their attention, while other flights approach unnoticed. His aim is to break up the formation, or at least isolate several of the bombers, and then by concentration to destroy them. Sometimes a single enemy pursuit airplane will fly below and in front of the formation in an attempt to entice a bombing pilot to dive at him. Other enemy airplanes, at greater altitudes, will immediately dive on the bomber thus separated from the formation.

57. Having decided to attack, several of the enemy usually approach from the rear, and open fire at about 200 meters. While the observers are engaged with those at the rear other attacking airplanes will dive under the formation and attack from the dead angle under the tail. This attack is usually directed at the airplanes at the rear of the formation. Other airplanes will dive

rapidly at either side of the formation and rake the whole arm of the V with deflection fire. One, or perhaps two, will try to shoot down the leader, and thus break up the formation. Occasionally when the enemy has vastly superior numbers, he will make a determined rush at the formation. This attack, when made by experienced flights, is very hard to combat, especially if the bombers are inexperienced. An enemy formation sometimes flies parallel to the bombing formation at slightly greater altitude. In an attack of this kind the individual pilots make sudden dives at the flank of the bombers, deliver their bursts, and then sideslip to safety before regaining their positions alongside and above the formation.

Methods of Defense

58. The observer first to sight enemy airplanes fires a rocket of six red stars. The formation tightens up, and the observers fire at the nearest enemy airplanes. Fire is concentrated upon the leading airplanes until they turn back, or are brought down. When this is accomplished fire is brought to bear on the enemy airplanes which venture closest to the formation. During a combat the pilots watch the progress of the fighting by means of mirrors, and endeavor to maneuver their airplanes into the best firing positions for the observers, and at the same time keep their places in formation. The formation leader maneuvers to take advantage of the wind, clouds and sunlight. He should never increase the formation speed beyond that possible to the slowest airplane in the formation. In a group operation he will lead his formation so the guns of the other formations can be brought to bear on the enemy. The leaders of the other formations will maneuver to conform to the necessities of group protection. If an observer has his guns completely jammed, or if he is too badly wounded to operate his guns, the pilot will fly directly below the leader for protection. If a motor is put out of commission the pilot will attempt to regain the lines. The leader can sometimes maneuver a formation to protect a pilot who has been forced to drop out, but no pilot will leave the formation for that purpose. The leader must always bear in mind the prearranged cooperation with the pursuit, and try to lead the enemy toward the rendezvous. The pursuit airplanes can inflict great losses by attacking when the enemy is engaged with the bombers.

Tactics of a Single Two-Seater

59. When a bombing airplane becomes separated from the formation the pilot and observer generally have to fight their way back to the lines. A large bombing formation attracts enemy pursuit airplanes from over a wide area. Pilots with motor trouble, or forced to drop behind because of broken control wires, are attacked by enemy airplanes from the main combat as well as those which were too late to attack the formation proper. When thus attacked the pilot must fly an irregular course. He must give his observer every chance to fire bursts at favorable targets, and try to reach the lines as quickly as possible. If the attacking airplanes are numerous, and the pilot, considering the disability of his airplane, sees no chance to cut his way through, it is well to make a tight spiral in descending. Often a pilot can risk the accuracy of ground fire if such a maneuver would throw off the attacking airplanes.

Part V. Balloons

Chapter I. Organization

1. The Mobile Army. There should be a balloon company for each division, one for each corps, and three companies as reserve balloons for each army. These companies should be completely motorized in order to assure efficient functioning with the elements of the army with which they are working.

2. Tables of Organization. The details of organization, the amounts and kinds of transportation, and the factors on which the allowance of transportation is based are fixed in the Tables of Organization, Air Service, U.S. Army.

Within a corps, a balloon company should be assigned to each division and one to the corps. These assignments should be permanent or at least continue while the divisions are with the corps, so that perfect liaison can be established.

Chapter II. Information

1. That which is collected in time of peace. This consists of a study of maps, of types of balloons and airplanes of our own and other nations, and of such other information as is available.

2. That which is gathered in time of hostilities. This consists of all information gathered during hostilities by balloon companies at the front. In general this information is only that which is seen from the basket, relative to troop movements, destructions, enemy batteries, infantry actions, information on our own artillery fire, flares, explosions, fires, etc. This information is transmitted to the Information and Operation Sections of the General Staff of the unit with which the balloon is working. The means of communication is usually the telephone, but in the event of the failure of this means, recourse is had to radio-telegraphy, radio-telephony, visual signalling, or runner.

3. The only other reconnaissance which balloon personnel is called upon to make is that by balloon observers in airplanes to make themselves more familiar

with the immediate field of operations.

4. Reports. In addition to routine administrative reports, the following reports are submitted.

(a) By balloon companies to Group Headquarters.

(1) Daily balloon company report.

(2) Observers' ascension report.

(3) Report on enemy balloons.

(4) Daily hydrogen report.

(b) By Balloon Group to Balloon Wing, and to General Staff of unit with which employed.

(1) Daily Balloon Group Report.

(c) By Balloon Wing to Army Air Service Operation Section.

(1) Daily Balloon Wing Report.

Chapter III. Security

Security embraces all those measures taken by a balloon company to protect itself from observation, annoyance, or surprise by the enemy.

(a) From observation. This consists of all the ordinary precautions taken by troops in the field to prevent observation by the enemy. It further consists of all possible efforts to conceal the position of the balloon bed. This is effected by choosing defiladed positions which are also concealed by overhead screens such as trees, vines, etc. It is further effected by the use of vari-colored camouflage balloon fabric. When the balloon is out of its bed, great care should always be taken to leave nothing in the vicinity of the bed which would disclose its position. All machine gun and automatic cannon positions should be screened from observation. When the balloon is in the air, screening should be provided for the winch, tender and personnel from aerial observation. These points cannot be too highly emphasized as they are vitally essential to uninterrupted functioning.

(b) From annoyance. This consists of an equipment of machine guns and automatic cannon on anti-aircraft mounts manned by experienced personnel. As the chief source of annoyance by the enemy is their airplanes, specialists are trained in balloon companies whose only duties are to study continuously types of airplanes and to watch the sky for them. These lookouts and the anti-aircraft armament personnel must be highly trained. Furthermore, balloon company commanders must always arrange to have at least one anti-aircraft artillery battery within protective radius.

(c) From surprise. This consists of the usual precautions against surprise as well as the proper training and functioning of lookouts.

Chapter IV. Marches

A successful march, whether in peace or war, is one that places the company at its destination at the proper moment and in the best possible condition.

In war, marches are of frequent occurrence, and success depends in a great measure upon the skill with which they are conducted.

Balloon companies, being completely motorized, move always as a motor train.

There are two types of marches undertaken by balloon companies: those with the balloon inflated, and those with the balloon packed.

Marches with the balloon packed follow the rules and regulations prescribed for motor trains.

The rate and length of marches with the balloon inflated depend on the tactical situation entirely. The rate is dependent only on the rate of travel of the winch transporting the balloon.

The most common forms of obstacles encountered during a march with balloon inflated are wires crossing the road, camouflaging crossing the road, trees bordering the road, and tall buildings on narrow streets in villages. Wires may be either insulated or high tension, and radio antennae are sometimes found stretching across roads. These latter are usually on very high poles or from the tops of tall trees. It is usually considered advisable in crossing wires to pull the wires down and when the winch has crossed them, to fasten them up immediately. This is far better than cutting the wires and splicing them together afterwards. Sometimes, however, wires must be cut and if they are, they should be immediately repaired. Often, it will be necessary to maneuver the balloon over wires rather than to cut them or let them down, but the first two methods are better if the number of wires is not too great. In maneuvering the balloon over wires, use can be made of the tender in conjunction with the winch, or by throwing the maneuvering ropes over the obstacles one by one and slowly working the balloon over in that manner.

With reference to maneuvering around trees, the height of the trees must be considered, their proximity to the road, extent to which branches reach over road, and the velocity and direction of the wind. The maneuvering spider[12] can usually be used to very good advantage in passing trees, and they may often be maneuvered around by what is known as "jockeying." This consists of taking the opportunity, when the balloon swings back and forth in the wind, of catching it at the right angle and driving quickly past the tree. Most trees, however, can be passed by running the winch on the windward side of the road and by the use of the maneuvering spider. Occasionally the balloon can be put up 100 meters higher than it is usually transported and then hauled down rapidly. This straightens out the cable and to some extent overcomes the action of the

12. The maneuvering spider consisted of several ropes—usually 4 in number, at least 1 inch in diameter to permit firm hand grasp, and usually about 25 feet long—spliced into a common eye which was fastened to the maneuvering block (pulley) through which passed the cable to the balloon. The winch to which the cable was attached was situated some distance from the block, the latter being weighted with sand bags so as to keep it down near, but not touching, the ground. The purpose of the spider was to provide a means of applying manpower to the block. By pulling on the ropes, men could haul down the balloon when the winch was out of order, or they could maneuver the block so as to bring the balloon around an obstacle.

wind on the balloon by the rapid descent. If at the same time the winch moves, the obstacle can be passed.

In passing through villages practically the same means can be used as in traveling along roads bordered with trees.

The usual maneuvering height of a balloon is about 100 meters. This, of course, varies with the wind.

Roads should be reconnoitered before the march so that the best roads can be picked.

In maneuvering with the balloon inflated, the train should be made up as follows:

(a) Light truck ahead carrying telephone material and personnel.

(b) Winch, with winch crew, maneuvering officer, and the balloon.

(c) The tender, transporting men of the maneuvering squad, and machine guns.

(d) The remainder of the trucks, in whatever order is deemed best by the company commander.

It is always more desirable to move by day than by night, but often, due to exigencies of the service, it becomes necessary to make night marches. If this becomes necessary a reconnaissance of the road by daylight is imperative. If it is possible to choose the time of marching, the early morning or the early evening are usually best as there is often a lull in the wind at those times.

Chapter V. Combat

1. Combat Principles.

(a) Duties of Company Commander. In addition to his regular administrative duties, the company commander must be responsible for the proper use of the balloon, its defence, its marches, choosing of new sites, reconnaissance of roads, liaison with units which he is working, communications, and supplies. He is assisted in the execution of these duties by the various officers within the company, but he himself is responsible for their proper accomplishment.

(b) Duties of Maneuvering Officer. The Maneuvering Officer has, under the supervision of the company commander, complete charge of the balloon and its accessories, the protection squad and the winch. He is responsible for the proper safeguarding of the balloon against attack, for the proper posting of his means of defense, for the safety of the observers, and for the housing and precautions against observations for his balloon.

(c) Protection against attack. Machine guns and automatic cannon should be so placed near the point of ascension as to give the best barrage against an attacking plane. Lookouts should be posted at most advantageous points from which they can scan the sky. They should be close enough to the ascension point, however, to permit of a clear transmission of warning by word of mouth.

(d) Liaison. Group Commanders and Company Commanders should strive at all times to be in perfect liaison with the heavier-than-air units in their sector, the commanding officers of units with which the companies are working and the various section of the General Staff of Corps and Divisions. This is of utmost importance.

(e) Combat Orders should be issued by Group Commanders to their balloons. Those orders should conform to the combat orders of the corps and divisions. They should assign duties, and prescribe routes of movement either forward or rearward.

(f) Army Balloon Wing Commanders are responsible for the reconnaissance of all roads in their sector. Maps should be published showing all roads passable for balloons. We should confer with Signal Officers of units in the Army and arrange so that no overhead wire crosses roads marked on the map "Balloon Roads." He should see to the placing of signs, such as "Balloon Road—No Overhead Wires," on all roads in the army sector which balloons may have to pass.

Offensive Combat

1. During offensive combat, companies assigned to divisions move with the troops of the division. The liaison officer at the divisional P.C. transmits information and orders to the company commander relative to movements. In order to assure a place in the line of march in advance, the balloon company should be attached to a neighboring artillery unit, and move with it. The details of routes and positions are, of course, decided upon before the advance takes place.

2. Being in a position, with liability to move forward, in addition to the regular net of telephone lines, a forward line should be run and a forward telephone central established. The line should be run as far forward as possible, and the advance central placed so that it will be convenient to the next contemplated stop. This facilitates uninterrupted telephone communication with units with which the balloon is working.

Defensive Combat

1. In a defensive sector, all roads to the rear should be reconnoitered and routes established by each company commander. On days when the balloon cannot ascend, the personnel of the company should be utilized to construct balloon beds and positions at intervals along the line of retirement as far to the rear as time permits.

2. As in a advance, telephone lines should be run to the rear, a rear central established, and as many telephone preparations as possible made for successive rearward positions.

Night Combat

1. Balloons cannot do a great deal of work at night. They are able to see flares, signals, etc., but locations cannot ordinarily be accurately determined. By means of an electric signalling device, messages can be sent from balloons to front line positions and to the rear. Balloons can also be used as a receiving point for messages.

Chapter VI. Artillery Adjustments

1. To insure efficient cooperation with Artillery for the regulation of fire, balloon officers should meet with the artillery officers each evening for the purpose of securing detailed information concerning the batteries which will fire the following day and the targets which they will engage. It is a general rule that the evening conference should arrange to divide the observation so that balloons will observe fire for all targets which can be seen from balloons. All other targets will have the fire regulated by the airplanes of an observation squadron. When personal liaison of this kind is impossible the information from the artillery should be obtained by telephone.

2. The balloon observers should know in advance the following:

Coordinates of targets.
Batteries which will fire.
Caliber and number of pieces to fire.
Nature of fire (salvo or one piece at a time).
Type of projectiles with time of flight and type of fuse.
Interval between shots.

3. After securing information concerning the targets the observer should then procure the firing maps and photographs covering the target area.

4. Adjustments are reported on the line battery target. Distances are reported in meters to the "right," "left," "over," and "short," stating first the deflection followed by the range, thus, "25 right," "50 over."

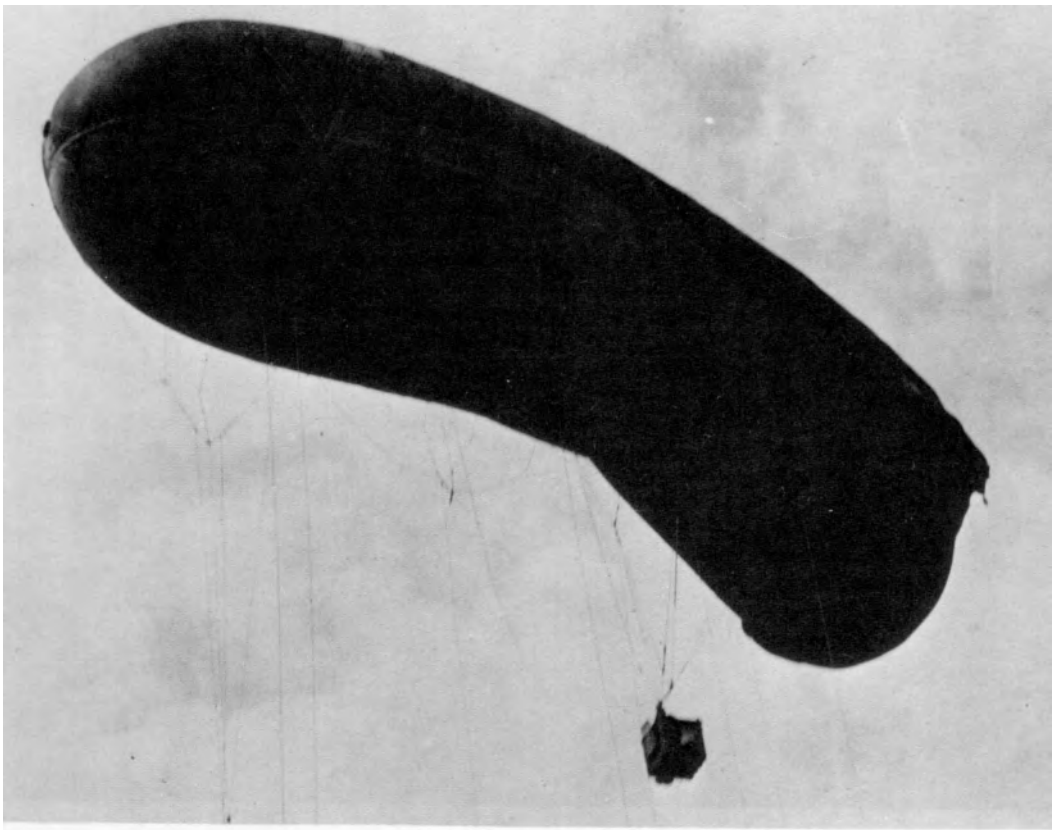
5. Figures are given by their digits, i.e., "two five right," "five zero over."

6. The telephone communication between balloon and battery should conform to the following example:

Battery: "Battery ready to fire."
Observer: "Ready to observe."
Battery: "No. 1 on the way, etc."
"No. 2 on the way, etc."
Observer: "No. 1 two five right, etc."

7. Shots should be reported "lost" if not seen, but reported as "not in position to observe" when the movement of the basket, a passing cloud, or other obstacle prevents a proper view of the target. When a salvo is reported "lost" by an observer the artillery fires the next salvo with data intermediate between that and the last salvo seen and the one lost, but if the report is "not in a position to observe," the salvo is repeated with the same data.

8. In order to observe successfully for several batteries simultaneously, it is necessary to have very efficient fire and telephone discipline; also knowing accurately the batteries which are to fire.



At left, Germans fire a captured French AA gun against Allied balloons.

DH-4. (art by Masami DaiJogo)

Appendices

A. Funds For Military Aviation[1] 1909–1918

1 Oct 1908	Allotted by Board of Ordnance and Fortifications	25,000[2]
4 Nov 1909	Allotted by Board of Ordnance and Fortifications	5,000[2]
3 Mar 1911	Appropriated by Congress, FY 1912	125,000[3]
24 Aug 1912	Appropriation for FY 1913	100,00
2 Mar 1913	Appropriation for FY 1914	125,000
27 Apr 1914	Appropriation for FY 1915	250,000[4]
4 Mar 1915	Appropriation for FY 1916	300,000
31 Mar 1916	Emergency Appropriation	500,000
29 Aug 1916	Appropriation for FY 1917	13,881,666[5]
14 Feb 1917	Aviation Seacoast Defenses	4,800,000
12 May 1917	Appropriation for FY 1918	10,800,000
12 Jun 1917	Seacoast Defense, Panama Canal	750,000
15 Jun 1917	Emergency Appropriation	43,450,000
24 Jul 1917	Emergency Appropriation	640,000,000
6 Oct 1917	Urgent Deficiency Act	8,300,000[6]
8 Jul 1918	Aviation Stations, Seacoast Defenses	8,000,000
9 Jul 1918	Emergency Appropriation	884,304,758
4 Nov 1918	Appropriation	60,000,000

1. Adapted from chart prepared by Historical Section, Information Group, Air Service, 23 May 1919, in *History of the Bureau of Aircraft Production* (reproduced by Hist. Off., AMC, 1951), Vol I, p 104.
2. For purchase of the Wright plane.
3. $25,000 available immediately.
4. $50,000 available immediately.
5. Includes $600,000 for purchasing land for aviation sites.
6. Allocation from $40,000,000 for Signal Service.

B. Squadron Plans and Programs
1917–1918

Document	Date of Plan or Program	Observation			Pursuit	Bombardment			Total Squadrons	Date for Completion of Plan or Project
		Corps	Army	Total		Day	Night	Total		
	10 Jul 17	15	24	39	15[a]			5	59	Dec 18
	18 Sep 17	15	24	80[b]	120[c]			60[d]	260	Dec 18
	1 Jan 18	(Ratio of 2 Obs to 6 Pur to 1 Bomb)							100	Dec 18
	6 Feb 18	(100 squadrons of 1 Jan 18 plus 20 bomb)							120	Dec 18
	5 Jun 18	15	24	39	120[e]	41	60	101	260	Jun 19
	29 Jul 18	49	52	101	147	55	55	110	358	Jun 19
	16 Aug 18	49	52	101	60	14	27	41	202	Jun 19

[a] Ten for corps and 5 for army aviation.
[b] In addition to corps and army, 41 for strategical aviation.
[c] In addition to corps (10) and army (5), 105 for strategical aviation.
[d] In addition to army aviation (5), 55 for strategical aviation.
[e] Divided between 40 monoplace and 80 biplace.

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