MAJ GEN CURTIS E. LE MAY

Combat Crew MANUAL

XX BOMBER COMMAND
APO 493

COMBAT CREW MANUAL

XX BOMBER COMMAND

December 1944

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FOREWORD

The success of the development of the B-29 is an outstanding example of the technical leadership and resourcefulness which is the American way of doing things. It typifies the energies of a nation that is willing to work and work hard, to learn, and to improve. The industry and resources of a great nation went into the development of the B-29. Without the foresight, experimentation, and study of many people the present operation of the B-29 would not have been possible.

You are charged with the responsibility of operating the B-29 in combat and of perfecting its employment to the highest degree. It is imperative that you be alert, conscientious, and learn by intensive training all you can about the operating of your airplane in the Asiatic Theatres.

This manual was prepared from many sources for your use. Study it. The material has been gathered to help improve the combat efficiency of both new and old crews, to serve as a reference, and to orient you not only in your job but in the job of others who work to help you put more bombs on the target. Nowhere in the conduct of warfare does study yield such direct and large returns as it does in aerial warfare; yet, nowhere is the standard so exacting as that of high altitude precision bombing. It is felt this training manual will contribute toward the goal of "MORE BOMBS ON THE TARGET" with a minimum of loss to our forces.

Curtis E. LeMay

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Major General, U. S. A.
Commanding

Headquarters
XX Bomber Command
APO 493

TRAINING

I. TRAINING

The object of a strategic air force is to disrupt the enemy's war economy. This object can be accomplished most effectively by destroying his facilities for producing war goods with special emphasis on those plants engaged in remedying deficits in equipment which are hardest to replace. Such plants are in general small targets, from a bombing viewpoint, and to knock them out usually requires accurate bombing by several formations. Now the value of a strategic air force depends upon how many strategic enemy targets it can destroy in a given time. This rate in turn depends on many factors: The number of aircraft it has, how well they are maintained, what bomb load they can carry, with what accuracy they can drop their bombs. In order to assess the relative importance of these factors a study has been made of the XX Bomber Command operations. The study indicates a very great increase in the effectiveness of the Command has recently come about and that a substantial part of this increase has been due to training. It shows, furthermore, that the cost of providing this training has been practically negligible compared to the results achieved.

Training and practice is given great emphasis in this Command. Probably it is felt sometimes that flying time is being wasted which might better be spent carrying more bombs to Japan. The study presented here shows such a view is not justified and that time spent in training is paying for itself many times over in bombs on the target.

Graphs A B and C of the following chart show the principal factors affecting the efficiency of a B-29 as a strategic bomber. Curve D combines the effects of the first three to give a single efficiency estimate. Let us consider each of the curves and how they combine to give an overall efficiency.

Graph A is probably the simplest. The upper curve gives simply the numbers of flying hours per month for a B-29 in this theatre. The average value for each month is shown by a "X". A smooth line has been drawn as a sort of average of the "X's". It represents the trend of the data and probably gives a truer picture of the situation than the monthly averages since the latter are more subject to chance fluctuations. From this curve we see that in November a B-29 will probably fly about 68 hours per month compared to about 40 hours in June. This means that a B-29 in November flies 1.7 times as many hours and is worth 1.7 times as much as a combat weapon. (This improvement is only to a small part due to the training of aircrews, the principal contributions having been increased experience of the maintenance personnel, modifications in the aircraft, and cooler weather.) The lower curve in Graph A shows the time available for operational use of the aircraft when the training time has been subtracted. The space between the curves represents training. The sharp downward bend in September, corresponding to an increase in training flying, is due to the lead crew school at Dudhkundi.

Graph B shows the improvement in load carrying capacity. In order to get this curve the situation on 20 October was taken as 100%. The improvement

is due to many factors, which are discussed below. The points on the graph were obtained as follows. It was supposed that a mission to the same target was to be flown again at the same bombing altitude and time of day or night and under similar weather conditions, but making use of the improvement gained up to 20 October. This calculation showed the bomb load actually carried on the mission was only a percentage of the new calculated value. These percentages are plotted in Graph B and the trend indicated by a smoothed curve. A large portion of the rise in late September and October is due to standardization of stripping and weighing the aircraft. This standardization resulted from information obtained in a study of irregularities in bomb loads which revealed the need for uniform stripping and weighing procedures. Another contributing factor is the increased experience on the part of pilots, flight engineers and navigators; as a consequence the cruise control data has been more closely followed and less fuel reserve has been required. Also, experience has led to placing the rendezvous points farther from base with a reduction of time in formation and to using more direct routes with less evasion of enemy defenses. Thus it is seen that the increase in bomb load is due to many causes and among these training, in the form of experience on the part of the aircrew, plays a significant part.

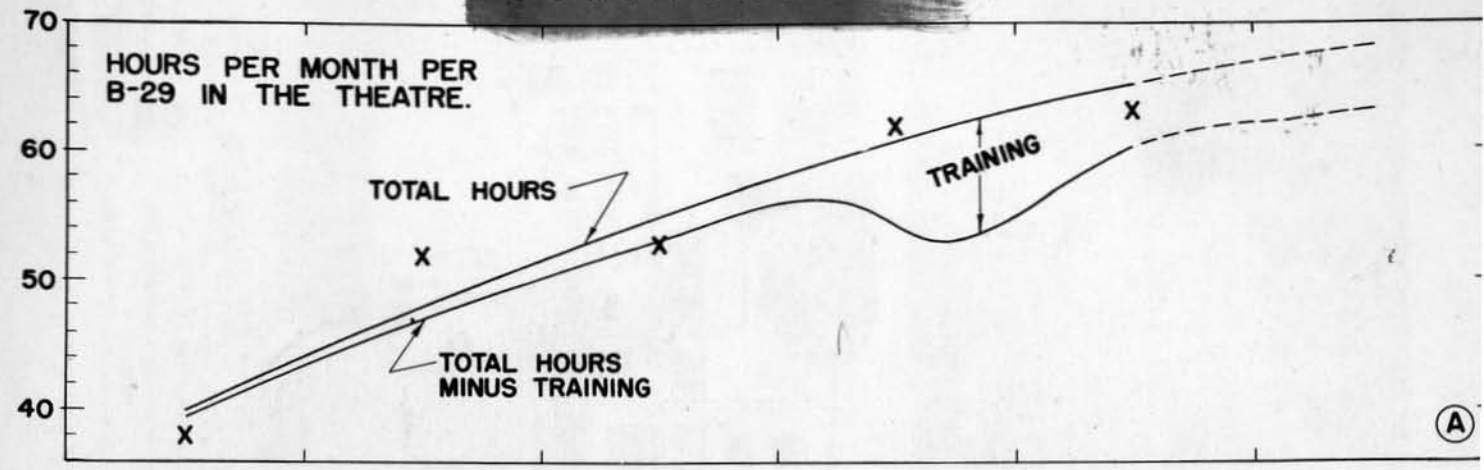
Graph C gives a measure of the bombing accuracy. What is shown is the percentage of the bombs dropped which fell within 1000 feet of the assigned aiming point. Some missions are not represented because of insufficient information. In other cases where a large fraction of the bombs are not located it has been necessary to estimate the accuracy. These cases are represented by vertical lines indicating that the accuracy probably lies within the range given by the line. Once more a line has been drawn to show the trend of the accuracy for visual bombing. It is to be noted the upward bend in the bombing accuracy begins shortly after the increase in flying training shown in Graph A. Other factors affecting the accuracy are changes in formation thus permitting the bombing to be controlled by a small number of lead crews. Also, improved weather with better physical condition for the crews may have had an effect. (However, if this latter factor were important, most of the rise would have occurred in early October.) However, the main factor is flying training for the lead crews.

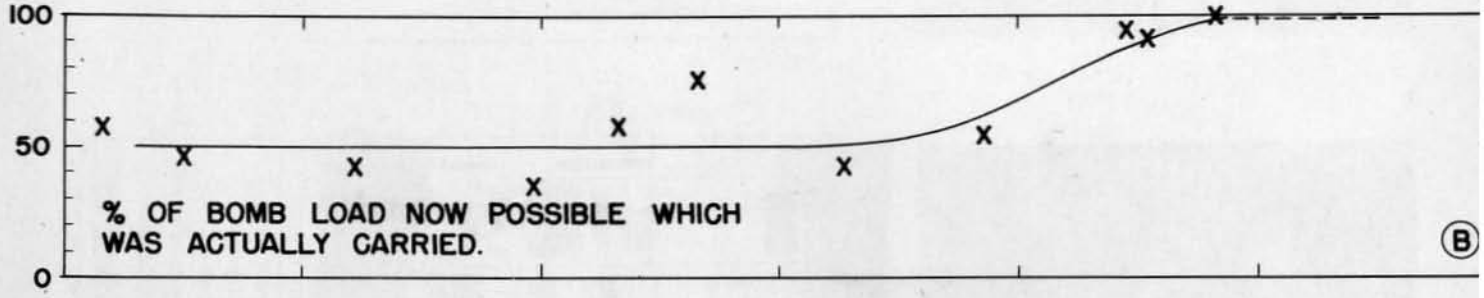
Next, the factors indicated in Graphs A, B, and C must be combined to give an overall efficiency figure. It turns out that the way to get this relative efficiency is to multiply together corresponding values for each of the three curves. For example, for 15 June the values are 40 hours a month, 50% as many bombs as now and 12% of the bombs within 1000 feet. Multiplying these together gives 2.4 (i.e. 40 x 0.50 x 0.12 = 2.4). For 15 October the values are 61, 90% and 22%. Now the October aircraft is 61/40 or 1.5 times as effective because of its increased flying capabilities, 90/50 or 1.8 times as effective because it carries more bombs and 22/12 or 1.8 times as effective in putting bombs on the target. In other words it is, all told, 1.5 x 1.8 x 1.8 or 4.9 times as effective. This result is in agreement with the relative efficiency obtained by multiplying the October figures together: 61 x 0.9 x 0.22 = 12 and 12 is 4.9 times as good as 2.4. Another way of seeing that the correct procedure is to multiply the curves together is to consider what would happen if the number of hours per month, the load, and the percent of bombs within 1000 feet of the A.P. were each doubled. This

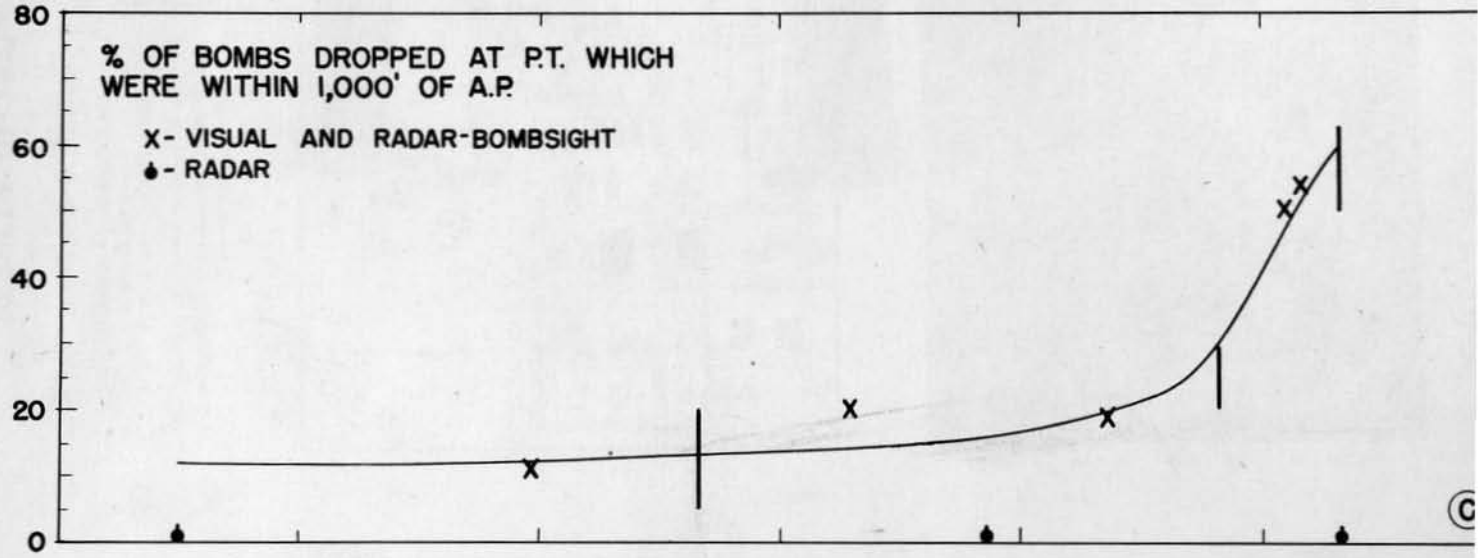
would mean twice as many raids would be made per month and since each carries twice the bombs, four times as many bombs would reach the target area. Furthermore, twice as large a fraction of the bombs would be dropped within 1000 feet so each bomb carried would be potentially twice as effective. Hence, the net increase would be eight times or the product of the three individual increase factors.

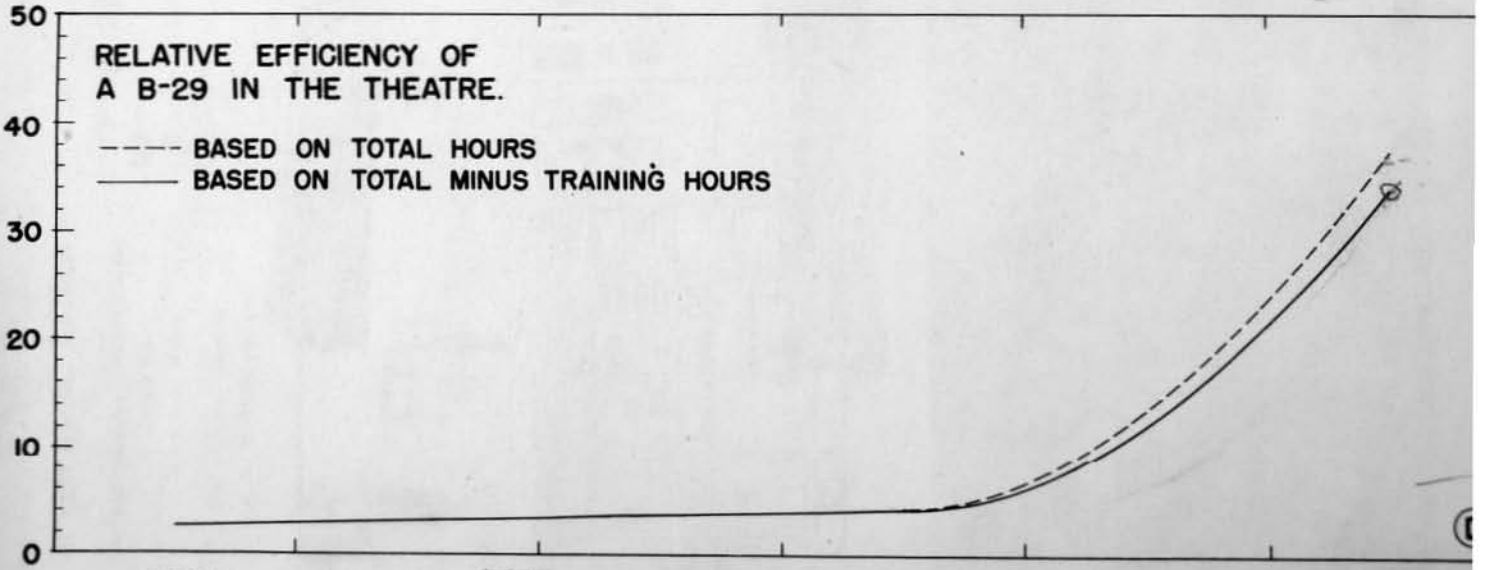
It is not correct in calculating the relative efficiency to use the total flying hours per month. Instead, the training hours should be subtracted leaving the hours available for operations. As a matter of interest, however, both values have been used in making Graph D. The small difference between the two curves shows how little the training time has actually cost. Even if only a very small fraction of the increased efficiency were due to training, the gain would still exceed the cost by a wide margin. In point of fact, however, training of lead crews is probably the largest single factor contributing to the rise in Graph D. Consequently, past flying training has paid for itself many times over and future flying training to improve and maintain the efficiency will also be profitable.

The really large change in efficiency, as shown in Graph D, deserves special attention. It means in fact that a B-29 in November is potentially ten times as effective in destroying enemy installations as in August. In other words, a squadron of B-29's is now more effective than three groups were in August. To achieve the effectiveness of the present organization would take 40 groups at the August level. These figures show the futility of numbers compared to quality of performance. The results achieved by increased efficiency have obviously far exceeded those which could have been reached simply by increasing number of aircraft or number of missions flown. This fact is often overlooked in an attempt to win in the numbers racket with everything being sacrificed simply for more numbers, more aircraft, more sorties, more bombs dropped - never mind where. The chart shows how little mere quantity can count compared to improved quality. Furthermore, the biggest improvements, those in Graphs B and C, are largely due to training. Out here seven man-months of preparation go into sending one B-29 on a combat mission. When we make that mission, we can knock out the target with a big bomb load well placed or do a partial job which calls for still more missions. When we train, we make every aircraft and every man hour of preparation count double and more. Bear this in mind when you train; it's not simply a chore to stop your sack time but is worth just as much to the war as flying combat. So train, train right, and train to do the jobs this manual describes.









RESULTS OF TRAINING

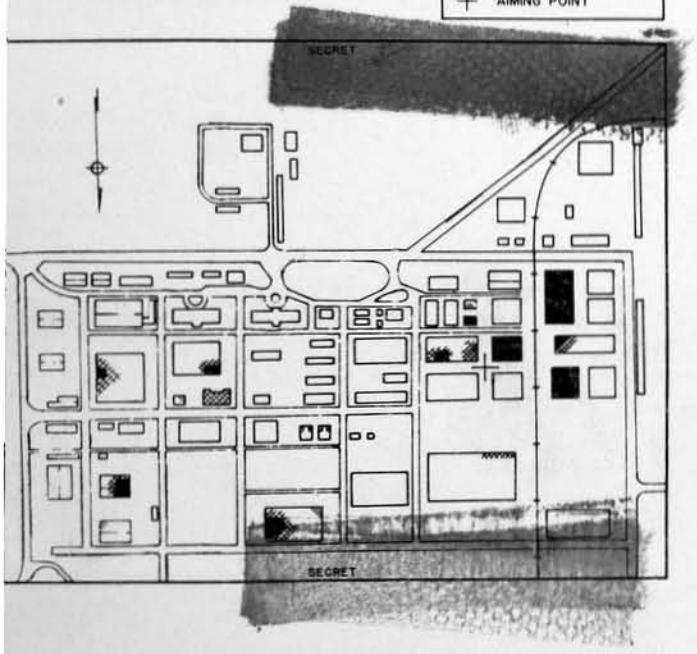
AFTER NAVAL ATTACK

ANNEX 2A
TARGET INT, XX BC

STATUS OF OKAYAMA A/C ASSEMBLY PLANT
14 OCTOBER 1944
AFTER NAVAL ATTACK

TIME OF ATTACK: UNKNOWN
WEIGHT OF ATTACK: UNKNOWN

DAMAGE KEY
- DESTROYED
- SEVERELY DAMAGED
- DAMAGED
- UNDAMAGED
- AIMING POINT



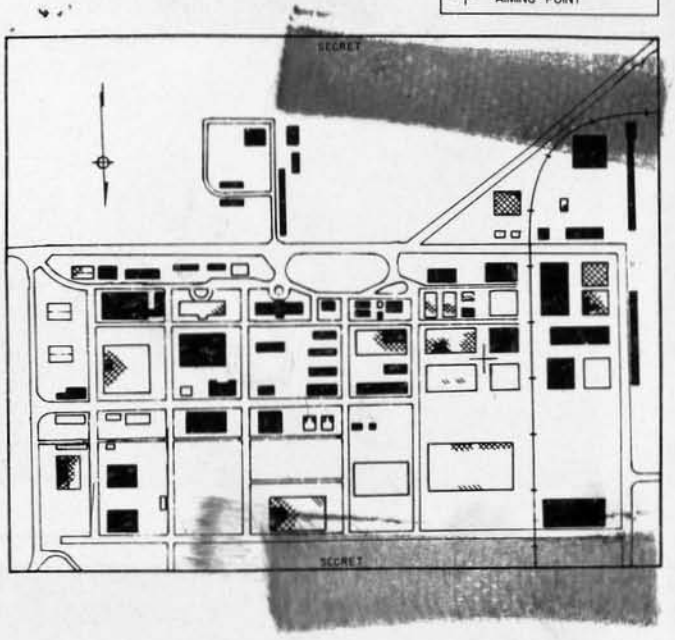
AFTER 1ST. XX B C ATTACK

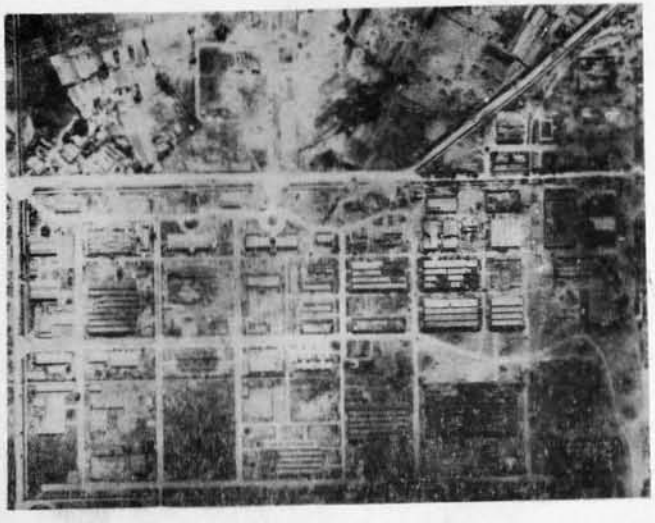
ANNEX 2B
TARGET INT XX BC

STATUS OF OKAYAMA A/C ASSEMBLY PLANT
MISSION NO. 10
AFTER 1ST XX BOMBER COMMAND ATTACK

TIME OF ATTACK 0346Z TO 0504Z 14 OCT
WEIGHT OF ATTACK 103 AIRCRAFT 1085 IB 500#
M-76 & 1519 G.P. 500#
AN-M-64 (TNT FILLED)

DAMAGE KEY
- DESTROYED
- SEVERELY DAMAGED
- DAMAGED
- UNDAMAGED
- AIMING POINT





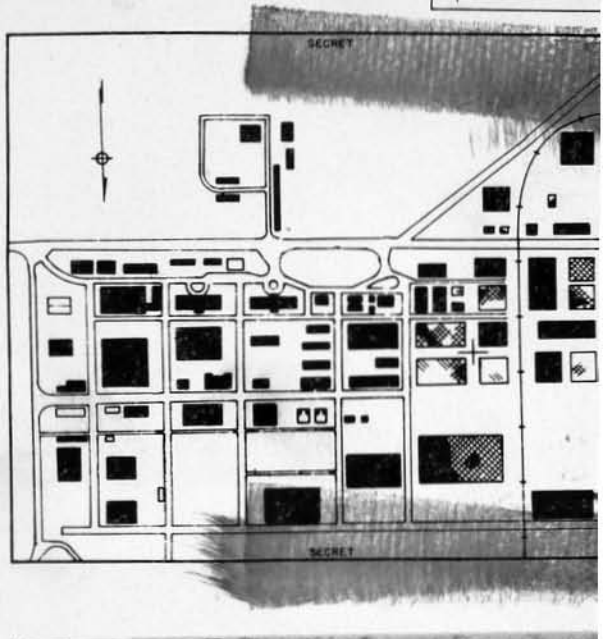
AFTER 2ND. XX B C ATTACK

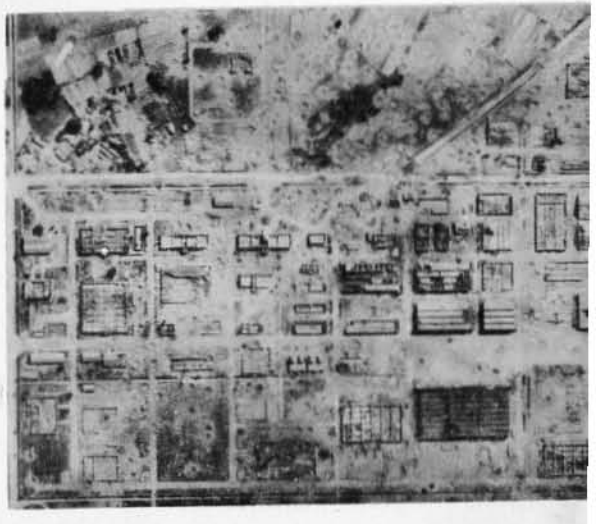
ANNEX 2C
TARGET INT, XX BC

STATUS OF OKAYAMA A/C ASSEMBLY PLANT
MISSION NO. 11
AFTER 2ND. XX BOMBER COMMAND ATTACK

TIME OF ATTACK: 0348Z TO 0423Z, 16 OCT
WEIGHT OF ATTACK: 43 AIRCRAFT, 440 IB 500#
M-76 & 656 G.P. 500#
AN-M-64 (TNT FILLED)

DAMAGE KE
- DESTROYED
- SEVERELY DAMA
- DAMAGED
- UNDAMAGED
- AIMING POINT





RESULTS OF TRAINING

TARGET: MALAGON MARSHALLING YARDS, RANGOON, BURMA (16 47N - 96 11E)

DATE : 3 NOVEMBER 1944

UNITS : 40th, 444th, 462nd and 468th BOMB. GROUPS, XX BOMBER COMMAND MISSION NO. 14

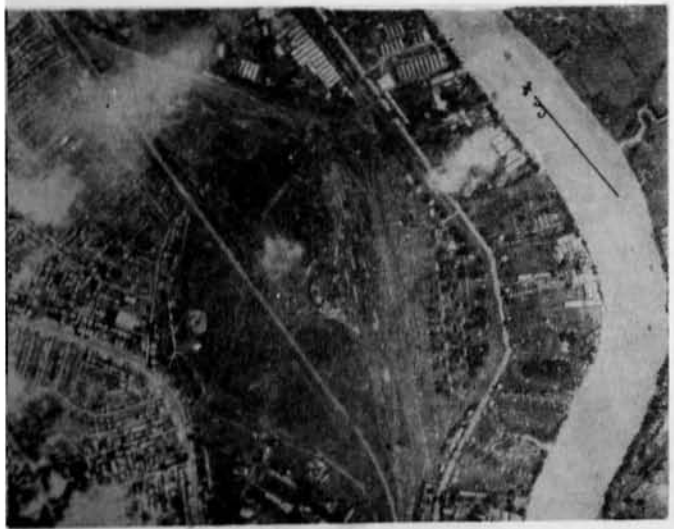
DETAILS OF ATTACK:

	40th BG	444th BG	462nd BG	468th BG	TOTALS
TIME OVER TARGET:	0348 Z	0342 Z	0344 Z	0353 Z	
NUMBER OF AIRCRAFT	10	9	12	13	44
ALTITUDE	20400'	22000'	23000'	20000'	
WEIGHT OF ATTACK	391*	360*	431*	488*	1670*
AIMING POINT	ROUNDHOUSE	ROUNDHOUSE	ROUNDHOUSE	ROUNDHOUSE	
HEADING	45 M	45 M	230 M	48 M	

* ALL BOMBS DROPPED WERE 500# AN-M64 GP (TNT FILLED), FUZED .1 SECOND NOSE AND .025 SECOND TAIL.

Prepared By: Target Unit, Intel. Sec
XX Bomber Command

BEFORE



1st OVER TARGET: 444th BOMB GROUP

2nd OVER TARGET: 462nd BOMB GROUP

AFTER

3rd OVER TARGET: 40th BOMB GROUP

4th OVER TARGET: 468th BOMB GROUP

PLANNING The MISSION

II. PLANNING THE MISSION

A. WHO DOES THE PLANNING?

The planning for every tactical mission originates in XX Bomber Command Headquarters. Rarely will one of the four tactical groups operate individually against an enemy installation; so the Command Field Orders coordinate the effort, and designate the force required, minimum bomb load to be carried by each Group, routes out, flight and bombing altitudes, times of take-off and support by outside agencies. These plans are reviewed and approved by the 20th Air Force and coordinated with the Headquarters of the Theatre which contains the assigned target.

The actual selection of VLR targets was made in Washington prior to the Command's departure from its training bases in the Zone of the Interior. This directive has since been modified in the light of studies made by a Committee of Operations Analysts and a changing tactical situation.

The sequence desired for attacks on those targets was inferred by the priority rating assigned each target by the original directive, but the specific timing was no more definite than General Arnold's brief instructions to "Commit the B-29 to combat as soon as possible."

B. THE SEQUENCE OF THE PLANNING.

The information on XX Bomber Command future capabilities, based on "Hump" lift of Petrol, Oil and Lubricants and aircraft available, is transmitted together with the Command's recommendations, to Headquarters 20th Air Force which in turn selects specific missions and the dates between which they will be run. The directive containing these instructions from the 20th Air Force also incorporates more or less specific requirements for the attack.

Next, the XX Bomber Command Staff Personnel study the weather trends, enemy order of battle and capabilities, possible routes out and back, flight plans and capabilities of other units for offering support, directly or by diversion, and provisions for air-sea rescue, and escape and evasion.

Drawing up the final details into a written field order is done by a Project Officer in coordination with the pertinent staff sections and outside agencies. When a draft has been prepared, it is submitted to the Commanding General, and, with his changes or additions, the plan is approved and a field order is published on approximately D-4. Meanwhile, advance information required by the Groups is transmitted by TWX to them, and if a written field order cannot be made available by D-4 necessary fragmentary instructions are furnished by TWX.

C. FACTORS INVOLVED IN THE PLANNING.

The route is designed so as to encounter a minimum of enemy opposition both from enemy aircraft and from flak. Since Groups rarely hit separate targets, routes vary only sufficiently to allow separate assembly points to be chosen

in order to minimize confusion and facilitate recognition. Waves of attack against the primary target are spaced as closely as possible to permit the greatest saturation of enemy fighter and flak defenses.

Due to the fact that great distances, and therefore variable weather conditions, are involved in VLR operations, routes out, Initial Points, and axes of attack are chosen primarily from a radar standpoint, but must also furnish a good approach to the target from a visual bombing and bomb pattern standpoint while minimizing the exposure of our formations to enemy flak and fighter defenses.

The bombing altitude is chosen after considering and weighing the different factors such as bombing accuracy, flak defense and fuel consumption at high altitudes.

Weather, of primary importance in all bombing operations, is the major factor in selecting the final date for a mission. Often it is necessary to change the date forward or backward at the last minute, or even change primary targets due to a forecast of a long period of bad weather in the original target area.

D. CONCLUSION.

The above covers the fundamentals involved in planning a XX Bomber Command tactical mission. Many types of specialist participate in the planning and their opinions receive careful consideration. The result is the plan which will most likely succeed in placing the maximum number of bombs on the target with the minimum loss to our forces.

AIRPLANE COMMANDER

III. THE AIRPLANE COMMANDER

In the operation of Very Long Range aircraft you as airplane commander have two separate and important functions. The first is the execution of the command of your crew, and the second is the actual piloting of your aircraft. Both are equally important. The best pilot in the world would get nowhere with a poorly disciplined crew, and a good crew with a poor pilot will in all probability never finish its combat tour. It is up to you to realize that you are responsible for the successful conduct of your part of the mission. On your ability rests the lives of ten other men. You must have a complete knowledge of the airplane's limitations and capabilities. You must develop all of your abilities to the finest degree so that you can successfully accomplish all assignments given you and are confident of making the right decisions when emergencies arise.

As the majority of our missions will be conducted deep within enemy territory, without the benefit of friendly fighter protection or accurate weather predictions throughout the flight, and without radio facilities except near your home base; you will be called upon to make many decisions affecting the success of the mission. Each decision must be the right one. Operations in Asia provide few alternate bases in case of emergencies. It is up to you to know your airplane thoroughly enough to recognize symptoms that will lead to trouble. Follow your flight plan closely and know just "where you stand" at all times, or else be prepared for a long walk out of enemy territory.

You are the Combat Crew Commander. In the air you are the leader, encouraging and directing your men. On the ground you must be the training officer, disciplinarian, and general advisor. Neglect the training and ignore the conduct of your men on the ground and the result will be disastrous in the air.

A. THE AIRPLANE COMMANDER AND THE COMBAT CREW

Too many pilots consider themselves pilots alone and forget that they are responsible for a very intricate and expensive piece of machinery run by eleven men as a team. The failure of any one of the crew members to perform his assigned duty correctly might easily prove disastrous. The way in which you, as airplane commander, execute your power of command to weld a highly trained group of men into a closely knit team will be reflected in the efficiency and capabilities of your crew.

1. Air Discipline.

Air discipline is based on the complete inter-dependence of the combat crew members. In the operation of the B-29 no one man is self-sufficient. Each and every man depends on the ten other men of the crew for the successful completion of his job under any circumstances. Air discipline is the factor that molds eleven men into a fighting team. You, as airplane commander, must not be lax with your men for the sake of popularity. A lax commander is not necessarily popular with his men, but you will find that a fair one is. The undisciplined man is unpopular with the other crew members because he cannot be relied upon in a game that is played for the highest stakes.

Air discipline starts on the ground for you will find that a man not disciplined on the ground, cannot be disciplined in the air. The correct type of discipline is evidenced when a man has a duty to perform and he performs it to the best of his ability under any circumstances. If a man is unreliable on the ground, he will be unreliable in the air under combat or any other conditions.

As we undertake larger formations in our operations, air discipline is of paramount importance. If eleven men cannot work as a team, elements cannot be expected to work together and larger units will not possess the coordination necessary for successful bombing and adequate defense. Fire control gunnery, bombing procedure, ditching procedure, unceasing vigilance and formation flying are examples of air discipline applied. The XX Bomber Command Tactical Doctrine and Standard Operating Procedures must be strictly adhered to by everyone operating in this Command. This will require thorough study and application of the principles involved. Remember, in combat, breach of air discipline usually results in loss of life or damage to someone's airplane. See that your crew maintains good air discipline.

2. Training.

Each Group is responsible for conducting the prescribed training program. The longer we remain in this theatre of operations the more training aids and tactical operational knowledge will become available. It is your responsibility, as airplane commander, to see that your men attend scheduled classes, and in addition, get instruction covering any weaknesses not covered by the current ground school. However, shaping your crew into a coordinated team will not come from any ground school program. It is your duty first to see that your crew members get the maximum amount of training and understand all of their duties for any circumstances. Then get your crew together and practice working as a team. Train your crew in such things as fire control, interphone procedure, ditching procedure and abandoning ship in order that clock-like precision can be reached and maintained.

B. OPERATING PROCEDURES

1. Starting Procedure.

Many engine failures on take-off and during flight have been traced directly to faulty starting procedure. You should be positive that the flight engineer completes his check list and uses the proper procedure in starting the engines. To prevent overheating the engines during the ground run, the following procedure is recommended:

a. Start the engines as quickly as possible. Three minutes should be sufficient time to start all four engines.

b. Keep cowl flaps open full (27°) during all ground operation.

c. When possible complete the engine run-up immediately after starting.

d. Avoid holding rated power for long periods on the run-up.

e. Taxi with 700 to 800 RPM where possible.

f. If cylinder temperatures rise above the maximum allowable shut down engines, but don't hold up a formation by blocking the taxiway.

g. When possible turn the airplane into the wind for the run-up.

h. Do not attempt to take-off with the cylinder head temperature over the maximum allowable.

i. Follow the recommended engine run-up procedure. A few points to remember are:

(1) Advance and retard throttles with a smooth, steady movement. Damage to the engine may occur by too rapid movement of the throttles.
(2) Check magnetos at 2000 R.P.M. by first moving switch to "left" and back to "both", then to "right" and back to "both". Remember holding the switch on one magneto too long will burn up the plugs.
(3) Check each engine individually.
(4) Moisture condensation on spark plug points may be cleared out by running up the engine at full power for a few seconds, and then re-checking the magneto.
(5) Do not attempt to take-off unless the engines are functioning normally. Remember, you are operating at extremely heavy gross weights. Your most critical period will be immediately after leaving the ground, and before the wheels and flaps are retracted. You will contribute nothing toward accomplishing the mission by crashing at the end of the runway.

2. Taxiing.

Be sure to check your hydraulic pressure, both the main and the emergency, before attempting to taxi. Considerable power will be necessary to begin taxiing if you are heavily loaded, and for the same reason, considerable braking action will be necessary to stop. Keep a safe distance behind other aircraft, and don't taxi as if you were on a race track. Excessive use of the brakes will cause them to overheat, and lose their effectiveness, or even to completely fail. This usually happens just when the brakes are needed to avoid an accident. Use a combination of engine power and brakes in taxiing, and taxi at slow speeds. All turns should be made smoothly with the wheel on the inside of the turn kept in motion. A sudden sharp turn may easily throw off a tire, or at heavy gross weights it could cause a structural failure of the landing gear.

While taxiing, the entire crew should be kept alert and on the lookout for obstacles. The B-29 has a large wing-spread of 141 feet and it is difficult to judge the distance objects are from the wing tips. When taxiing between obstacles, have a man at each wing tip to guide you through. This is

particularly important at night. A taxiing accident is usually one of the most humiliating you will ever experience, and unless you are alert it can easily happen to you.

3. Before Taking-Off.

Before taking-off be positive that the cylinder head temperatures are within limits. Be sure you have completed the check list. Everyone is fallible. The check-list is provided to prevent your forgetting something essential -- USE IT! Notify the crew to stand by to take-off, taxi out and line up with the center of the runway, using all of the available runway. The hundred feet behind you might make the difference necessary to clear an obstacle at the other end.

4. Taking-Off.

The take-off under heavy gross weights is the most critical time you will encounter in your whole flight. The B-29 has proved its ability to perform this task. However, it is mandatory that the airplane be functioning properly in all respects before the take-off is attempted. So many little things can happen to affect the safety of the take-off that it is of the utmost importance for you to perfect your technique and to have worked out with your crew a thorough system to take care of all emergencies.

Some pilots prefer to hold the brakes at the end of the runway and get a power check before beginning the roll, and others prefer to make running take-offs. Care must be used not to overshoot the turn onto the runway when using the latter method as this might throw a tire. No matter which method you use, the important thing is to control the direction of the airplane by use of the rudder as soon as possible. If you use the brakes excessively for control you cause excessive wear on the brakes and are slowing down your speed thus requiring more runway. If you juggle the throttles excessively you reduce the available horsepower thereby also slowing down your speed. Get control with that rudder.

You will notice that a speed of 100 MPH is reached very quickly, but from there on up the speed accelerates comparatively slowly. When a speed of from 110 to 120 MPH has been reached, raise the nose wheel from 2 to 6 inches above the ground and hold the plane in this position until you have attained 130 to 140 MPH, at which time you will find that you have exceptionally good control. As soon as you have broken from the ground the landing gear should be retracted. Because of the aerodynamic cleaness of the airplane, the landing gear drag is relatively very great. Raising the gear is equivalent to adding more power. Power should not be reduced until the gear is fully up.

Flaps should be retracted when the indicated air speed is 40 MPH higher than the take-off speed. The power-off stalling speed with the flaps up is 15 to 20 MPH IAS higher than the lowest take-off speed with 25° flaps at any weight, therefore, a margin of 20 to 25 MPH IAS above flaps-up stalling speed must be held when retracting the flaps. As soon as terrain conditions permit, the air speed should be allowed to increase to 200 to 205 MPH before continuing the climb. This will increase the cooling effect on the engines.

At the beginning of the take-off roll, cowl flaps must be closed to 7 1/2 to 9 degrees. If they are left in the wide open position, the airplane will never leave the ground. As the speed is increased the engines will be cooled by the increased flow of air. Remember that the maximum cylinder head temperature is 260°. Higher head temperatures result in reduction of power. The inter-cooler shutters will be in wide open position (15°) for take-off, 1/2 open after gear and flaps are retracted, and then cut down as required. When turbos are used for take-off a very high carburetor air temperature results with a consequent large reduction in power if the inter-cooler shutters are closed.

The use of flaps during take-off increases the drag during the run, but the flaps also increase the wing-lift and therefore take load off of the wheels, which in turn decreases the wheel rolling drag. The resulting net drag is not changed much, but the take-off speed is reduced with the use of 25° flaps. The use of more than 25° flaps increases the drag disproportionately to the amount of lift gained.

One common fault of many pilots is to get the nose wheel too high for take-off. This results in stalling the plane off and creates a definite critical point in case of engine failure. It is true that an engine failure is critical during any part of the take-off run, but there is no use to aggravate the situation.

At heavy gross weight take-offs, when the outside air temperature is 100°F or above, a take-off manifold pressure of 50 inches of mercury is permissible. However, continuously increasing the manifold pressure does not necessarily increase the horsepower output. A point is soon reached, due to engine pumping losses, when an additional increase in manifold pressure results in a decrease in horsepower delivered to the propeller shaft. Fifty inches manifold pressure will be exceeded only when an engine is lost on take-off and then only as long as it is possible to keep the engines out of the detonation range.

5. Climbing.

Normal climbs are performed at 200 MPH with a power setting of 43 1/2" Hg and 2400 RPM. This setting will result in a maximum rate of climb while maintaining cylinder head temperature within the desired limits and yet using a minimum amount of cowl flaps. You must work very closely with the flight engineer during climbs. Check with him repeatedly on the position of the cowl flaps and the temperatures of the cylinder heads. Make him keep the heads at the allowable 248° temperatures. Remember, your primary object is to get to your predetermined altitude as quickly as possible. Any unneeded opening of the cowl flaps will only decrease your rate of climb thereby increasing the overall time high power settings must be used, which in turn decreases the life of your engines.

Ordinarily the climb to high altitudes will not be started until after several hours operation at low altitudes. As the fuel consumption is highest at altitude it is important that minimum altitudes be maintained as long as possible. This should be the primary consideration in the operation of the

aircraft prior to starting the climb.

Before leveling off, you should climb to 500 feet above the designated altitude and then maintain rated power until the airspeed has increased to 220 or 230 MPH. Decrease your power to predetermined settings leaving the cowl flaps in the same position until cylinder head temperatures have started to decrease. Close cowl flaps as much as possible, maintaining 230° on your heads, and play with your altitude until you get the airplane "on the step" and the airspeed and cylinder head temperatures stabilize on cruise control settings.

6. Cruise Control.

On all flights, other than local training missions, you as airplane commander, will be charged with operating the B-29 at maximum range. In hauling gasoline over the "Hump" it is your duty to off-load every possible gallon, and on combat missions it is up to you to drop the maximum number of bombs on the target. Proper use of the "Form F" in determining the center of gravity and gross weight goes hand in hand with closely following your cruise control charts. These charts are made from actual test figures and have proved themselves time and time again. You should consider them as Bibles of operation, and govern your flight accordingly. Personal experimentation will get you nowhere.

Learn how to compute the "Form F" and know your cruise control charts and then check your engineer on them. Some strong points of cruise control are:

a. Remain at minimum safe altitude as long as possible at heavy gross weights.

b. Get into automatic lean as soon as possible.

c. Beware of the back side of the power curve.

d. Keep a close watch on your cylinder head temperatures and cowl flap settings.

e. Be sure that you are flying "on the step" at all times.

f. Be on the lookout for the "vicious circle" of cowl flaps and indicated airspeed.

g. Fly the indicated airspeed for specific gross weights.

h. Take advantage of your descent from altitude. One of the factors governing the economy of fuel used is the descent from altitude. Get together with your flight engineer and navigator and determine the point to start your descent. By letting down at a slow rate of 200 feet per minute, required air speeds may be maintained at greatly reduced power settings.

Remember, power curves and standard operating procedures have proved themselves. Use them and get the most out of your B-29.

7. Landing.

Just a word of caution. When it becomes necessary for you to make a landing at weights in excess of 130,000 pounds, be sure all of your drift is killed and that you don't drop it in. At those weights excessive strain will easily cause your gear to fold. Other factors concerning emergency landing will be covered in the emergency procedure section.

C. THEATRE OPERATIONS

Operation of the B-29 in Asia presents many added complexities not ordinarily encountered. A thorough study of the SOP and tactical doctrines of this Command is mandatory to enable satisfactory operation. Since our range covers such a vast territory we shall try to present some of the difficulties of operation in each of the three zones in which we normally fly.

1. India Bases.

The two biggest hazards to operation in India are heat and dust. In all but a very few months of the year the heat is so intense that accomplishing ground maintenance is very difficult. Touching any part of the plane exposed to the sun often results in serious burns. It will always be a battle to get off the ground before your cylinder head temperatures exceed their limits. The cockpit of the B-29 reacts like a large green-house. With ground cabin temperatures of 50°C. and better it will be necessary for you to watch closely all of your men for heat prostration.

During the dry season the dust is blowing continually. Be sure to check to see that your carburetor air scoop stops, pitot tube covers, and static hole covers are on whenever your ship is on the ground. There are also numerous little insects that seem to enjoy building their homes in the static holes. One take-off at heavy weights with a faulty airspeed indicator will teach you the value of covering the static holes, IF you live through it!

2. The "Hump".

When traveling to our forward bases for combat missions, it is necessary to fly over the largest "pile of rocks" in the world where for the most part, there is usually some mighty "stinky" weather. Normally, when your airplane is functioning properly, it amounts to nothing more than a routine flight. The accident rate over the "Hump" however, has taught us that you cannot underestimate the dangers of the route and live. Arm yourself with knowledge of the conditions to be encountered and what to do in cases of emergency and you will, in all probability, complete many a round trip over the "Hump".

Know the flying characteristics of the B-29 in turbulence and icing conditions. Recognize the weaknesses of the radio aids over the "Hump". Know the country you are flying over and the walk out procedures for each section. Keep your men informed of your position at all times and see that they are properly and fully equipped before each flight. If you and your men give serious study to all of the circumstances that can be encountered over the "Hump", there should be no reason, other than fate, for your crew's number ever to be added to the

"missing-over-the-Hump" list. It is up to you to be continually on the search for a more thorough knowledge of the "Hump" route. Some of the existing conditions to be encountered will be outlined below.

a. Weather

There will be relatively few trips over the "Hump" where instrument conditions are not encountered somewhere on the trip. Cloud layers generally start around 5,000 feet and extend up to 20,000 feet, frequently going as high as 28,000 to 30,000 feet. Assigned route altitudes are above 20,000 feet, so your primary turbulent weather will be encountered in climbing to altitude in the northern part of the Assam Valley and in penetrating cumulonimbus clouds over the first ridge and the "Hump" proper.

One of the most important instrument aids to pilots penetrating areas of severe thunderstorms is radar. Train your radar operator so that he can successfully guide you around the thickest areas of turbulence when you are flying on instruments. In order to successfully penetrate severe turbulence you should be acquainted with the following characteristics of the B-29:

(1) Probably the most noticable effect of turbulence is rapid fluctuations in air speed. Split second variations of 60 M.P.H. in air speed are not uncommon in severe turbulence, and a reduction in air speed to the point of danger of a stall has been known in several cases. The rapid flux is due probably to two reasons. First, B-29's react more like B-24's than B-17's inasmuch as the horizontal attitude of the ship is susceptible to change, and thus with the "nose up" or "nose down" attitude of the ship, rapid changes in I.A.S. result. The B-17 on the other hand is more likely to ride out turbulence with less change in its horizontal attitude. Secondly, gusts and lulls and vertical currents have a more violent reaction on the B-29 because of its fighter plane speed.

(2) Although vertical longitudinal stability is more like that of a B-24 than that of a B-17 there is no difficulty in retaining near normal attitude of the B-29 about all axes. When corrections are necessary, however, it has been found that they are more difficult to make and take longer in the B-29 than they do in either of our other four engine bombers.

(3) All the flight hazards of turbulent air that affect the flight of other aircraft affect the B-29. A heavily loaded airplane is in greater danger than the same plane lightly loaded. Because of the tremendous carrying capacity of a B-29, the effects of turbulence are therefore widely varied. The danger of structural damage, the time and effort required to correct the ship's attitude, and the risk of stall due to fluctuation in air speed are considerably greater when the B-29 is flying with a maximum load than with a minimum load.

(4) Most ice formation that has been picked up over the "Hump" has proved to be rime. The B-29 has accumulated as much as 2½ inches while in level flight and managed to continue, although considerably higher power settings have been necessary to maintain flight. If the ice is picked up in a climbing attitude however, the results have not been so favorable. Some pilots have reported losing as high as 500 feet per minute with full rated power. Relatively little experience has been gained with clear ice, but it is true that planes with high wing loadings are more quickly rendered unflyable by accumulations of even small amounts of clear ice than are ships with low wing loadings. Time and experience may show that clear ice will be more hazardous to a B-29 than to other similar ships.

b. Radio Aids.

Radio aids in India and the Chengtu Area are excellent. However, the terrain effect and the presence of weather over the "Hump" proper limit range and cause wide variation of the beacons there. It will be necessary for you to make many instrument let downs both in the Chengtu and India Areas. Know your let down procedures thoroughly and know the limitations of all the radio aids.

c. Walk Out Procedures.

There is a complete section in this manual covering this subject. (See Chapter X, Section I) It is up to you to become thoroughly familiar with all aspects of getting your crew out safely. See that your men know how to take care of themselves in case you are forced to bail out over the "Hump".

3. China Bases.

Bases in the Forward Area are located at Hsinching, Kwanghan, Kuinglai, and Pengshan near the foothills of the Himalaya mountains. All of these fields have been built entirely by hand labor of the Chinese coolies and the construction itself offers the only handicaps to ground operations in the Forward Area. During the dry season dust conditions are extremely bad, causing a definite hazard to taxiing and shortening the life of your engines. The hardstands and the taxiways are covered with small rocks that result in large nicks in propellers every time an engine is run up or excessive power is needed to taxi. The taxiways are narrow and marked with small white rocks. Be sure to stay within the markers as the ground just outside the markers is very soft and will not support the weight of the B-29.

Ceilings and visibility are often very poor. Practice your let down procedure every time you go to the Forward Area and it will ease your mind and perfect your technique for the time when you actually have to let down to minimum altitudes.

All supplies for the Forward Area are flown over the "Hump" and, therefore, are quite limited. Do not perform any unnecessary maintenance or waste gasoline in the Forward Area.

D. FORMATION FLYING

1. Assembly.

As each mission will be a maximum range problem, assembly of the formation must be accomplished as quickly as possible. Local terrain and weather conditions will largely determine the type of assembly to be employed. In all cases the assembly will be accomplished as briefed prior to take-off. The following observations may be of assistance in affecting the assembly.

a. Normal Assembly.

(1) Obtain sufficient flying speed before maneuvering.
(2) Fly a collision course with the leader rather than use excessive power.
(3) As the assembly plan will follow a predetermined series of headings, keep track of the time intervals and anticipate the turns of the aircraft ahead of you.
(4) Anticipate the relative speed of the airplane ahead of you to avoid overrunning as much as possible.

b. Assembly during the hours of darkness.

(1) Assembly of a large formation during darkness is difficult even in good weather. An aldis lamp shining from the tail of each ship will facilitate assembly.
(2) It is extremely difficult to judge distances at night, the approach to position in formation should be made with caution.
(3) The formation should be flown loosely until daylight.

c. Assembly above an overcast.

(1) Assembly above an overcast will be done in accordance with the existing tactical doctrine, and as briefed before take-off.
(2) Predesignated headings, air speed, and rate of climb must be strictly adhered to while climbing through an overcast.
(3) The flight will usually be assembled at a predesignated altitude above the overcast and over a radio range or homing beacon. Stick to the proper altitude to avoid assembly with the wrong flight.

2. Climb.

During the climb to bombing altitude you will find it easier to avoid straggling by staying in close formation. Straggling leads to use of excessive power settings, this overtaxes the engines and is the cause of a great percentage of abortives.

3. Formation Enroute.

The basic combat unit in our operations is the twelve (12) aircraft flight. The flight is composed of four (4) three (3) aircraft elements. The quality of

the formation depends first upon the ability of the flight leader and secondly upon the ability of the element leaders. The element leaders must maintain their position with a minimum of throttle changes and maneuvering. The leaders should have their navigators inform them in advance of any anticipated turns, climbs, or let downs so as to be ready for them. This is an excellent aid to the smooth execution of these maneuvers.

Leaders must be careful never to place their formation in the prop wash, or to maintain such high or low airspeeds that the rest of the formation will have difficulty in maintaining proper position. The leader should always bear in mind that he has other aircraft following him. The effort that the leaders put into their work will be reflected through the quality of the formation.

The element leaders and wingmen determine the depth of the formation and the number of turrets that may be brought to bear on enemy fighter attacks. A depth of thirty to fifty feet between aircraft gives the best results by allowing all turrets to be uncovered. All aircraft commanders should fly their positions with a minimum of movement and change in order not to force other aircraft out of position. Each movement of the aircraft in the lead of the formation is accentuated as it travels to the rear. Furthermore, abrupt changes in throttle settings invite supercharger and engine failures. The trim of the aircraft will change with each change in power setting, and it is fatiguing to fight the controls with each throttle change.

A tight formation is easier to fly than a loose one and will usually make an enemy fighter think twice before he attacks. When a close formation is flown it is easier to detect changes in relative positions and corrective measures will not have to be excessive. Straggling elements and single aircraft are always targets for concentrated attack by enemy fighters, so DON'T STRAGGLE.

The response of the B-29 to changes in power varies considerably with different loadings and different altitudes. As an example: A formation of B-29's averaging 105,000 lbs. weight is cruising at 25,000 feet, and after a maneuver, one airplane finds itself 100 yards behind its assigned position. In order to catch up, the pilot applies rated power. The total time required for him to regain his assigned position will be 35 seconds. Besides exposing himself to possible enemy aircraft, the pilot has exceeded his cruise control curve, and each application of rated power will cut down his fuel reserve. When the formation is flying open or spread out, changes in altitude are effective in gaining or losing speed in order to maintain a relative position. Also, small maneuvers of wingmen will aid in maintaining position without changing power settings.

As our missions are of long duration, the physical strain of flying formation is considerable and the co-pilot must necessarily be another first pilot. In addition, in certain positions of the formation, the co-pilot is the only one who has adequate vision to maintain formation. Therefore, the co-pilot must possess as much ability at formation flying as the pilot. Whoever is not piloting will be the fire control officer and will also keep watch on the RPM and MP guages.

Cabin supercharging is a tremendous aid in reducing fatigue at high altitudes. In formation flying, to prevent abrupt changes in cabin pressure, due to large changes in throttle settings, a good practice is to maintain the inboard throttles in a constant position, and to regulate the air speed with the outboard throttles.

4. Let Down.

When a let down is started it is possible to maintain your cruising speed with a large reduction in power, resulting in economy of fuel. The let down should be performed at standard rates, and must be started at the proper time in order to obtain maximum range. Excessive power settings and rates of descent will quickly use your fuel reserve. During the let down, the formation should be maintained and the crew kept on alert status to prevent surprise attacks by enemy fighters. Be prepared for an attack at all times when within range of enemy fighters.

5. Landing.

Landing the flight in favorable weather conditions is a comparatively simple process. However, when bad weather prevails, the landing of an airplane can become complicated. Although the B-29 is a large airplane, proper use of the flaps in the traffic pattern will enable you to make a slow pattern and a short approach.

If each aircraft tends to make a longer approach than the preceding one, the third or fourth aircraft will not be able to see the runway when they start the approach. Consequently, they miss the runway and have to "go-around". "Go-arounds" not only disrupt the traffic pattern, but are bad practice in the B-29 due to the probable shortage of fuel, and the excessive drag produced by the flaps and landing gear. Do not lower the landing gear until the landing is a "sure thing" and then allow one minute for the gear to be extended.

The correct landing approach will make the landing simple. Final approach should be 30 MPH, IAS, above the power off, stalling speed with the flaps all the way down. Boost should be full on, and the RPM set to 2000. It is important not to reduce the power rapidly during any part of the approach. Never allow the speed to fall below the power off stalling speed even when landing. Although the airplane will stand inadvertent three-point landings on the main wheels and the nose wheel, it is not a good practice. Neither should the tail skid be allowed to touch first unless making a short field landing. The best method is to land on the main wheels and then allow the nose wheel to settle as the airspeed drops off. If the nose wheel is held off too long, it will drop with considerable force when the airspeed falls off and may result in structural damage.

E. THE COMBAT MISSION

Since our primary objective is aimed at the heart of the Japanese Empire the majority of our missions will be run from the Forward Bases. In the

past we have run both individual night and daylight formation raids. Since the night raids present few problems other than those normally encountered this section will deal, for the most part, with daylight formation raids.

1. Route Out to the Target Area.

Enroute to the target you will be flying over enemy held territory the majority of the time. Although the Japanese Air Force is scattered over a wide area, it is capable of highly mobile action. Keep gunners on the alert and stay in formation.

If it becomes necessary for you to abort and to return alone, it is only prudent that you should avoid enemy airfields and enemy concentration of troops. Know the location of advance friendly airfields in order to use them if it becomes necessary. In case of bail out or crash landing in enemy occupied territory, you have a good chance of walking out if you will follow evasion and escape procedures.

2. Initial Point and the Bombing Run.

The procedures to follow at the initial point and during the bombing run are covered by "Formation Assault" in the Tactical Doctrine. From the initial point in to the target, and on the first leg away from the target will be your most dangerous period. Here you can expect, and will get, the greatest concentration of enemy fighter attacks and anti-aircraft fire. The formation should be tight to offer concentrated defense against enemy fighter attacks. A tight formation will also present a smaller target for AA.

You have flown a long distance with the purpose of dropping bombs on the target, so don't spoil the effectiveness of the effort in the last few minutes. The leader must use the AFCE to obtain the maximum bombing results. The wing men must drop immediately on the leader. It is here that proper crew coordination becomes important. Here your combat crew will prove whether they are a close-knit team or just eleven individuals out for a ride. If you keep cool and calm, even in an emergency, the rest of the crew will follow your example.

When you are under attack there is a possibility of losing your cabin pressure as a result of gun fire. Require your crew members to have their oxygen masks on with tubes connected and ready for instant use.

Use of the radio in the target area is recommended when it is needed to aid in maintaining formation. Needless chattering over the air, however, may prevent an important message from getting through.

3. Return from the Target Area.

On the break away after photographs have been taken the leader must remember that the formation is following him. Additional airspeed must be gained by losing altitude and not by increasing power. If any aircraft is crippled, the formation must be slowed down to pick him up, providing the safety of the entire formation is not jeapordized. If your aircraft is crippled, employ every expediency to remain in formation

for protection. Observe other aircraft that have been shot down or that may leave the formation later. Note the position, altitude, heading, and how many parachutes have been seen to open.

If you have an engine knocked out you will be able to maintain formation by using higher power settings on the remaining three engines until you are out of the danger area. If it is necessary for you to land near enemy territory, but within range of friendly fighters, do not hesitate to call upon them for escort and cover when landing at an emergency field.

Immediately after leaving the target make an interphone check with the crew members to determine battle damage and casualties. It will be necessary to know this in order to properly plan your return flight.

Send in the required radio messages after leaving the target, and upon entering the control zone. If you fail to turn on your IFF, units in the friendly area will be alerted. This will lead to much confusion and disrupted plans, particularly at night. When operating from the China bases you are susceptible to enemy fighter attacks at any time, even over your own field. Maintain a constant alert status of the combat crew.

During the flight out and back, make note of any unusual activities observed or installations not previously reported. Reliable information of enemy dispositions and facilities in occupied territory and in Japan proper, is difficult to obtain from other sources. Anything unusual that you observe may be valuable information to the Intelligence Section.

4. Landing.

On reaching the field carry out the normal formation landing procedure, unless you have sustained battle damage, or have wounded crew members aboard. Remember that there is a relatively short period of time to land all the ships of your Group and all of them will be short of gas. If you have sustained structural damage to your airplane and there is the slightest doubt that you will be able to clear the strip after landing, circle the field until all other ships have landed, or if you are low on gas use the crash landing strip when one is available.

If you have wounded men aboard and have not sustained structural damage, fire a series of red flares, break away from the formation and land first.

Before entering the traffic pattern be sure to go over your check list completely. Check the operation of your flaps, watch the brake pressure, and have your gunners check for flat tires.

F. MAINTENANCE

In the past we have had many abortions due to lack of knowledge and skill on the part of the combat crew in flying the airplane, and on the part of the mechanics performing maintenance. This lack of skill was understandable due to our short training period with the B-29. As our experience has

increased, the percentage of abortions has decreased. The key to the success of a mission is good, precise maintenance. Insured maintenance will insure missions completed.

In our operations, a large share of the maintenance falls upon the members of the combat crew. Close coordination between the airplane commander, the flight engineer, the crew chief, and the engineering officer is necessary. The airplane commander must maintain constant supervision over the maintenance being performed on his airplane. It has been clearly shown that the airplane with a commander who supervises the maintenance will participate in the largest number of missions, and will have fewer aborts. You must know your airplane thoroughly, the maintenance needed, the best and most efficient means of getting the work done, parts needed and how to get them, and when the airplane will be ready to fly again.

Preventive maintenance before the airplane takes off will help insure its completing the mission. When you have had a successful flight, give a "pat-on-the-back" to the ground crew. Let them know you are aware of their part in the mission. If the flight is not a successful one, give the crew chief all of the helpful information possible. If you do not know exactly what the trouble was, find out, and see that it is properly remedied. Never be afraid to get your own hands or clothes greasy in working on the airplane. It is to your advantage to increase constantly your practical knowledge in maintaining the airplane.

Another factor that causes abortions is carelessness. The human element is always present, and you must constantly be on guard against it. Follow the standard procedures in pre-flight inspections and insist that your ground crew and combat crew do the same. Too many airplanes have aborted due to loose fuel and oil tank caps coming off during flight. The B-29 is too large for one person to be responsible for the entire pre-flight inspection. Certain duties must be assigned to separate individuals. This will prevent the often heard remark, "I thought the other fellow was going to check that".

1. <u>Before the Mission</u>.

When the airplane returns from a mission work should immediately be started on preparing it for the next one. From the time the airplane leaves the rear base until it returns again, usually approximately 25 hours flying time, there is little time allowed for maintenance. Therefore, it is apparent that a complete and thorough pre-mission shakedown inspection is necessary. Each group will have its standard procedure for accomplishing this inspection.

Following the inspection a pre-mission engineering flight is necessary. This flight should be for the purpose of thoroughly testing the engines and equipment of the airplane. During the flight you should have each crew member check each item of his equipment for efficient operation.

Personal equipment for the flight should be inspected and placed in the airplane prior to reporting for the flight. While each individual is responsible for his personal equipment, you as airplane commander are responsible that everyone is completely equipped and ready to conduct the mission.

2. Before Station Time.

It is essential that a thorough inspection be made of the exterior of the airplane. This will often prevent starting engines or taking off when some part of the equipment is out of place, or is malfunctioning. Consult your flight engineer and crew chief on defects noted in the Form 1A.

Many airplanes have failed to release bombs at the proper time due to improper bomb loading. Don't let this happen to you. Insure yourself that the bombing equipment is functioning properly, and that bombs are correctly loaded. Your primary object is to release bombs on the target, and not to jettison them in the China Sea.

3. After Landing.

After you have landed and performed the crew inspection, go over the airplane with your crew chief. Tell him what was wrong during the flight and explain the symptoms. If the defects are properly written up in the Form 1A and explained to your crew chief, he will have less difficulty in performing the needed maintenance.

The Form 1A should be filled out in the air. As defects are discovered by members of the crew, they should call in this information to the flight engineer who will then record it in the Form 1A. Nothing should be omitted. The pilot who fails to write up defects to spare crew chief's feelings is doing everyone concerned an injustice. Your crew chief should take pride in correcting every defect that is noted.

G. EMERGENCY OPERATIONS

1. Loss of an Engine on Take-Off.

The loss of an engine just prior to or immediately after take-off is the most crucial emergency you will encounter in the B-29. Once you are committed to take-off there is little you can do but continue, and for that reason it is essential for you to have a definite procedure established with your crew for such an emergency. There are so many points where the loss of an engine can influence your decision that it is difficult to put down any set rule; however, if you are just airborne the first requisite is to reduce drag as quickly as you can. Bring up the gear and flaps as soon as possible, feather the bad engine and increase power on all others, and have your engineer close the cowl flaps as much as possible. This must be instantaneous. As soon as a safe flying speed and sufficient altitude have been reached, salvo as much of the load as possible and move crew members around to secure the most favorable C.G. Reduce power and continue around pattern with normal three engine operation.

With the increased power settings and closed cowl flaps, cylinder head temperatures will rise quickly to the detonation point and, therefore, must be watched closely. Don't use excessive power longer than you absolutely have to. In some cases there is little else to do but chop your throttles and land straight ahead. Whatever the circumstances are it's undoubtedly a gamble and it calls for split second decisions. Train your crew for such emergencies.

2. Three Engine Operation.

The B-29 has flying characteristics very similar to the B-24 under three engine operating conditions. Providing the propeller can be feathered trim tabs may be used in a way so that no unusual flying conditions are encountered.

The primary concern of three engine operation is the increased fuel consumption in case an engine is lost at extreme ranges from the home base. Experience has shown that if you can descend to an altitude where automatic lean may be used (fly from 10 to 15 MPH below the airspeed required by power curves if necessary to get into auto-lean) you should have no difficulty in reaching the home base.

3. Two Engine Operation.

Two engines out on the same side presents the difficulty of maintaining direction; however, it can and has been done. Altitudes may be maintained if at light enough weights. Extending your range sufficiently to reach home base under these conditions is highly improbable; however, it may mean the difference of reaching friendly territory or not. Do not hesitate to lighten the load any way possible under these conditions.

4. Emergency Landings.

Whereas, the B-29 is proving itself capable of taking belly landings equally as well as the B-17, experience has shown that if only one wheel fails to extend better results are accomplished if a landing is made on any combination of two wheels extended. However, if two wheels fail to extend it is recommended that the operative wheel be retracted and a belly landing be made.

If either of the main gears fail to extend make a normal landing as slow as possible keeping the wing up with ailerons as long as possible. Cut all switches as soon as you are definitely on the ground. To date there have been no resulting fires from this type of landing, and in one instance the plane was back in commission in a period of two weeks.

In case the nose wheel fails to lock in the down position make a normal landing holding the nose in the air as long as possible, but do not hold it up so long that the nose will tend to slam down on the runway. Be sure and get the C.G. as far aft as possible with safety.

H. CONCLUSION

We are cognizant of the fact that further operation of the B-29 might change the outlook on many of the theories advanced in this manual. This manual was not written as a directive, but rather as a guide.

Remember - there is nothing that will take the place of experience. Keep your mind open, continue to learn, and you and your crew will stand an excellent chance to successfully complete your combat tour.

FLIGHT ENGINEER

IV. THE FLIGHT ENGINEER

You, as flight engineer, should begin planning at the first notice of an impending mission. First, determine the general condition of the airplane; second, find out what kind of load and weight is to be carried; and third, actually plan the flight.

1. Preflight Check.

If the regular crew is to take the airplane on the mission, the procedure is somewhat simplified as due to close association with the airplane, you will already know its general condition. If the crew is to take an airplane new to it, it will be necessary for you to consult the regular flight engineer, the crew chief, the Forms 1A and 41B, and to make a thorough physical check of the new airplane. Check the airplane for cleanliness and do everything possible to clean it up and keep it clean. A dirty airplane has increased drag and will burn more fuel than a clean ship. Check engine cooling surfaces for cleanliness and inspect the engine baffles. Cooling air seals should be checked for leaks to guard against excess fuel consumption caused by the large cowl flap openings required to cool the engines if the air seals leak. To insure the accuracy of the airspeed system, check it for leaks and plugged lines. On lead ships this is doubly important and must be done without fail. Go over the airplane completely with the regular flight engineer and crew chief to insure a perfect understanding of any modifications or changes incorporated in the new aircraft. During the planning of the mission, close coordination between you and the pilot as to the condition of the airplane is essential.

2. Loading.

The kind and amount of load to be carried are obtained from the airplane commander or at an engineers' specialized briefing. If it is a combat mission, obtain the number and weight of bombs, and the amount of fuel, oil, and ammunition. These may be merely proposed loads because after the flight plan is completed, it may be found that it is possible to carry less fuel and maybe one or two more bombs, or vice-versa. In this respect you must consider the particular characteristics of the airplane as well as the position it will fly, if the flight is in formation. Complete the weight and balance Form F first, so the weight and center of gravity location may be determined. Bear in mind when distributing the load that the pilots prefer a forward center of gravity location rather than one bordering on the aft limit. When checking the airplane to see that all of the necessary equipment is aboard, it is equally important to inspect for and remove all unnecessary items.

3. Fuel Consumption.

From the navigator obtain the flight plan and calculate the fuel consumption from the Climb Control Chart and the Range Versus Weight Chart. Estimate the power required from the Composite Cruise Control Charts. Remember these charts of necessity are constructed for the average airplane, and on the basis of past performance, you should know whether your airplane can do better than the

charts indicate, or whether it will require slightly more fuel. Construct a flight progress curve of hours versus fuel consumption. It is a good policy to write on the graph the weight for each hour in order to save as much time as possible while in the air.

It is necessary for you to be present when the airplane is serviced. An additional 100 to 200 gallons of fuel can be carried by careful servicing, which may be the difference between getting back safely or having a forced landing. Personally check the oil and fuel filler caps just prior to take-off to prevent an embarrassing abort.

Always use the check lists and operate according to specifications for maximum fuel economy; operation of cowl flaps is especially important. Keep the flight progress curve up to the minute so the pilot can be kept informed on the relation of the actual fuel consumption to the preflight estimate.

4. Fuel Transfer.

Transfer of fuel has a pronounced effect on the location of the center of gravity, particularly if three bomb bay tanks are carried in the forward bomb bay and a load of bombs or cargo is carried in the aft. When the fuel is transferred, the center of gravity is shifted toward the rear. Since many pilots prefer a forward C.G. location, there have been objections to the policy of transferring fuel into the wing tanks as soon as possible. However, there are two strong arguments which make it advisable to replenish the supply of fuel in the wing tanks as it is used by the engines. First, fuel should be transferred as soon as possible due to structural strength considerations. Transferring fuel to the wing tanks maintains a balance between fuselage and wing strength factors. If the transfer is not made, any violent maneuvers such as may be encountered on combat missions or in turbulent air may cause severe damage to the aircraft. The second argument in favor of immediate fuel transfer is that if transfer is delayed on a long mission, a malfunction or combat damage may make fuel transfer impossible and the aircraft could not return to friendly soil. The responsibility for loss of the aircraft and crew would rest directly on you and the pilot. This has happened. Don't let it happen to you.

You should acquaint yourself with the fuel system of the airplane which you are to fly on any particular mission, since at present there are several different fuel systems. Determine the location of check valves, fuses, circuit breakers, etc., so that fuel transfer can be accomplished with a minimum of trouble and under any emergency condition where a unit of the system is inoperative.

5. Automatic Mixture Control.

The automatic mixture control automatically compensates for variation of carburetor airflow while the central lever is in the detent. The mixture control should not be used for manual adjustment. Used in that manner, it would only be chance that a satisfactory fuel flow corresponding to the air-flow would result. The position of the mixture control lever on the

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quadrant has no relation to the fuel flow. A small movement of the lever in one section of the quadrant has no effect at all, while in another sector the same movement produces a very great change in fuel flow. Any variation of altitude, carburetor air temperature, or power setting will change the fuel requirement of the engine. In the automatic position the carburetor makes the necessary changes to maintain correct fuel-air ratio, but this is not the case when the mixture is controlled manually. The carburetor was designed for auto-mixture control only and any other method of controlling fuel flow is risky and should not be used.

6. Cowl Flaps.

Cowl flap openings have such a large effect on the drag of the airplane that the effect of their use on cylinder temperature and drag should be thoroughly understood. For a typical operating condition, there is a reduction of 20°C. in cylinder head temperatures by opening the cowl flaps from 4° to 8° (1 1/4" to 2 1/4"). An additional 5°C. reduction in temperature is all that can be obtained by increasing the angle to 12° (3 1/2"). The drag is increased by the same amount in each case. What this represents from the flight engineers standpoint is probably best illustrated in the following manner. Assume a cruising condition with cowl flaps open about 8° and cylinder temperature at 220°C. The cowl flaps could be closed down to give a temperature of 230°C. and 6 M.P.H. indicated airspeed (8.5 M.P.H. true speed at 20,000 feet.) would be picked up. Whereas, in the case where the cylinder temperature was 220°C. and the cowl flaps were already closed fairly tight to 2°, the flaps could only be closed another 1/2" which would result in a cylinder temperature of 230°C. and an increase of indicate airspeed of only 1.5 M.P.H. (2.0 M.P.H. true speed at 20,000 feet). It is, therefore, apparent that at the higher cowl flap angles, every attempt should be made to operate as close to maximum permissible temperatures as possible; whereas, at the very small cowl flap angles, unless every gallon of fuel is of extreme importance, it is better to save on the engines by operating at reduced temperatures.

7. Emergencies.

See that auxiliary and emergency equipment is complete. Check the oxygen supply to insure that the full amount is carried and that all walk around bottles are charged. Check the hydraulic reservoir tank to be sure it is filled to the correct level on the gauge. Ascertain the location of the portable emergency flap motor which should be located on top of the spar in the mid-way section. Make sure the necessary tools for emergency repairs are carried. See that the life raft equipment is complete and the doors are securely fastened.

You must be absolutely familiar with your duties involving emergencies on the ground and in flight. Loss of an engine on take-off is the most critical situation which can be encountered. It is, therefore, necessary that you obtain instructions from the pilot as to your duties in such an event. The procedure must definitely fix the responsibility for specific action. Completely close the cowl flaps and intercooler shutters on the dead engine and if temperatures permit, decrease cooling flap openings on the live engines.

You must know without doubt or question the emergency procedures for fires, ditching, brake failure, operation of landing gear, bomb doors, bomb release and wing flaps.

Aside from having a thorough knowledge of engine operation and use of Cruise Control for computing gasoline consumption, you must know your airplane so thoroughly that when the unusual emergencies arise, you will be able to improvise means of completing the mission and getting safely on the ground. For example: Shorting across a burned relay in the fuel transfer system, shorting across a toggle switch to operate cowl flaps, plugging a leaking hydraulic line, or exchanging parts in an emergency.

8. Landing.

The engineer's duties during landing are relatively simple--use the check list, and compute the landing weight and the center of gravity location. Also maintain a constant check on the hydraulic pressure. This is as important as the co-pilot's calling off airspeeds on final approach.

9. Forms.

All of the required forms must be filled out clearly and completely. All of the information required on the forms and logs is necessary. There is seldom a valid excuse for improperly recording the data. The engineer should go over each entry in the Form 1A with the airplane crew chief, explaining the circumstances and symtoms of each malfunction so that the trouble shooting can be carried out in an efficient manner. Follow through on all maintenance work, learn if possible the cause of the trouble, how it was corrected, and how it can be avoided in the future.

RADAR OPERATOR

V. RADAR

As radar operator your job on the bombing team is a vital one. On any mission, combat or operational, you will be required to work hand in glove with the navigator. On every bombing run, visual or blind, you and the bombardier must work together to hit the target. Your pilot must have complete confidence in your judgement and technique. He will rely on you equally with the navigator and the bombardier to get to the target, strike it, and to get back.

A. NAVIGATION

You will soon discover Asia is a difficult theatre of operations for radar navigation. Good check points are often few and far between. Long stretches of mountainous terrain will make it difficult, at first, for you to pinpoint yourself and get accurate ground speeds and drifts. Only the very large cities will give you anything like the target return you get from a town in the United States. Ordinary towns won't show up at all. Watch for large bridges though, as they nearly always give a sharp bright signal.

You will discover for yourself that a continuous knowledge of your position is essential and that means just one thing--good Dead Reckoning procedure. True heading, drift, and ground speed, (whether observed or metro) will provide you with the necessary information to follow the pilot with a Dead Reckoning plot on either a mercator or an aeronautical chart. With this information you can figure ETA's for check points ahead. In this way if you can't pick up the check point on the fifty mile range, you will know when you can expect to see it on the twenty or ten mile ranges, with the clearer mapping these low ranges give.

Charts of most of China will give you trouble. The mountain elevations and contours are not accurate and the river courses are subject to change without notice. Some rivers shown on the maps don't exist and there are new ones not indicated at all. The prominent ones are at least in the right locations even if their turns and twists are somewhat erroneous. Most of the larger lakes are located properly but you will soon notice their actual shape isn't as represented. Beside all this, flood conditions at certain seasons of the year will change the appearance of many of your water landmarks. Coastlines, however, are quite accurate as are the maps of your main target area. So now you see why you need good Dead Reckoning to keep on the ball.

That brings us to log procedure. Your log form is very much like the navigator's. You can't do accurate, intelligent Dead Reckoning without a log. There just isn't anything better than a neat log to insure logical navigation and to keep you from getting lost. It is essential to make entries at regular intervals, and it's easier to average, too. When you locate a checkpoint make a log entry even if you can't identify it. You may be able to do so later and you have one more place catalogued in your mind.

Your navigator and pilot will expect you to be able to provide them with accurate drifts and ground speeds at any time. So you can't get too much practice in all the methods of getting this information. Make it a regular part of your job to get a ground speed and drift at least every half hour on

all flights. This isn't easy. It requires really "putting out" on your part and an earnest effort to resist the temptation to skip it. Be sure to notify your pilot so he can hold the heading and air speed while you are making the run. You'll want to calibrate your air speed indicator. You can do this at the time the navigator calibrates his. It will save a lot of unnecessary interphone conversation.

Give your navigator accurate fixes by bearing and range at every possible opportunity. This will help him to check his DR and build up his and the pilot's confidence in your navigational ability. Always give the navigator the time and position of a coastal crossing.

Before each mission, work with your navigator on the flight plan. You will need one of your own to save you work in the air and to give you a step by step outline of what you are going to do on the mission. You'll find the actual flight follows the plan pretty closely in most cases.

The weather at the China bases is often soupy and that is when you can be of most assistance in keeping the plane located. Fortunately, there is a good river in the valley where the air fields are located. It shows up well if your radar technique is good. So once located on the river you can pick up any of the airfields. The flights are long and at the end of fifteen hours everyone is tired, but that's when you have to do your best job. While we're on the subject of weather remember you can see thunderstorms way ahead on your scope and its up to you to guide your pilot around them.

One last word on navigation -- you are a radar navigator, you must be prepared to take over complete control of the navigation of your plane at any time.

B. BOMBING

Your bombing job begins on the ground. Thorough target study pays off in a big way. After a "Hump" trip and a seven hour flight to the target it only takes a little confusion about the aiming point to nullify all that effort. Often you won't even have radar reconnaissance photos to help you and at present its pretty difficult to predict how the target will appear with any degree of accuracy. That's when target study will mean the most to you. Memorize the general layout thoroughly. Are there nearby lakes or rivers, big cities or bridges that will help you get oriented so that you can't miss identifying the target even if the return is weak? When you do have radar-recon photos get every bit of good out of them you can. Plan just where you will change to get the extra magnification of the lower ranges. Compare the scope photos with actual aerial photos if they are available. This will help you locate the exact aiming point. But remember the aspect of the target will undergo startling changes if you approach it on different headings.

Your equipment must be in perfect condition for the mission. It is your responsibility to give it a thorough preflight operational check. Do this well before take-off so there will be plenty of time to fix any defect that shows up. Check your lighting and interphone systems at the same time.

Check lists will relieve you of a lot of worry and keep you from forgetting important things. Make them, keep them handy, and use them. A sample is shown at the end of this section.

On the way out your main job is to know where you are all the time. Be sure you get a good point of departure to start your DR plot. Get your sweep centered right away. As soon as you get to altitude calibrate the set so that it will give you accurate results. With our system of formation bombing you will have some difficulty with interference, but you will soon develop the knack of reading right thru it. Invariably you will be the first to pick up the IP. It will be your job to direct the turn over it onto the bombing run. You must thoroughly understand how to plan and use a procedure turn to accomplish this. It will require close teamwork between you and your pilot. If you are in control of a lead ship never forget you have a formation behind you. Your corrections must be gentle and your turns of short duration or you will spread the formation all over the sky.

Before you reach the IP you should have an accurately determined wind so you will know your drift and ground speed for the bombing run. You should have determined your absolute altitude. As soon as you know the ground speed and absolute altitude mark the Slant Range for release (or the delay time and SR to the Aiming Point for offset bombing) with a grease pencil on the top of the glass face of your computer.

You will use the standard radar-bombsight procedure. This means the bombardier has prepared his bombsight ready to synchronize it with information you will give him. You will read off a series of predetermined sighting angles which he uses for setting and correcting rate and displacement of the bombsight telescope thereby establishing synchronization. You also make changes in the heading of the plane to kill any slight amount of drift. If the target is obscured this procedure can also be used for a blind bombsight release (a release when the indices meet) or to enable the bombardier to be ready to take over for even a very short visual run should the target become visible at the last minute. You and the bombardier will have to practice incessantly to perfect the technique and coordination necessary for a successful bomb run. But you must set up your computer and be ready to release in case something goes wrong. You will have to allow yourself time to do this after you have read off the sighting angles. So when you know the absolute altitude at which you will bomb you can determine the lowest sighting angle you can safely call off and still leave yourself fifteen seconds or so to set up the bomb release circle at the proper SR to drop. Be sure to shift to the lowest possible range before calling off your first sighting angle so you can take advantage of the better mapping. Don't forget to turn on the sector scan which you can position while you are in the turn at the IP. Do you have an idea of how much practice all this will take? Right -- but eventually when you are whipped into a smooth polished team it will become automatic.

C. SET OPERATION AND AIR MAINTAINANCE

Develop your ability to get the most out of your set. Be familiar with the refinements of technique that will give you the best mapping and produce accurate bombing.

1. Here are Some Ideas.

a. Be sure when you are reading a scope bearing or a computer setting that your eye is squarely in the line of proper sight to avoid parallax.

b. Always use sector scan on ground speed and bombing runs to decrease the timing error.

c. Center the pattern on your scope by aligning the heading line exactly under the master drift line at two bearings approximately ninety degrees apart. This will prevent unnecessary errors in the bearings you observe.

d. Use azimuth stabilization all the time. Learn how to check its accuracy on each heading and to correct the error for the bomb run by having your navigator adjust the variation on his master indicator.

e. Turn on your heading line as little as possible so as not to obscure targets ahead. You'll be surprised how little you need it. Theorectically you don't need it at all if you'll use your own fluxgate compass repeater indicator.

f. Fight constantly to school yourself to use as little gain and brilliance as possible, especially in the target area.

g. Use the tilt very carefully. It's the best control to bring up target returns. If you have the time it is best to adjust it with the sweep stopped. In this way you can see which portion of the scope is being affected.

h. Practice using the four mile range until you can make it really map clearly for you. At times this ability will be invaluable.

All this is very fine when your set is working. But sometimes, despite the best efforts of the ground crew, it will act up or it just won't act at all. That is when your knowledge of the technical side of radar and your own ingenuity comes to bat. You must be familiar enough with the equipment to analyze, locate, and repair any trouble which might occur in the air and which can be repaired in flight. That calls for an intimate knowledge of the set, a result of study and observation. There will be plenty of chance for both if you'll stick around and watch the maintenance men do trouble shooting. And you'll also learn just what he wants to know about the troubles you couldn't repair in flight. You must observe and report symptoms if you want fast and efficient results from the maintainance section.

Finally study all the Bomber Command RI's (Radar Instructions) carefully until you have absorbed and understand all the information in them pertaining to your job.

D. RADAR OPERATOR'S CHECK LIST

1. Pre-Flight.

a. Mission Information

(1) Flight plan
(2) Charts with course drawn
(3) Complete target folder
(4) Escape and evasion information
(5) Bomb tables

b. Navigation and Radar Equipment

(1) Plotter
(2) Dividers
(3) Lead pencils
(4) Grease pencils
(5) Eraser
(6) Hack watch
(7) Stop watch
(8) E6B computer
(9) Slant range computer
(10) McNair tables
(11) Log sheets
(12) Scratch paper
(13) Flashlight
(14) Screwdriver
(15) Spare fuses
(16) Repair kit
(17) Voltmeter

c. Time Tick

d. Personal Equipment

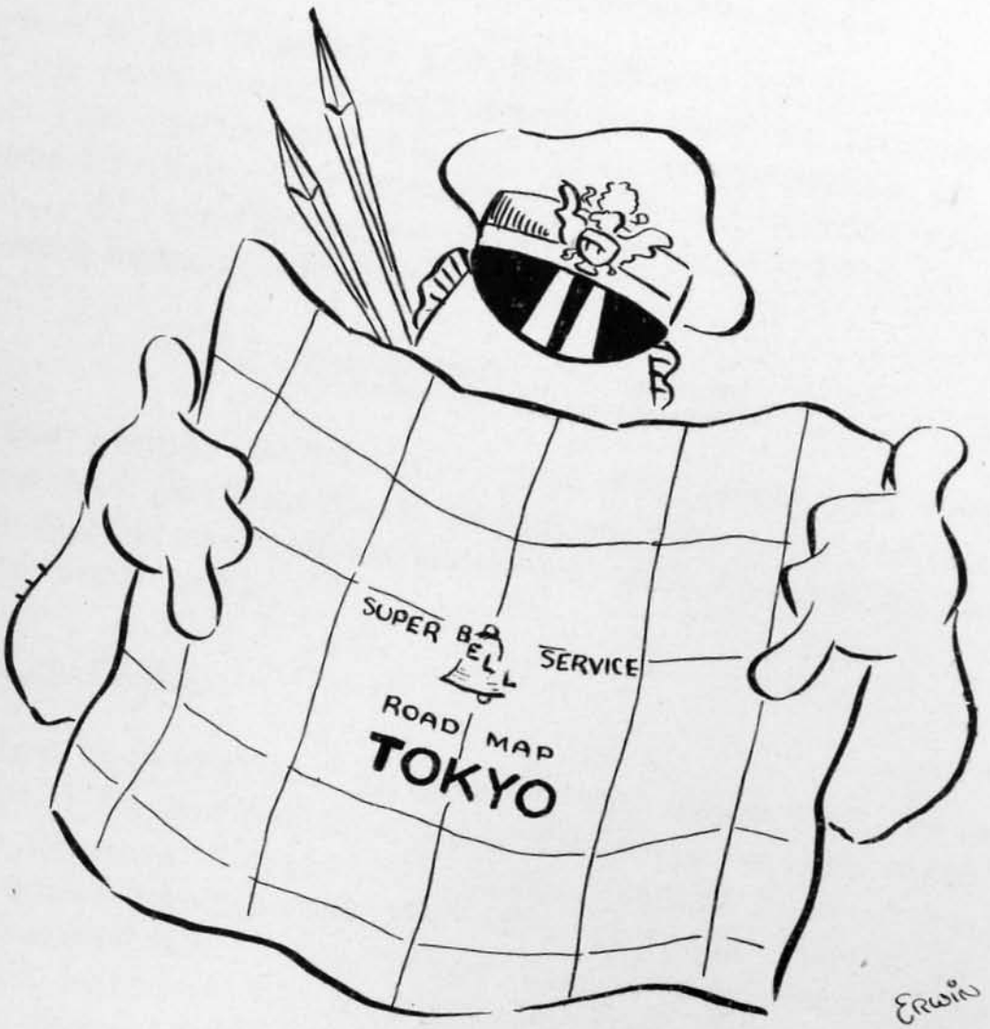
(1) Parachute
(2) Mae West with CO2 capsules
(3) Oxygen mask
(4) Helmet and earphones
(5) Escape vest
(6) Jungle kit
(7) Flak suit and helmet
(8) Canteen
(9) GI shoes
(10) Goggles
(11) Warm clothing

2. Just Before Take-Off.

a. Oxygen system
b. Interphone system
c. Lighting system
d. Altimeter setting at 29.92

3. After Landing.

a. Check all radar equipment off
b. Turn in In-Flight reports
c. Turn in target folders
d. Pick up Camera Log
e. Report for interrogation



COMBAT NAVIGATION

VI. COMBAT NAVIGATION

The requirement for first class navigation is extremely important in a Very Long Range bomber. The fundamental problem of getting to the target and back to base as prescribed in the field order is a long ardous, and difficult one in VLR airplanes and it is further complicated in Asiatic operations by difficult weather conditions, poorly charted terrain, and few aids to navigation. The most important phase of navigation develops from tactical operations, and you can't afford to be satisfied with mediocre results or efforts. You have to be right the first time. The necessary combat and flying odds against a successful mission are sufficient without adding further uncertainty from equipment trouble and lack of knowledge, technique, and cooperation.

A. CALIBRATION OF EQUIPMENT

The navigator's instruments are the source of his most important information and he must continually work against an increasing tendency that develops in the field to "get by" with instruments as they are. The compass, airspeed meter, and octant should get loving care and the most exact calibration. All instruments should be calibrated in accordance with XX Bomber Command Memorandum 55-12.

B. THE NAVIGATOR AND THE CREW

Aside from the proper working of your equipment and your individual proficiency, getting there and getting back requires the cooperation of all the crew members so good decisions can be made and all available information and techniques can be put to best use.

1. Navigator - Pilot.

Navigator-pilot cooperation is absolutely essential in combat navigation. Decisions should be mutual and completely in accord with the pilot's and your estimate of a situation. A pilot should have unquestioned confidence in his navigator's navigation decision and you should by deed and diligence deserve this confidence. The pilot should appreciate the importance of engendering and cultivating your confidence in yourself. You should teach your pilot how hard it is to take a shot in an unsteady airplane, how important it is to fly a good course, and how important it is to fly climbs and let-downs according to plan.

2. Navigator - Bombardier.

You can expect from the bombardier pilotage information, drift checks, ground speed, and wind direction and velocity. You can provide the bombarider with ground speed, wind direction and velocity, and target identification help.

3. Navigator - Radio Operator.

You can get from the radio operator QDM's, QTE's, QTF's, relative and true bearings from the radio compass, and sundry information the radio operator picks up by listening. You will give the radio operator times at which necessary reports must be made.

4. Navigator - Radar Operator.

The radar operator can give you ground speed, wind direction and velocity, coastline landfalls, drift checks, and fixes according to azimuth and ground range. You can help the radar operator orient himself.

5. Navigator - Flight Engineer.

You and the flight engineer are the two people who intergrate the two vastly important factors of: "How much gas have we?" and "How far do we have to go?" A fuel consumption expert remarked of B-29 navigators, "Analysis of flight logs to date shows that increased navigation proficiency will do much to reduce the variation in fuel consumption among airplanes on the same mission. This is a very lucrative source for improvement in overall efficiency and every possible means should be used to impress the navigator with the effect his errors have on the fuel consumed."

In the first raids on Japan some of the navigators were very impressed with the effect their errors had on the fuel consumed; they will not forget how close they came to not getting back! Some did not get back. Work with your flight engineer and learn the gas problem.

6. Navigator - Gunners.

You learn from the gunners important intelligence data of all kinds to record properly in your log.

D. STANDARD PROCEDURES

The procedures set forth here apply to lead and wing navigators alike. The distinction between lead and wing navigators is essentially one of responsibility. The lead navigator is responsible for getting the formation to the target and back as directed in the field order. Wing navigators, though handicapped by the difficulties encountered navigating on a wing, accomplish the same navigation that the lead navigator accomplishes. The only difference in navigation is one of method. Wing navigators do DR based on follow-the-pilot procedures.

1. Flight Plan.

It is considered good procedure to have at hand before a mission as many answers as possible concerning the proposed flight. The best aggregate of answers you can produce is a detailed flight plan based on the latest winds made out with the help of the flight engineer and pilot. No-wind flight plans in Asia do not depart very much from actual flight times except in the rare cases of extremely strong winds. When first hand information in limited

a flight plan properly followed provides a good general basis on which to make decisions. You are required to make a flight plan for each mission.

2. Logbook.

A carefully made, accurate log is the best testament to your procedure and technique. A navigator can not do everything required of him unless he has an orderly procedure--a good log is the basis of an orderly procedure. The log is also an official document--the record of the mission. It is subject to scrutiny and review by higher headquarters for many reasons included among which are: Investigation of an operational loss involving navigation difficulty, investigation of claims made by the airplane commander which involve questions of time and place, investigations of operational performance, and investigations concerning tactical performance. Navigation logs are checked after every mission.

3. Navigation Procedure Based on DR.

Navigation itself is fundamentally dead reckoning: Time, direction, speed, distance, altitude, and wind are the basic elements. Your ability to navigate stems from your ability to dead reckon accurately. In this Command you will consider dead reckoning the principal method of navigation and practice it and its counterpart of follow-the-pilot with meticulous care at all times during a mission. If you dead-reckon well, the auxiliary methods of navigation and aids to navigation can be used to a much greater advantage. If you dead-reckon well and use all the information available along with old fashioned horse sense you won't be in trouble.

D. RADIO AND RADAR AIDS

Thus far radio navigation has not been developed to a high degree in the India-Burma and China Theaters where it is affected by weather, terrain, and great distances. You must, nevertheless, learn how to use it to the best advantage close-in because in many cases it's the only way you will find your field. You must learn how to ask for, evaluate, and use a QDM, a QTE, and a QTF. You must learn how to interpret single radio LOP'S which you can obtain from your radio compass. In addition to D/F and homers there are some radio ranges and YJ beacons. Learning to use these aids during bad weather when you need them most requires a great deal of attention and technique. You must be able to use them. Radar is an aid which you carry with you in the airplane and it is of tremendous value over and near coasts and over relatively flat areas where rivers and modern towns may be found. Radar does not prove to be much of an aid over mountainous area but with practice it can be used most of the time over land to obtain ground speed and drift. Very often radar provides the only information available. Learn how to use it in cooperation with your radar operator.

E. CELESTIAL NAVIGATION

Celestial navigation requires considerable equipment, accurate time, and a navigator with a high degree of training. It is not satisfactory unless

the navigator practices constantly to maintain his technique. The principal of celestial navigation at night or day is without equal in theory. The procedure is comparatively simple; the resources are adequate, providing the sky is visible; it cannot be interfered with by the enemy; and the necessary equipment is carried entirely within the aircraft. In Asia celestial navigation has been hampered by weather from time to time, but on every mission it has been used to advantage. As has been pointed out above, navigation aids are limited and because of that a Group Commander of a famous Heavy Group in China remarked "Celestial navigation in this Theater is at its zenith." It is up to you to practice celestial unceasingly in the air when your ground position is known so you will be familiar with and will have solved or compromised the many problems of combat celestial in a B-29. You will know then what to expect of yourself when you need a shot or a fix desperately. Celestial navigation, the highest form of your art, is stressed in this Command.

F. LANDFORMS, PILOTAGE AND CHARTS

Of all the theaters probably the least is known about terrain in yours. Use of maps and charts in the normal manner is not possible. If you are able to follow a course mile by mile on the ground often charts may be used for pilotage, but this is almost never the case. Charts of India and the "Hump" are reasonably good except for altitudes on the "Hump" and rivers which are at flood tide during the monsoon. Charts of inland China are to be used with caution as only the most prominent of landforms and cities are reliable. Rivers are disproportionately charted and mischarted and terrain altitudes are off as much as five or six thousand feet in some areas. Except when near the coast (the China coast itself is not charted too well) the best policy is to DR on a master chart using radio, celestial, and radar to the best advantage and not to confuse yourself by trying to pinpoint the airplane by reference to the pilotage charts and ground. You must learn to know this wild country and to build up on your master mercator a file of accurate pilotage information as well as to help build up a fund of accurate information in your Group. Orientation from charts in coastal regions is not difficult either visually or by the use of radar.

G. WEATHER STUDY

Your knowledge of weather conditions, reactions, and trends influences every navigational decision you make. Be sure you know and understand navigation weather so you can evaluate and use the various methods of navigation accurately. The "metro" section usually provides good winds aloft and enroute weather, but you must realize that this is difficult because of the great distances involved and because of limited reporting facilities. "Hump" weather is a phenomenon by itself and China weather is often difficult to judge. There has been a great deal of instrument flying on missions in China and unpredicted wind shifts have caused trouble. Learn the weather of this area as well as you can because, as always, weather is the greatest factor affecting all sorts of navigation.

H. NAVIGATOR'S CHECK LIST

Before going on a mission it is necessary for you to check carefully all your equipment and materials. The following navigator's check list is standard in this Command.

1. Pre-flight.

   a. Mission data

      (1) Complete flight plan with latest wind in log book or on special sheet provided by Group. Run over this with the crew.

         (a) ETA at target.
         (b) ETA at base.
         (c) Rendezvous
         (d) ETA in enemy territory in and out plus ETA at important enemy areas
         (e) Escape areas

      (2) Charts prepared and checked.
      (3) Celestial procedure for mission organized.
      (4) Inspect and check communication and intelligence flimsies. Plot all radio aids, emergency landing fields, and important intelligence data on master chart.

   b. Navigation Kit. Complete set of navigation equipment for celestial and dead-reckoning navigation anywhere in the intended operational area. This equipment will include:

      (1) E6B computer
      (2) Weems plotter
      (3) Dividers, triangles, parallel rule (optional)
      (4) A-13 chromometer
      (5) A-11 hack watch
      (6) A-3 stop watch
      (7) Current Air Almanac
      (8) Necessary H.O. 218 or H.O. 214 chart
      (9) Ageton or Dreisonstok and forms
      (10) Rude Star Finder
      (11) Supplementary blank forms, TM's, and H.O. publications.

   c. Charts

      (1) Complete set of AAF Aeronautical Charts, International Map of the World Charts or similar charts, scale 1:1,000,000 for pilotage anywhere in the intended operational area.
      (2) All available AAF Aeronautical Charts, scale, 1:500,000 for pilotage anywhere in the general target area.
      (3) Necessary AAF Long Range Air Navigation Charts, scale, 1:3,000,000 or similar charts covering the entire operational area.

(4) Sufficient 1:3,000,000 mercator plotting charts or V-P plotting charts.

d. Sextant and accessories

(1) Check sextant for correction using either a stationary curve or a collimator
(2) Check sextant batteries and light bulbs
(3) Check bubble for operation
(4) Check averaging device

e. Weather

(1) Terminal forecasts
(2) Route forecasts
(3) Winds aloft

f. Correct time (time tick frequency)

(1) Obtain time tick
(2) List of frequencies from which to obtain time ticks
(3) Chronometer rate

g. Astro compass aligned properly

h. All calibration cards. Date zeroed on deviation cards with dates of calibration displayed on master indicator and remote indicators for gyro-fluxgate compass.

2. Before take-off.

a. Check personal effects including clothing, parachute, life vest, flak suit, helmet, check CO2 capsules, escape kit, and flashlight.

b. Synchronize all aircraft clocks and watches of crew members.

c. Check oxygen system.

d. Set altimeter 29.92 to read pressure altitude.

e. Gyro-fluxgate compass. Check to see

(1) Uncages on "on" at all times
(2) System is functioning
(3) Compass sensitivity set properly
(4) Spare fuses available

f. API functioning and set properly

3. During flight.

a. Continually check and cross-check all navigation instruments.

(1) Check T.H. with astro compass. Check GFG compass against the magnetic compass to see that GFG is operating correctly. See that GFG variation knob is at desired position.
(2) Continually set proper data into CFC Gun Computer Handset.
(3) See that IFF is on and off at the proper times.

b. Enroute to target

(1) Rendezvous control points must be made good in time, place, and altitude.
(2) Inform crew when they may test-fire guns.
(3) Constantly brief crew with respect to enemy territory and installations.

c. Navigation in the target area.

(1) Record as much as you can of enemy aircraft, antiaircraft, observed damage, and formations.
(2) Get a pinpoint before leaving the target area.

d. Navigation to Home Base. This is the navigation that is by far the most difficult. You have to find your base in the middle of a large land mass without much help from terrain or radio aids. Just beyond your base are the biggest mountains in the world. You must never relax until you are <u>on</u> your field. You must constantly be prepared to make direct for an emergency field. Be sure you are squared away on the help you can get from your radio operator.

4. <u>After landing</u>.

a. Check all switches and stow equipment.

b. Give your reports to the proper authority.

c. Interrogation

d. Navigation analysis

e. Turn in your charts and flimsies

COMBAT BOMBING

VII. COMBAT BOMBING

The combat bombing run, from the Initial Point until bombs are away, will seldom last more than a few minutes; but the offensive effort of bombing and the purpose of the mission is achieved in that fractional part of an hour. To be able to achieve that purpose, you, as bombardier, have spent many hours over the bombing ranges of the U.S. Now you will spend more practice hours flying over the bombing ranges of India. You must continue to learn and to perfect your technique even to the eventful day when you have completed an operational tour.

Much is expected of you as a bombardier. If you are leading, you aim not only your bombs but those of the rest of the formation. If you are flying a wing ship, your job is to release your bombs at the proper instant to supplement the pattern made by the lead ship. If your navigator is injured, you must be able to continue with the navigation accurately and confidently. You will also man a gun sighting station and you must be proficient in its use, care and operation. Learn all you can about your Central Fire Control equipment. Your knowledge and skill in gunnery is sound insurance. You will be the photographer of your crew and as such will be responsible for obtaining strike photographs of your bombs. It will be necessary to make periodic checks to make certain that the camera equipment is in proper working condition.

Thus, a heavy responsibility befalls the bombardier and it entails more than a few minutes work on the bombing run. Every bombardier, after his training period is concluded, is capable in the mechanics of hitting any target within reason. Nevertheless, many more new techniques must be mastered and the old ones practiced before accurate combat bombing is achieved.

A. THE PROBLEMS OF THE LEAD BOMBARDIER

Let us take up the problems of the lead bombardier, after he is told he is to lead the next operational mission. It is taken for granted that this man has spent many hours in ground study and many hours in the air over the practice bombing ranges under various conditions. He has developed a sense for target identification and procedure by the study of target charts and maps and by use of the bomb trainers and camera bombing.

This brings us to the point where all of the known data of the actual mission such as weather, routes, maps, charts, target photos, bomb loads, etc., is placed before you, the lead bombardier. It is now the task of a good technician to gather the essential material from the mass of information at hand, to memorize that material, and to keep in mind the points of lesser importance. Too much emphasis cannot be placed on the importance of knowing the target from any approach and knowing completely those check points which will help to find and identify the target.

After knowing the target thoroughly, the equipment which you are using must be in perfect working condition in order for you to hit the target after you have found it. You must know your equipment and see that it is in good

working condition by checking it yourself. Before the ship is loaded with bombs, you personally, should go out and run through your racks and check your salvo system. With this completed you will know that you have done everything you can to insure that the rack equipment is in shape.

1. Preflight Inspection.

Prior to take-off perform the following preflight inspection:

a. Make sure the bombardier's kit contains those items listed in the Bombardier's Amplified check list (Section E of this chapter) in addition to the target folder with the necessary maps, photos, and metro data for both primary and secondary targets.

b. A complete and thorough preflight of the bombsight.

c. Set bombardier's altimeter to read 29.92.

d. Check bombs and fuses as outlined in Bombardier's Amplified Check List (Section E, this chapter).

e. Check intervalometer, also the bomb indicator lights on the newer type aircraft.

f. Test the interphone.

g. Check operation of the bomb bay doors.

h. Make operational check of the front sighting station.

i. Brief the crew for any possible contingency on the bomb run.

j. Check camera installation, operation of hatch doors and camera vacuum valves and the position setting on the camera intervalometer.

2. Flight Operation.

Now with your equipment all checked and with a thorough understanding of the objective, you are ready to take off and hit the target. After take off and on climbing to altitude, it is well to assist the navigator in all important jobs of assembly by doing pilotage to check against his DR navigation. Pilotage checks should be made on the way to the target to make certain that your course will bring you to the assigned IP.

On the route out to your target every attempt should be made to practice synchronization to get accurate winds and ground speeds by use of the Automatic Bomb Computer, which will be valuable to both the navigator and yourself. Remember that every known aid to bombing has been placed at your disposal and all that remains to accomplish a successful mission is the proper use of these aids.

At altitude request the pilot to turn the ship over to you for several minutes so a thorough check can be made on the C-1 autopilot. In order to operate properly, the C-1 autopilot must be readjusted after some of the fuel supply is used. So do not wait for the pilot to call for a check. Remind him! While adjusting the C-1, gentle turns should be made from both the pilot and bombardier's positions. If the system does not meet with your approval, then shut it off and prepare to make a manual run. Nothing will give you a better chance to hit the target than the C-1 autopilot when it is operating correctly, but it is far better to make a manual run if it is evident that the automatic equipment is not functioning properly. Another important factor about the use of the automatic pilot is the importance of knowing how to lead a formation. This cannot be stressed too much. You must remember your turns or corrections are not only affecting your aircraft, but those of your whole group as well as the groups behind you. It is imperative that your corrections be gentle and that no one turn is sustained for a long period of time. Steep or violent turns spread the formation and make it vulnerable to fighters.

The bomb bay doors should be opened by each group after leaving the IP so that each airplane has a chance to open the doors and get into position. The whole idea of formation precision bombing is built on the premise that the bombs will form a pattern on the ground the size and shape of the formation flown. It can readily be seen that the concentration of bombs desired on the Mean Point of Impact cannot be achieved if the formation is spread out and the planes are straggling.

If you know your target, you will see it from the IP, or at any rate, you will see your check points which will pin-point you into the target. If you find these quickly, pre-set your data, and you will have a normal run, your procedure will work out smoothly and you will have plenty of that so-called "precious time".

Finally, you make your bomb run which actually is not more than a few minutes. You know that the sight gives the correct results because you checked it yourself. Your racks will release at the correct instant because you checked these too. You have no doubt that you will hit the correct target and the assigned AP because you have spent many hours memorizing the target and portions of the surrounding districts from the objective target folder. You have turned at the IP on the correct heading and you have pre-set the wind data because you have checked drift enroute to the target. Yes, bombardier, you have good reason to believe that you have hit your target because you have utilized every known aid to bombing to hit your objective.

You have trained many months but now you will find there was not one repetitious thing you did in training that you did not need from take-off to landing on an operational mission.

B. BOMBARDIERS FLYING IN A WING

Except for the actual sighting operation, there is not much difference between the job the lead bombardier must do and the job the men flying on his wings should do. At any time you may have to take over the lead, or in

some future mission you may be lead bombardier and without the practice of checking data while flying on a wing, the chances of having successful mission when you do lead the group, are greatly reduced.

It is found that in order to get more bombs on the target and to destroy it effectively, the patterns made by the formations have to be made to cover a smaller area on the ground. It was found that the biggest factor for irregular and scattered patterns was the time element that existed between the instant the leader's bombs dropped and the remaining ships dropped. That is why it is imperative the wing bombardiers release their bombs simultaneously with their leaders. There is probably no better way of missing a target than to have the lead bombardier figure his problem on the premise that the pattern formed by his group will effectively cover the Aiming Point, then have his wingmen do everything but release the bombs at the right instant. Remember, the lead man aims the pattern but the wingmen give the pattern its characteristics. Who can say which is the most important? It takes a good job of both to destroy the target!

C. BOMBARDIERS AS NAVIGATORS

You as bombardier-navigators have an added responsibility in navigation. Brush up on what you have learned in various schools. Bombardiers have often contributed to the success of a mission by their knowledge of navigation and have on numerous occasions, throughout the Air Forces, led their aircraft safely back to base, after their navigators have been injured.

D. BOMBARDIERS' AMPLIFIED CHECK LIST

1. Prior to Take-off.

   a. Bombardier's Kit. Check kit to insure that the following items are contained:

      (1) Copies of pertinent bombing forms.
      (2) E6B computer.
      (3) C-2 computer, pencil and notebook.
      (4) Stopwatch.
      (5) Correct bombing tables.
      (6) Pliers and screwdriver.
      (7) Tachometer.
      (8) Tangent of dropping angle scale for ABC
      (9) Complete target information.

   b. Bombs and Fuses. Note the station position of the bombs and see that the stations are cocked. Make certain the arming wires are secured to the shackles. Check to be sure fuses are snug and with proper setting. Check bomb bay switches, be certain that safety locks on racks are not stuck, and that the A-2 or A-4 release units are snug against the rack.

   c. Preflight Bombsight. (see Memorandum 56-14, this Headquarters)

d. Altimeter set at 29.92. Set Kallsman scale of bombardier's altimeter at 29.92 inches.

e. B-3 Intervelometer. Check to make certain the number-of-bombs pointer is on zero and the switch is on "train".

f. Bomb Indicator Lights. (In newer type aircraft only) Check lights against stations which are loaded with bombs.

g. Interphone. Test operation of earphones and microphone by checking on interphone system with the airplane commander.

h. Bomb-Bay Doors. Be sure they are closed to prevent dust and dirt from getting into the bomb-bay.

i. Check Camera. Make certain camera has been installed properly, is loaded and prepared for operation.

j. Operation of Camera Hatch. Check operation of camera hatch doors.

k. Camera Intervalometer. Check intervalometer fuse and setting.

2. After Take-off.

a. Read drift by bombsight. Assist the navigator in his dead reckoning by taking drifts with the bombsight.

b. Pull pins. Bomb fuse safety pins will be pulled prior to reaching an altitude requiring the use of oxygen or prior to pressurization.

c. Bomb-Bay switches. Check position of bomb-bay switches in both bomb-bays. The switch in the bomb-bay in which bombs are carried will be turned "ON".

d. Open camera hatch doors. Doors to camera hatch will be opened prior to pressurizing. This will allow a visual check to be sure doors are open.

e. Open camera vacuum valves. Prior to pressurization check to make sure that camera vacuum valves are open.

3. At Altitude.

a. Compute true altitude. True altitude will be computed in accordance with Memorandum No. 56-16 this Headquarters.

b. Set data in bombsight. Set disk speed and trail into sight.

c. Aid in setting up C-1 auto-pilot. Prior to IP assist the pilot in setting up the C-1 autopilot.

d. Level stabilizer. Check the level of the stabilizer when aircraft is flying straight and level.

e. Set up ABC. (See Memorandum No. 56-17, this Headquarters.)

f. Re-check data for accuracy. Re-check true altitude, disk speed and trail set in bomb-sight.

g. Set up B-3 intervalometer. Set ground speed opposite interval in feet, as instructed at briefing, and set pointer at number of bombs in train. Turn intervalometer switch to train. (Note: approximately one minute is required for the intervalometer to warm up).

h. During spare time study target folder, and assist navigator.

4. Over Enemy Territory.

a. Observe Terrain. Keep a constant lookout for enemy activity and new installations in the area.

b. Assist in locating IP. Assist navigator and radar operator in picking out the IP.

5. After the IP.

a. Open bomb-bay doors. Open doors in sufficient time to allow an accurate bomb release.

b. Unlock Racks. This is accomplished immediately after the bomb-bay doors are opened.

c. Turn on bomb group selector switches. Turn on, only those racks which are loaded with bombs.

d. Turn on master camera switch. This should be accomplished at the same time as the bomb group selector switches are turned on.

e. Notify radar operator if bombing is visual. When certain that bombing can be accomplished by use of the bombsight, notify the radar operator that a visual run will be made.

6. After Release.

a. Start camera, immediately after release.

b. Lock racks, close bomb-bay doors, and inform pilot when bomb-bay doors are closed.

c. Turn off rack selector switches.

d. Turn off camera switch after bomb impact.

e. Turn off bombsight after descent to low altitude.

f. Close camera hatch doors. This will be accomplished prior to landing.

7. Before leaving aircraft

a. Put overnight setting on sight.

(1) Make certain gyro is caged.
(2) Set trail arm at zero.
(3) Set telescope index to maximum sighting angle.
(4) Set disc speed drum at minimum disc speed.
(5) Engage secondary clutch.
(6) Engage directional clutch.
(7) Close air vent in stabilizer.

b. Cover sight.


ERWIN
RADIO
PROCEDURE

VIII. RADIO PROCEDURE

A. INTRODUCTION

To be a good radio operator you must know the equipment you have to use while in flight, and what ground installations are available for you to contact. You are the crew member who is trained primarily as a radioman. In the event of an emergency, the lives of all your fellow crew members may depend on your ability. The other crew members will also expect you to answer their questions regarding the radio equipment carried in your airplane, and what goes on in the ground installations. The only way you can answer those questions is to know the equipment. Be eager. If you haven't seen the inside of a Direction Finding station or a control tower, go to visit one. Learn all about your equipment and its capabilities and practice using them. And then practice some more.

B. AIRBORNE RADIO EQUIPMENT

1. Command Set.

The command set (SCR-274N) is primarily used for voice communication between the aircraft and control tower for airdrome control, and for command communication between aircraft when flying in formation. This is a multi-channel piece of equipment and normally three receivers and two transmitters are installed, with the third transmitter carried as a spare.

As a rule, one of the transmitters is tuned to the international control tower frequency (4495 kcs) and the other to the air-to-air command frequency assigned to your Group. Of the three receivers, one is used for monitoring control tower, beacon and range frequencies; the second is used to monitor the Group air-to-air command frequency; and the third remains unused, or is tuned to the XX Bomber Command air-to-air command frequency. The transmitters each have an output of approximately 12 watts when used for voice transmission. However, they may also be used as Continuous Wave transmitters and have a keying circuit for this purpose. When used as a CW transmitter the peak power output is approximately 40 watts. This is a good point to remember if your liaison transmitter goes out, for by tuning one of the command set transmitters to the desired frequency, it may be used as a liaison transmitter for requesting D/F aid, clearances, etc.

2. Liaison Set.

The liaison set which consists of the AN/ART-13 radio transmitter and the BC-348( ) radio receiver is primarily used for contacting air-ground radio stations other than the control tower. The receiver is a conventional superhetrodyne receiver with a frequency range of 200 to 500 kilocycles and from 1.5 to 18.00 megacycles.

Radio transmitter AN/ART-13 is a ten channel pretuned transmitter with automatic tuning. The pilot is furnished with a remote control head and

may select any of the ten channels at will. Frequencies to be setup are listed in SOI and generally include: The Group air-ground frequency, "route" frequencies to contact flight control stations and the international distress frequency of 500 kilocycles.

3. Radio Compass.

The Radio Compass SCR-269-G installed in B-29 aircraft is one of the most valuable aids to air-navigation carried in your airplane. It can be used to "home" on radio beacons or ranges or on any radio station which is broadcasting on a frequency which can be tuned in on the compass receiver. It can also be used to determine your position by taking a bearing on two or more radio stations whose identity and position can be established. The intersection of the bearings indicates the aircraft's position.

The radio compass employs two types of antennae, a loop antenna and a sense antenna. If the situation arises where the sense antenna becomes useless, a wire jumper between the antenna binding post of the radio compass and the antenna binding post of the antenna switching relay of the SCR-274N radio set, will enable the antenna of that set to be used as an emergency sense antenna.

All aircraft commanders are cautioned not to depend on enemy radio stations as a homing aid for use with the radio compass.

C. GROUND RADIO FACILITIES

1. Air-Ground Stations.

At both its Forward and Rear Area bases, each Group maintains an air-ground station for working the ships assigned to that Group. This is the normal ground contact for B-29 aircraft, and should always be used for that purpose in preference to other installations. However, if the airplane commander deems it necessary, he may authorize you to contact any air-ground station available.

The XX Bomber Command maintains two air-ground radio stations which are operated by Army Airways Communications System. In India, this station is located at Kalaikunda transmitting and receiving on two CW and two voice frequencies. It is used by transport aircraft in a manner similar to the B-29's use of the Group stations. The second Bomber Command station is located at Hsinching, China, and transmits and receives on two CW and four voice frequencies. This station, working with the Aircraft Traffic Control Center, controls all flights in the Hsinching area. B-29's are required to work this station while flying in China, but are not required to work the station in India, though it may be contacted by B-29's if the need exists. The Air Transport Command maintains numerous air-ground stations throughout India. The stations of particular interest to aircraft of this Command are those along the "Hump" route. They stand by on normal "route" frequencies and furnish D/F aid and weather reports if requested.

In China the 14th Air Force maintains an elaborate fighter control net, with air-ground stations scattered all over Unoccupied China. In an emergency,

these stations may be contacted on the common fighter control frequency. These stations can furnish local weather and may be of aid in locating position, or obtaining directions on course to fly, but they do not have D/F equipment.

Frequencies and call signs of XX Bomber Command installations are listed in XX Bomber Command SOI. Air Transport Command installations are listed in the ICD-ATC Radio Facility Chart which is carried in all Command aircraft. Fourteenth Air Force facilities are included in special briefing material. All information regarding air-ground facilities along the route flown will be given at preflight briefing.

2. Aids to Air-Navigation.

By far the most common aid to air-navigation is the radio beacon. This is nothing more than a low frequency transmitter emitting a continuous coded signal in a 360° field pattern, which may be homed on with the radio compass. All beacons in India-Burma and China Theatres use A-1 (CW) emission, so care must be taken to have the CW-Voice switch on the radio compass control box in the CW position when using a radio beacon. The frequencies, call signs, and locations of beacons are contained in the ICD-ATC Radio Facility Chart and in special briefing material.

The next most common aid to air-navigation is the radio range. These ranges are of the normal four quadrant coded type and are more common in India than in China. Frequencies, call signs, and locations of ranges are contained in the ICD-ATC Radio Facility Chart.

3. Direction Finding (D/F) Stations.

D/F stations are installed at all XX Bomber Command bases and at numerous ATC fields. The accuracy of the bearings they can "shoot" depends upon weather conditions as excessive atmospheric disturbances produce static affecting the accuracy of the D/F equipment. However, any inaccuracy caused by weather will be reflected in the class of bearing which is always given. There is a special procedure for contacting these stations and obtaining D/F aid which must be followed. This procedure is given in Section D 4 of this chapter. Frequencies and call-signs to use in working D/F stations and their locations are contained in ICD-ATC Radio Facility Chart.

4. Instrument Approach System.

There is installed at all bases of this Command a SCS-51 Instrument Approach System which may be used by B-29's in letting down under instrument conditions.

The system consists of a beamed transmitter which indicates the line of the runway, and of a series of fan marker beacons which indicate to an approaching aircraft the distance it is from the end of the runway. Carried in the aircraft is a marker beacon receiver which indicates when the fan marker beacons are passed over. Also carried is an indicator which by means of a swinging needle indicates whether the aircraft is to the right or left of the desired flight path along the runway. By using a predetermined rate of descent in conjunction with the beamed transmitter and marker beacons, a safe let-down

can be made under conditions of low visibility.

As soon as additional equipment is available, a glide path transmitter will also be installed. An additional needle on the aircraft indicator will then show whether the aircraft is above or below the glide path which when followed will let the aircraft touch down at the end of the runway.

D. OPERATING PROCEDURES

1. Radio Telephone (R/T) Procedure.

Your voice messages must be kept short and to the point. Standard phraseology achieves this, and R/T speech should always be clear and slow, with an even emphasis on each word. Words must not be run together and messages will be spoken in natural phrases and not word by word. The phonetic alphabet will be used as an aid to more intelligable R/T procedure, and will be used in spelling out words. The alphabet will be memorized and must be strictly adhered to.

a. Phonetic Alphabet

A-Able	G-George	M-Mike	S-Sugar	Y-Yoke
B-Baker	H-How	N-Nan	T-Tare	Z-Zebra
C-Charlie	I-Item	O-Oboe	U-Uncle	
D-Dog	J-Jig	P-Peter	V-Victor	
E-Easy	K-King	Q-Queen	W-William	
F-Fox	L-Love	R-Roger	X-Xray	

b. Pronunciation Of Numerals

0 - Zero	5 - Fi-yiv
1 - Wun	6 - Six
2 - Too	7 - Seven
3 - The-ree	8 - Ate
4 - Fo-wer	9 - Niner

c. Components Of A Voice Message

(1) The Call. For example, "Hello Uncle Sugar" (call sign of receiving station) this is Abraham" (call sign of calling station).

(2) Text (subject matter). Contains plain language, code words or figures. If it is necessary to spell a word use the phonetic alphabet.

(3) Ending. Every voice transmission must end with one of the following procedure words: (a) "OVER" meaning "My transmission is ended and I expect an answer from you." (b) "OUT" meaning "This conversation is ended and no reply is expected."

d. Transmitting and Answering

When both stations are in good communication all parts of the transmission are made once. When communication is difficult, phrases, words or groups may be repeated at the end of a message, or may be transmitted by using the procedure phrase "words twice". A group of figures will be transmitted in the ordinary manner using the "words twice" procedure if necessary.

Time of origin will be expressed in four digits and will be preceded by the word "TIME" (assuming that you are instructed to assign a time of origin to a voice message).

When words are missed or doubtful, repetitions will be requested by the receiving station before receipting for the message. The procedure phrases "Say again" or "I say again" will be used in conjunction with "all before," "all after", "word before" or "word after". EXAMPLE: "Hello Abraham, this is Charlie Uncle. Say again all after fifty. Over." "Hello Charlie Uncle, this is Abraham. I say again all after fifty. Seven three zero nine. Over."

When a word is required to be spelled to insure correct reception, the phrase "I spell" will be used immediately before beginning to spell the word in question.

A station is understood to have readability of good strength, unless otherwise notified. Except when making original contact, strength of signals and readability will not be exchanged unless one station cannot clearly hear another station. The response to "How do you hear me?" will be a short concise report of actual reception, such as "Weak but readable", "Strong but distorted", etc.

Procedure and priority designations are seldom used in voice transmissions. However, if it desired to use a priority designation, it will be spoken in the clear as the last part of the message.

In the interests of security, only those transmissions which are absolutely necessary will be made by R/T. No idle chatter will be engaged in. The more the enemy can hear the more he can find out about you.

e. Procedure Phrases

Word Or Phrase	Meaning
Roger	I have received all of your last transmission.
Acknowledge	Let me know that you have received and understand this message.
Wilco	Your last message received, understood and will be complied with.

How do you hear me?	How strong and clear is my transmission?
Wait	If the pause required is longer than a few seconds, it must be followed by the ending "OUT."
Say again - I Say Again	When requesting the repetition of a previous transmission, or used to preface a previous transmission. The word "REPEAT" is never used in this sense as it has a distinct operational meaning for the British Army.
Verify	Check coding, check text with the originator and send correct version.
Message for You	I wish to transmit a message to you.
Send Your Message	Go ahead, transmit.
Read Back	Repeat this message back to me exactly as received after I give "OVER."
That is Correct	You are correct.
Words Twice	(1) As a request: Communication is difficult, send every phrase (or code group) twice. (2) As information: Since communication is difficult, I will send every phrase (or code group) twice.
Correction	An error has been made in this transmission (or message indicated). The correct version is _____.
Wrong	What you have just heard is the incorrect version. The correct version is _____.
Groups	The number of groups in this code or cipher message is _____.
Break	I hereby indicate the separation of the text from other portions of the message. This word is used only when there is not a clear distinction between the text and other portions of a message.

2. Wireless Telegraphy (W/T) Procedure.

Wireless telegraphy (W/T) procedure will be as outlined in Combined British and U.S. Procedure (FM 24-10). Operators will limit their procedure to the prosigns given in that publication. The purpose of a standardized radio procedure is to speed up communications. Any use of unauthorized prosigns, operating signals or procedures will have the opposite effect.

a. Prosigns To Be Memorized

Prosign	Meaning	Prosign	Meaning
AA	All after	IX	Execute to follow
AB	All before	IX (followed by 10 second dash)	Executive signal
AR	End of transmission	J	Verify and repeat
AS	Wait	K	Go ahead
B	More to follow	N	Not received or exempted
BT	Long break	NR	Station serial
C	Correct	O	Urgent
D	Deferred	OP	Operational priority
EEEEEEEE	Error	P	Priority
F	Do not answer	R	Received
G	Repeat back	T	Transmit to
GR	Group(s)	V	From
II	Separative sign	W	For information to
IMI	Repeat	WA	Word after
INT	Interrogatory		

Combined Operating Signals ("Q" Signals) contained in FM 24-13, which is an air extract of Combined Operating Signals CCBP 2-2, will be used by all

operators. A copy of FM 24-13 will be furnished as part of the radio operators folder. The following "Q" signals with their meanings will be memorized.

Signal	Question	Answer or Advice
QAA	At what time do you expect to arrive at ____?	I expect to arrive at ____at ____(time).
QAL	Are you going to land at ____?	I am going to land at ____or: Land at ____.
QCY		I am working (or work) on a trailing aerial.
QDL	Do you intend to ask for a series of bearings?	I intend to ask for a series of bearings.
QDM	What is the magnetic course to steer with zero wind, to reach you (or ____)?	The magnetic course to steer with zero wind, to reach me (or____) is ____(degrees) at ____(time).
QDY		The magnetic course to steer, with zero wind, to reach me (or____) is ____degrees at ____(time). There is a balloon barrage within 60 miles of me on that track.
QFE	Can you give me the present barometric pressure, not reduced to sea level, at the surface of ____aerodrome (name of aerodrome)?	The present barometric pressure not reduced to sea level, at the surface of ____aerodrome (name of aerodrome) is ____.
QIA		Check your authentication of last transmission (or message ____).
QKA		Authentication of this message of transmission (or message ____) is ____.
QMF	How does my frequency check?	Your frequency is correct.
QMM	Of what precedence and for whom are your messages?	I have (or____has) ____messages (numeral indicating number of messages may be followed by O, OP, P, or D to indicate precedence other than routine) for you (or ____).
QPA		Authentication challenge is ____ (based on time in the zone indicated by the suffix letter____).

Signal	Question	Answer or Advice
QPN		Increase height to enable more accurate bearing to be completed.
QPZ		Affirmative (Yes).
QQZ		Negative (No, Not).
QRK	What is the readability of my signals (1 to 5)?	The readability of your signals is ____(1 to 5).
QRN	Are you troubled by atmospherics?	I am troubled by atmospherics.
QRU	Have you anything for me?	I have nothing for you.
QRX	Shall I wait? When will you call again?	Wait. (or: Wait until I have finished communicating with ____.) I will call you immediately (or at ____).
QSA	What is the strength of my signals? (1 to 5)?	The strength of your signals is ____(1 to 5).
QSV	Shall I send a series of V's?	Send a series of V's.
QTE	What is my true bearing in relation to you (or ____)? or: What is the true bearing of ____(call sign) in relation to ____(call sign)?	Your true bearing in relation to me (or____) is ____degrees at ____(time). or: The true bearing of ____(call sign) in relation to ____(call sign) is ____degrees at ____(time).
QTF	Will you give me the position of my station according to the bearings taken by the direction-finding station which you control.	The position of your station according to the bearings taken by the direction-finding station which I control is ____latitude ____longitude.
QTG	Will you send your call for fifty seconds followed by a dash of ten seconds on ____ kc/s in order that I may take your bearing?	I will send my call for fifty seconds followed by a dash of ten seconds on ____kc/s in order that you may take my bearing.
QTH	What is your position in latitude and longitude (or by any other way of showing it)?	My position is ____latitude and ____ longitude (or by any other way of showing it).

Signal	Question	Answer or Advice
QTN		Send your call sign followed by a 20 second dash (repeated ____times).
QVN	Will you send your call sign and dashes of five seconds' duration at intervals in order that I (or____) may home on you?	I am about to send my call sign and dashes of five seconds' duration at intervals in order that you (or____) may home on me.

When contacting ground stations, radio operators will, unless transmitting a "fox type" message, use normal call-up and answer procedure. This procedure, described below, will be strictly followed, except in an emergency when a continuous call-up may be made to contact the ground station.

Initial attempt to contact the ground station will be made using the long call-up. Such a call-up might be: 5C5 5C5 V 671 671 QMM K. If no answer is received, you will wait one minute and repeat the long call-up. If no answer is received from the second long call-up, you will wait three minutes and then transmit your message using "fox type" transmission (i.e., use the prosign "F" in the heading of your message).

If a "fox type" message is sent by an aircraft, it will have the long call-up repeated at the end of the message. Such a message might be: 5C5 5C5 V 671 671 NRI F 061722Z BT ACO ACO PLV PLV ZVY ZVY LKB LKB BT 5C5 5C5 V 671 671 AR

b. Procedure Messages

A procedure message is a short plaindress message, the purpose of which is to expedite the handling of messages. A typical procedure message might be: 5C5 V 671 NR1 061722Z BT ACO PLV RSO ZVY BT K. Note: The long break (BT) has been used to separate the heading from the text of the message. However, a long break (BT) is not used to separate the text from other components of the procedure message, except where a date-time group is assigned the message. A procedure message consists of operating signals, call signs, identification of message and prosigns, if necessary; but does not have a group count in the heading.

A procedure message may carry the precedence designation considered necessary to ensure accomplishment of its purpose. All messages transmitted from XX Bomber Command aircraft will be assumed to carry an OP precedence, so unless a higher priority is considered necessary, no precedence need by indicated in the heading of the message.

3. Interphone Procedure.

In an airplane as large as the B-29, where the crew positions are widely separated, the interphone plays a most important part in the combat efficiency of the crew. Interphone procedure will undoubtedly vary from crew to crew, but a standard procedure, preferably based on R/T procedure, should be

adopted and strictly adhered to by each crew. This is the only method by which confusion inherent in a fast moving situation can be avoided. Idle chatter should not be indulged in via interphone, and the airplane commander is responsible for proper interphone discipline.

In the event the interphone amplifier malfunctions and cannot be repaired while airborne, an emergency interphone system can be set up by having the pilot turn the transmitter selector switch of the command (SCR-274N) set to position 2, and the VOICE-CW switch to the VOICE position. He and the remaining crew members then place their interphone selector switches at position 4, and the audio stages of the number 2 transmitter of the command set will then serve as an emergency interphone amplifier. When using this emergency system, however, care should be taken that the interphone switch remains at position 4.

4. Air-To-Air Homing Procedure.

Air-to-air homing is used to effect a rendezvous of aircraft when rendezvous cannot be accomplished visually. It is accomplished by having the lead aircraft send homing signals on its liaison transmitter while the other aircraft home on these signals with the radio compass. Special frequencies are employed for this purpose as well as a special procedure. This procedure is explained in the following paragraphs.

When the formation leader desires to effect rendezvous of aircraft by air-to-air homing, the radio operator of the lead ship will call the formation on the air-ground frequency using the formation collective call sign, and will send QTG followed by the code designator consisting of a two digit number group for the frequency to be used for air-to-air homing. The long call-up will be used and the entire call will be repeated three times, with an interval of approximately thirty seconds between calls. Such an initial call-up might be: 7A3 7A3 V CEWL CEWL QTG 35 AR, meaning, "Formation from formation leader. I will send my call for fifty seconds followed by a dash of ten seconds on frequency 35 in order that you may take my bearing. Do not answer."

Immediately after making the third call-up, the lead operator will turn his transmitter to the air-to-air homing frequency and start the QTG procedure. Radio compass receivers in other aircraft will at the same time home on the frequency of the calls being made by the lead aircraft carrying on the QTG procedure.

The lead operator after completing the QTG procedure will again call the formation and send QVN meaning "I am about to send my call sign and dashes of five seconds duration at intervals so that you can home on me". These signals will be made at intervals of approximately thirty seconds. The QVN procedure will be continued until rendezvous is accomplished.

In the event an individual aircraft desires to home on a formation or another aircraft, it will call the formation leader or aircraft on which it is desired to home and send INT QTG, followed by code designator of the frequency to be used for air-to-air homing. The long call-up will be used. Such a

call-up might be: CUHO CUHO V CEWL CEWL INT QTG 35 K, meaning, "Aircraft from aircraft. Will you send your call for fifty seconds followed by a ten second dash on frequency 35 so that I may take a bearing on you? Go ahead."

The aircraft, after acknowledging request will immediately turn liaison transmitter to air-to-air homing frequency and start QTG procedure. After QTG procedure has been completed, the aircraft being homed on will call the homing aircraft and send QVN. The QVN procedure will be continued until rendezvous is accomplished.

The aircraft transmitting the homing signal will ordinarily use the fixed antenna. In the event that contact cannot be established with this type antenna, the trailing wire antenna will be utilized. If it is necessary to use the trailing antenna to rendezvous, the aircraft being homed on will so inform homing aircraft before the QVN procedure is started. This will be done by including the operating signal QCY (I am using trailing antenna) in conjunction with the operating signal QTG. Such a transmission might be: 7A3 7A3 V CEWL CEWL QTG 35 QCY AR. However, when using a trailing antenna, the radio compass of the homing aircraft will indicate toward a point on the ground which is the intersection of a line through the trailing antenna of the aircraft transmitting the homing signals and the ground. Since this point is considerably to the rear of the aircraft transmitting the homing signals, unsatisfactory results may be obtained. If the aircraft transmitting the homing signal is circling and a trailing wire antenna is being used for transmission, the radio compass of the homing airplane will swing continuously through an arc of approximately thirty degrees. Therefore, the pilot of the homing aircraft should fly so the compass needle is swinging equally to both sides of the center line of the compass indicator.

If, while flying in formation, another aircraft requests homing aid, and the trailing wire antenna must be used, the formation leader will deputize one of the rear elements of the formation to transmit the homing signals as the lead aircraft should never use the trailing antenna.

5. Direction Finding (D/F) Procedure.

D/F stations are prepared to give two types of D/F service. You can request a "QDM" in which case you will be given the magnetic course to fly to bring you directly over the D/F station, or you can request a "QTF" in which case you will be given your geographical position in the form of coordinates of latitude and longtitude. Normally a "QDM" is referred to as a "bearing" and a "QTF" as a "fix".

To an aircraft lost or uncertain of its position these D/F stations are a valuable aid. However, to obtain the maximum results when using these facilities, the following definite procedure must be used.

a. Call the ground station and send INT QDM. The ground station will answer you by sending INT QTG.

b. Then send your call-sign for a period of fifty seconds followed by a ten second dash and stand by.

The ground station will then call you and send QDM followed by the course to steer the class of bearing (one, two or three) and the time the bearing was taken. Such a call might be: 672 V 5C5 BT QDM 290 ONE 1127Z BT K.

Procedure for aircraft requesting a QTF:

a. Call the ground station and send INT QTF.

b. The ground station will answer you and sends QRX (Standby) and you then standby for approximately thirty seconds. This is to allow the ground station time to alert adjacent D/F stations, inasmuch as more than one D/F station must report a bearing to obtain a fix.

c. After standing by approximately thirty seconds the ground station will call you and send INT QTG.

d. You will then send your call-sign for a period of fifty seconds followed by a ten second dash and stand by.

e. The ground station will then call you and send QTF followed by the geographical coordinates and time of the fix. Such a call might be: 671 V 5C5 BT QTF 2320 North 8915 East 1104Z K.

If during the time you are engaged in "QTG" procedure the D/F station is unable to obtain a bearing, the ground station will ask you to "QTG" again. You will comply, following the procedure outlined above.

Aircraft engaged in training flights may request practice "QDM's" or "QTF's" to acquaint crew members with D/F procedure. However, all such requests must contain the phrase "PRAC" immediately before the operating signal QDM or QTF when the request is made. For example: 5C5 V 671 INT PRAC QDM K or 5C5 V 671 INT PRAC QTF K.

The practice "QDM" or "QTF" will be given by the ground station providing it will not interfere with normal traffic. If it does the request will be denied and aircraft will have to request again at a later time.

When an aircraft receives a "QDM" (i.e., a bearing) from a ground station, the class of the bearing will be indicated. These classifications are as follows:

Class ONE : Bearing accurate to a plus or minus 3 degrees
Class TWO : Bearing accurate to a plus or minus 5 degrees
Class THREE: Bearing accurate beyond a plus or minus 5 degrees

If you hear any transmission involving the use of any of the D/F operating signals listed above, you will regard it as an emergency transmission and will maintain radio silence until the D/F traffic is completed.

E. EMERGENCY PROCEDURES

1. R/T Procedure.

To indicate distress when using a radio voice channel use the phrase "MAYDAY" (from the French M'aider), making this phrase the address of your call-up. If possible state the reason for your distress and what you want to do, or would like to have done. For instance: "Clear the runway", "Get the Engineering Officer on the radio", etc. Such a message might be: "Mayday Mayday! This Is Seven Three One. Number Two Engine Out. Clear The Runway For Emergency Landing. Over."

You must remember voice transmission is more limited than CW transmission as far as distance is concerned, and distress procedure using voice transmission should be used only when there is no doubt that the ground station is within receiving distance.

2. W/T Procedure.

To indicate distress when using a CW channel, use the operating signal SOS as an address to your call. All stations hearing the call will immediately standby after contact has been established to render any possible aid.

If it is evident that your aircraft must be abandoned, ditched or crash-landed, send a distress message including the reason for distress and the position of your aircraft. If possible, the message should be encoded. If there is not enough time to do so, the message may be sent in the clear. However, any such text messages sent while over enemy territory will not include the position of the aircraft.

If the aircraft is being abandoned, you will leave your liaison transmitter turned on and will screw down the hand key to a closed position before leaving the aircraft. This is done as it might be possible to take a D/F fix on the aircraft after it has been abandoned.

If the aircraft is being crash-landed, or ditched, you will shut off all your equipment immediately before taking your emergency position. This is done to remove any fire hazard from electrical sparks.

Radio set SCR 578 ("Gibson Girl" Transmitter) is a hand powered, self-contained radio transmitter designed to be used from a rubber life raft in the event your aircraft is forced to ditch. It transmits a coded signal on 500 kilocycles, using A-1 emission, and is keyed by an internal keying device. If desired, a selector switch may be thrown allowing keying to be done by the hand key provided. Two types of antenna support are provided: (1) A collapsible box-kite, or (2) a rubber balloon for which a hydrogen inflating apparatus is furnished. If the latter is used, care must be taken not to allow any of the chemicals used to overflow on to the liferaft. A signal lamp is also provided with the "Gibson Girl" for visual signaling at night. It, too, may be coded automatically or keyed by hand. However, the radio transmitter will not transmit when the lamp is being used.

In using this emergency radio, do not fly the antenna and then crank the transmitter continuously. This will only tire out the crew members and actually will do no more good than if signals are made at intervals. The recommended procedure is to transmit for the first three minutes of every

fifteen minute quadrant of the hour. However, if it is believed that there is a searching aircraft or sea rescue craft in the immediate vicinity, it would be a good practice to transmit at longer and more frequent intervals. There is a complete set of instructions and Morse characters lithographed on this equipment. Follow them closely.

F. VISUAL SIGNALING EQUIPMENT

1. Very Pistol.

A very pistol and an assortment of colored flares are included in your life-raft equipment. These flares should not be used aimlessly, but should be saved for that occasion when it is apparent that the searching aircraft or rescue craft will be able to see them. If at all possible, very flares should be discharged when a searching aircraft is approaching the life raft as then more chance exists of the flare being seen.

2. Sea Markers.

Sea marker of florescine dye used for visual identification should not be used aimlessly. The dye should be so distributed that a well defined streak is placed on the water when the raft is drifting. If the raft is not drifting, use only enough dye to mark a well-defined patch around the raft, and replenish it from time to time.

3. Mirror.

Provided also is a signaling mirror so designed that it can be aimed at searching aircraft or rescue craft. Care must be taken to aim the mirror in exactly the proper manner, or it probably will not be noticed.

4. Aldis Lamp.

A special set of Aldis Lamp operating signals has been assigned for use while engaging in interplane communication. These signals were devised to allow faster transmission and easier reading when using the Aldis Lamp. They are as follows:

Signal	Order or Advice
Q	"Aborting" (Wing to Leader) or "Aborting, take lead" (Leader to Wing).
QD	Aborting or leaving formation in distress, will ditch, bail out, or crash land.
FL	Take over formation lead.
FJ	Join me in formation.
FC	Close up formation.

Signal	Order or Advice
X	Have reached altitude for bomb run.
N	Take new heading to alternate target or alternate base.
M	Airspeed too slow.
IP	Am increasing power.
U	Airspeed too fast.
L	What is our location? (When used as answer: Our location is ____)
O	Are we off course? (When used as answer: We are off course ____nautical miles north, east, south or west.)
Y	We are on course.
H	What is our ETA? (When used as answer: Our ETA is ____GCT.)
G	What is our groundspeed? (When used as answer: Our ground speed is ____knots.)
W	What is wind? (When used as answer: Wind is ____ ____knots.)
ZO	"Radar out" (Wing to Leader) or "Radar out, take over lead" (Leader to Wing).
Z	Turn off radar (Leader to Wing).
D	Prepare for descent through undercast.
A	Prepare for ascent through overcast.
AC	Prepare to climb.
P	Prepare for penetration of front.
VC	Am trying to contact you on interplane frequency.
VL	Am trying to contact you on liaison frequency.
INT	Is the following correct?
C	Correct.
IMI	Say again. Repeat.
R	Receipt of message acknowledged.

The operating signals INT, IMI, C and R will be used as in CW procedure, with the exception that INT will be used only to indicate "Is the following correct?".

When signaling with the Aldis Lamp make certain with the aid of the sights provided, that the lamp is aimed directly at the aircraft being signaled. In other words, if you are in such a position that you can see the pilot of the called ship, aim the light so that you would hit him in the eye, if instead of an Aldis lamp you were using a rifle.

The lense of the lamp should be kept bright and clean. Use a soft lintless cloth and issue window cleaning fluid for this purpose.

G. BRIEFING MATERIAL CARRIED IN AIRCRAFT

The container used for briefing material carried in your aircraft is a weighted canvas bag with a serial number stenciled on it for identification purposes. It is issued previous to a flight and should be returned, contents complete, to the issuing authority after the flight.

This bag will contain the following items: Index of contents, Group Route Guide, ICD-ATC Radio Facility Chart, maps, current colors of the day, current weather forecasts, blank WAF 2 forms, necessary flimsy extracts of SOI, XX Bomber Command Airport Guide, and any information deemed necessary by the Group Operations Officer for the successful completion of the flight. In addition, codes ALACO, ACOD ( ) or CSP 1270 ( ) only will be carried in this canvas bag. However, ACCOD ( ) will only be carried on non-tactical missions and CSP 1270 ( ) will only be carried on tactical missions.

H. COMMUNICATIONS PUBLICATIONS AND FORMS

1. Radio Facility Chart.

The Indo-China Division of the Air Transport Command (ICD-ATC) publishes the Radio Facility Chart used by this Command. It is similar to the AAF Radio Facility Chart (T.O. 08-15-1) published in the United States. You will study it carefully and be able to locate desired information at a moments notice.

2. Signal Operation Instructions.

Signal Operation Insturctions (SOI) are the publications by which Headquarters, XX Bomber Command transmits information regarding frequency assignments, call sign assignments, radio nets, etc. to lower echelons of the Command. These publications are never carried in aircraft. Extracts of the necessary information printed on flimsy are used for this purpose.

3. XX Bomber Command Memoranda.

Memoranda are publications, each of which is assigned a base number such as 55, which indicates the series of the memoranda, and a second number which indicates the number of the memoranda within the series. The 55- series

[redacted]

memoranda deal with the operations of aircraft and the procedures they must follow while in flight. Memoranda 55-1, 55-2, and 55-3 are especially important. The 100- series memoranda deal with communications. The majority of communications Standing Operating Procedures are contained in this series of memoranda.

4. Tactical Doctrine.

Section VIII of the Tactical Doctrine contains all information regarding the conduct of communications on Tactical Missions. A thorough knowledge of its contents is mandatory. This publication is on file in the Group Operations Office and is available for reading by aircrew members. A thorough study of its contents will greatly increase your efficiency as far as communications is concerned.

5. Radio Operators Log.

A supply of XX Bomber Command Radio Operators Logs will be furnished the radio operator prior to each flight, so he may keep a record of all communications activities during the flight. There are spaces provided to enter call signs, date, mission purpose, etc. All blank spaces should be filled in. The operator will sign his name to the completed log. This log is provided for your benefit. If any question should arise as to when you did a certain thing, or why it was done, the log can be used to substantiate your statements. Therefore, the log must be legible and complete.

It is mandatory that the following entries be made in the log:

a. The time of and frequency on which sent of all messages plus the call of the addressee.

b. The time of receipt of each message.

c. Entries as to the signal strength of ground stations and the strength of atmospheric interference if any.

d. Any unusual occurences, such as interfering stations on your frequency, strange stations trying to contact you, jamming, etc. In recording these occurrences, the frequency, time, and call signs, if heard, must be entered.

e. A complete entry of any distress traffic which might be intercepted. Aircraft of this Command forced to crash-land have been located through the alertness of radio operators in other aircraft logging the distress traffic occurring before the airplane was forced to crash land.

f. Any malfunctions that occur to communications equipment should be entered in the log. Enter time the equipment went out, and if possible, the cause of the malfunction.

6. Radio Operators Interrogation Form.

After each combat mission you will be interrogated as to communications activities during the mission. The majority of the questions asked will deal with the entries you are required to make in the Radio Log. Correct and complete answers to these questions are very important, as future planning and preventative measures depend on the thoroughness of your answers to these questions. You should ask your Communications Officer for a copy of the interrogation form to read and study so you will know what questions will be asked you.

I. MISCELLANEOUS

1. Visual Rendezvous Aids.

Each Group is assigned a different color lense insert for use with the Aldis Lamp in accomplishing formation rendezvous. Each Group is also assigned a different color very pistol flare for this purpose.

2. Weather Broadcasts.

All group air-ground stations broadcast Alaco weather for the base at which the ground station is located. The India bases broadcast the weather every hour on the half-hour and the China bases broadcast the weather every hour on the hour. The XX Bomber Command Aircraft Traffic Control Center at Hsinching, China also broadcasts the weather every hour on the hour and the AACS Transport Control ground station at Kalaikunda broadcasts the weather every hour on the half hour.

In addition, ATC stations along the "Hump Route" broadcast the weather for certain fields at fifteen minute intervals on a special weather frequency. A list of these ATC stations and their special weather frequencies is contained in the briefing data.

During the first minute of every fifteen minute quadrant of the hour, all XX Bomber Command air-ground stations also broadcast a series of V's followed by the station call sign. This is done to enable aircraft radio operators to determine if their receivers are tuned to the proper frequency.

3. Time Ticks.

All India broadcast stations and station WUTK in China broadcast time-ticks at regular intervals. Call signs, frequencies and time of broadcast are included in briefing material.

4. Codes and Ciphers.

CSP 1270( ) is the short title for the aircraft code which is carried by all aircraft on tactical missions flown from China. All messages that require encoding will be transmitted using this system.

ACCOD( ) is the short title for the XX Bomber Command Aircraft Control Code which is carried on all non-tactical missions. All messages that require encoding will be transmitted using this system.

On tactical missions flown from other than the China bases, Rekoh Code (CD 0251) will be used.

5. Authentication.

Authentication between a ground station and aircraft, or between aircraft is accomplished by using the authentication system contained in the codes listed in paragraph 4 above. The calling station need not be challenged each time a call-up is received, but should any reasonable doubt exist as to the identity of either the calling or the answering station, a challenge should be made at once. It should be kept in mind, however, that it is better for you to challenge at every opportunity rather than to be misled by an enemy station.

6. Security.

The majority of the material carried in the aircraft briefing container is classified. The enemy, if it were to fall into his hands, would profit enormously by his possession of that material. If the aircraft is in distress over water, the material should be collected, put into the weighted container, and disposed of by sinking. In other circumstances, try, if possible to burn the material, or if that cannot be done, bury or mutilate it. Do not attempt to scatter it over the countryside. It can be and undoubtedly will be picked up. If any of this material is inadvertently lost, report the loss as soon as possible to the agency issuing the briefing container, so that a proper report may be made to higher headquarters.

J. CONCLUSION

After reading over this material, you should have a very good idea of how communications are handled in the XX Bomber Command. These systems and the equipment given to you to use are provided to make your job as easy as possible. In the final analysis, however, the major responsibility is yours, for you are the man at work in the airplane. So learn to use your equipment and keep the following thoughts in mind, and you'll be a radio operator the other crew members can depend on and be proud of:

a. Memorize all the procedures you will have to use.

b. Remember that a 16 word-a-minute operator who gets his message through the first time is a better operator than the lad who burns up the air making mistake after mistake, causing everyone a lot of grief.

c. Remember to listen in before you transmit and make sure you have a clear channel. You would not want someone breaking in on your message. Don't do it to the other fellow.

d. The more you know about your equipment, the better you will be able to do your job.

e. PRACTICE MAKES PERFECT.

COMBAT GUNNERY

IX. GUNNERY

The first requisite of a good gunner is a correct mental picture of his job and a knowledge of the capabilities and limitations of his equipment. With the B-29's remotely controlled turrets and computing system, guesswork is completely eliminated in "Point of Aim". However, the computer is not a magic box which, when operating properly, automatically gives excellent hits on the target. It takes practice, and lots of it to attain the skill in tracking, firing, and ranging necessary to give the Central Fire Control (C.F.C.) system accurate enough data to obtain percentage of hits. Furthermore, only after considerable practice will you as a gunner develop a desired operating procedure and do all the necessary things to operate successfully the C.F.C. equipment. Once this technique is developed, you can feel confident in your responsibility because tests indicate you can score more hits with C.F.C. equipment than with any other type. The success of future bombing operations, as well as the safety of your own airplane and formation, will depend upon your skill with your weapons. Your guns and your turrets are precision instruments capable of extremely accurate fire, but their dependability depends upon your care and knowledge of your equipment. Take care of it and know how to use it.

A. CARE OF EQUIPMENT IN ASIATIC OPERATIONS

Each gunner is personally responsible for the care and maintenance of his guns and turrets. Repairs to the turrets are made by turret specialists and to the guns by station ordnance personnel. The gun should be field stripped as soon as possible after a mission and all parts thoroughly cleaned with prescribed cleaning fluid. While cleaning the gun, each part must be carefully examined, and if not found perfect in every detail should be immediately replaced with a new part. Parts to be closely examined for full and free movement are: (1) The ejector, (2) the extractor switch, (3) the belt holding pawl, and (4) the cover group.

Thoroughly clean and flush the firing pin and driving spring cavities in the bolt. Wash the back plate in the cleaning fluid, but don't soak it as the cleaning agent may deteriorate the buffer discs. Springs should be checked for length against the "Spring Gauge Chart". Polish the front of the barrel and barrel bushing with crocus cloth. All moving or wearing parts or surfaces should be evenly covered with A.X.S. 777 oil. Immediately before each mission all old oil should be removed and new oil applied. It has been found that the gun will perform better at varying temperatures with a fairly heavy coating of A.X.S. 777 oil. No gun properly prepared will freeze at temperatures that have been encountered in Asiatic operations.

B. HEADSPACING AND TIMING

Headspace will change, loosening after a number of rounds have been fired. It is, therefore, necessary to set the headspace each time the gun is assembled. This is the easiest, yet the most important adjustment to be made. There are two methods of setting headspace and one should be used to check the other. Note: Before setting headspace check the breech lock cam. This

cam should have a slight lateral floating movement of from .001 to .008 of an inch. Be sure the nut fastening the cam is secured with a cotter pin.

1. The First Method of Headspacing.

   a. Screw the barrel into the barrel extension hand tight.

   b. Assemble the gun in the receiver with a dummy round in the chamber.

   c. Install the back plate to prevent the driving spring from disengaging. However, the backplate will not go past the oil buffer, which will be protruding since the gun will not yet go into battery.

   d. With a screw driver or other blunt instrument unscrew the barrel one notch at a time, breaking the action each time, until the gun will just go completely into battery without being forced or driven.

   e. Break the action and back the barrel off two more notches.

This will permit faster firing action and allow easier and faster feeding.

2. The Second Method of Headspacing.

   a. Assemble outside of the receiver the barrel, barrel extension and bolt, with a dummy round in the chamber.

   b. Start with the barrel loose and breach lock held firmly up, lock the bolt, and turn the barrel hand tight into the barrel extension. Be sure it contacts the face of the bolt or T slot.

   c. Back the barrel off two notches. If all parts of the gun are in perfect condition this should give the same setting as the first method.

3. Timing.

Headspace adjustment accomplished, install the gun charger making sure the guns are not loaded or pointed in a direction that will endanger personnel or equipment. For proper timing each of the following steps must be accomplished accurately to insure positive operation of guns and chargers.

   a. Cock the gun by placing a screwdriver in "socket C" of the charger and pushing toward the muzzle end of the guns until the bolt moves to the rear; then release the screwdriver.

   b. Check to see that the sear pin adjuster has been turned clockwise as far as it will go.

c. Insert the go-gauge (0.090 in.) between the barrel extension and the receiver of the gun.

d. Turn the sear-pin adjuster counter-clockwise one notch at a time, and after each notch adjustment attempt to release the gun's firing pin by placing a screwdriver in "socket F" and pushing away from the gun muzzle. Continue to turn the sear-pin adjuster one notch at a time until the firing pin is released. A click will be heard when the firing pin is released.

e. Cock the gun as described in step a. above, depress the action switch on the sighting station from which the turret is being operated, then squeeze the trigger on the sighting station. The firing solenoid should pick up and release the gun's firing pin. If the firing pin is not released, turn the sear pin adjuster in a counter clockwise direction until the energizing of the firing solenoid by trigger action causes the firing pin to be released.

f. Insert the no go-gauge (0.116 in.) in place of the go-gauge, cock the guns, and attempt to fire by squeezing the trigger. The gun should not fire, i.e., the firing pin should not release. Remove gauge and push the reset button on both gun chargers. Timing is complete.

C. PREFLIGHT INSPECTIONS

1. Gun Preflight.

During flight the guns are not readily accessible, so it is imperative that you make absolutely sure that the guns and ammunition are in perfect condition when installed in the turrets by performing the following checks before take-off:

a. Check gun operation using dummy rounds.

b. Check all equipment to see that it is safetied by safety wire where required.

c. Check ammunition carefully for excess corrosion, defective primers, position of the link on the round, position of the round with respect to each other, bulges or burrs, and size of extraction rim.

d. Load the ammunition cans making certain the rounds point in the correct direction and do not bind in the cans.

2. Turret Preflight.

Prior to each mission you must make the following operational check of your turret. This preflight must be accomplished as early as possible in order to allow time for turret maintenance and any repairs needed before take-off.

a. Check all AN connectors for loose wires and tightness.

b. Check oil in the air compressor.

c. Check ground connection and brushes in dynamotor and amplydyne.

d. With auxiliary power supply, main line, and batteries on, turn on the auxiliary power switch. The compressor motor should start and run from three to five minutes if at sea level, then stop.

e. Turn the A.C. power switch on, and you should hear the dynamotor start.

f. Check the rheostat illumination control and both filaments of the reticle lamp.

g. Turn computer switch "in". If by feeling the gyros you determine they are running all right, turn the computer switch "out", to save the gyros.

h. Turn the turret power switch on. You should hear the amplidynes start, then:

(1) Run the turret in azimuth and elevation.
(2) Check the sight for correct operation in azimuth and elevation.
(3) Check the range control handle for correct reticle movement.
(4) Check the solenoid and firing switches.
(5) Check the fire cut-off control.
(6) Check interphone switch.

i. Clean thoroughly the plexiglass sighting window, sight glasses and filters.

3. Final Preflight.

To make the following final checks of your equipment, guns, and ammunition to see that they are in place and ready is your responsibility as a gunner.

a. Check to see that you have your oxygen mask and helmet, flak helmet and vest, sun goggles and flashlight.

b. Check your Mae West for CO_2 cartridges and its condition.

c. Check to see that you have the required spare gun parts and tool kit required.

d. Load guns as per group directive. Feed the ammunition against the cartridge stops putting the double link in first. Be sure

to have a round in the double link, then check to see that the ammunition is not jammed in the feeding.

e. Check to see that the gun covers are down and secured during loading, that the turret domes are securely latched, and the turret well safety switches securely closed.

f. Check that the gun chargers are reset.

4. Station Check.

After the final briefing by the pilot at the airplane, go to your station, take with you the necessary tools and spare parts, and make the following station checks:

a. Check to see that you have your parachute and seat cushion.

b. Check to be sure the cabin pressure valve is in the open position.

c. Check the oxygen system. Pressure should read between 350 and 450 pounds per square inch.

d. Check the interphone as follows; put on the headphones, adjust the throat mike, and stand by for interphone check. When the alarm bell is rung by the airplane commander during combat station inspection, the left and tail gunners will notify him that they heard the alarm bell. Also, when the phone call signal is operated by the airplane commander each gunner will notify him that his signal light works properly.

e. Upon call from the co-pilot over the interphone, gunners will observe and report the position of rudder, elevators, and ailerons as the airplane commander operates the controls.

f. Upon call from the airplane commander each gunner will report on the status of his own check list as to whether or not it has been completed.

D. OPERATING PROCEDURES

1. During Taxiing.

The tail gunner will start the auxiliary power "putt-putt" when the pilot directs. During the taxiing the top gunner is responsible for promptly reporting to the co-pilot the presence of any approaching aircraft in flight which might interfere with taxiing, but all gunners must report promptly any dangerous condition they may observe.

2. During Take-off.

Just prior to take-off the pilot will announce over the interphone "wing flaps". When the flaps are down the left gunner will reply, "left flap

down 25 degrees, sir", and the right gunner will make a similar report for the right flap. Fasten your safety belt!

3. After Take-off.

The right and left gunners will report over the interphone as soon as the flaps and landing gears are up. The top gunner will then supervise the fire-control system operational check and firing consisting of the following:

a. Turn on the AUXILIARY POWER switch on the control box. This turns on the air compressor and the heaters for the guns, cameras, and the computer.

b. Turn on the AC POWER switch. This starts the dynamotor which you should be able to hear running. If the dynamotor does not start, press hard on the breaker button to reset the breaker. The operations thus far have provided sight and control power.

c. Unstow the sight and make sure it has freedom of motion throughout its entire azimuth and elevation travel.

d. Turn up the rheostat for the reticle light, check to see that both lamp filaments light, and that the range control wheel can be moved over its entire range.

e. Turn the target size input knob to see that the target size figures appear properly.

f. Select a filter combination and adjust the reticle lamp brilliancy. As a rough guide it is suggested that enough filters be used to permit you to see the reticle with reasonable brilliance when looking at the brightest portion of the sky, not including the sun or area adjacent to it.

g. Set the switches on the blister system control box, blister system switch box, and nose system switch box in accordance with Standard Operating Procedure.

h. Put yourself in a comfortable position for scanning and tracking. Have padding where you will need it. Kneel with your knees spread wide apart. Place the mike cord, oxygen hose, etc., so that they won't be in your way as you track with the sight. Adjust your clothes and parachute harness so you will have proper freedom of movement.

i. Last, but by no means least, feel for the best position of your hands on the sight grip. This is important because you have to get your grip set right and quickly when you spot a target, so you should know from practice how to come in on the grip quickly. If you do it wrong, you will have to change your grip during tracking. If the tracking is jerky you give the computer wrong information, it will compute wrong, and you will hit nothing.

4. Turning On the C.F.C. System.

The generators cannot start all of the turret amplidynes at once so each of you must take your turn. The airplane commander will tell you when to start your equipment, and when he does, take the following steps:

a. Turn on the rest of the switches on the control box marked POWER one at a time at ten second intervals and listen. These start the amplidynes which make quite a noise. If you don't hear them start, open the switches again and press hard on the circuit breaker reset button and then try again.

b. Turn the COMPUTER switch on the control box to IN. This supplies DC power to the computer and sight gyros. See that the computer IN-OUT light is ON. This light should be on when both the computer switch on the control box is ON and when the computer standby switch is at STANDBY. It also lights when you are outside of the computer's limits of control.

c. Turn the COMPUTER STANDBY switch on the sight to IN. The IN-OUT light should go off.

d. Close the action switch and move the sight. Check to see that the primary control turret follows the sight. Remember, the top gunner can see the upper turret, the tail gunner can see the tail mount, the blister gunners can see the lower aft turret guns when the turret is pointing broadside, and the nose gunner can have the top gunner check the upper forward turret and have the navigator listen for movement of the lower forward turret.

e. Check the secondary control in accordance with Standard Operating Procedure. Observe that the secondary turret follows the sight. The blister gunners should also check for the proper signal indicator lights on the auxiliary control box.

f. Dim the lights on the auxiliary control box in the blister sighting station to the proper brilliancy to suit you.

g. If he hasn't already informed you, check with the navigator over the interphone to see that he has set the altitude, air speed and temperature on the hand set.

h. It is assumed the target will first be seen when it is a long way off, so set the range control for the smallest size reticle, or maximum range; and you will be ready to start tracking when a target is sighted.

i. If the airplane commander wishes you to fire a short practice burst, turn the guns switch from SAFE to FIRE and when finished return to SAFE. Make your bursts short and be sure you aren't aiming at someone in your formation when you press the trigger.

5. Putting the C.F.C. System At STANDBY.

If the mission is a long one, the airplane commander may want you to shut down to STANDBY. If he does, take these steps:

a. Stow the turret by stowing the sight while keeping the action switch depressed. Be sure you know what position to stow your turret.

b. Turn off the TURRET POWER switches to shut down the amplidynes and then release the action switch.

c. CAUTION! Never turn the system all the way off until the end of the mission. Leave the AC control power on to keep the tubes and other parts warm and ready for action. Be sure to turn the TURRET POWER switches on again before entering the combat zone.

6. Scanning.

The airplane commander will assign you an area to scan when you are in a combat zone. Keep a sharp lookout when you receive your assignment. If you are not on the job you make a blind spot for your airplane. See your enemy first and you will have a better chance of bringing him down.

If you wish to move the sight while scanning, leave the action switch open so the guns won't follow along, but when the target appears take these four steps:

a. Report the target to the fire control officer by the o'clock system.

b. Recognize the target as enemy or friendly. If it's an enemy airplane, identify and check wing span.

c. Set the target size on the reticle. Note: You may find it helpful to set the target size previously to the wing span of the most frequently encountered enemy fighter.

d. Turn the guns switch to FIRE.

7. Sighting.

When you are sure it's an enemy airplane, get your sights on him and start following, taking the following steps:

a. Put the reticle center dot right on the middle of the target and keep it there to the best of your ability. The computer will make all the necessary corrections for ballistics, parallax and lead.

b. Keep the range set properly by spanning the target with the reticle carefully. Remember the computations of the computer are no better

than the data you give it, and range is one of the important items.

c. Be sure you get your hands set on the grips the way you like them so you won't have to change your grip while tracking.

d. Sight with both eyes open. It's natural, much easier, and it works.

e. Track the target smoothly because if you don't you won't hit it. The computer calculates the amount of lead to give the gun from the rate at which you turn the sight. If you turn it in a series of jerks, the computer will jerk the guns back and forth. Don't pause when you fire a burst or jerk the sight while you are tracking. If you do get off the target, come on again smoothly. Keep adjusting the range handle continually so that the reticle just spans the target's wing-span or silhouette.

f. If your own airplane is rolling or maneuvering in evasive action, keep on tracking smoothly. The computer will make all the necessary corrections for you. The main thing you have to do is keep the center dot right on the target and span its silhouette with the reticle.

g. When you change from one target to another, slew the sight quickly with the action switch open. When you get on the new target close the action switch again. This prevents the computer from cranking in erroneous lead corrections, especially during nose attacks.

8. Firing.

a. Fire before the enemy does. Begin firing at 1000 yards range except in nose attacks when you should fire as soon as you see the target. Keep your target in the reticle and don't try to sight with tracers. If you are on the target and have it properly spanned, the computer will do the rest.

b. Fire short bursts. The maximum rate of firing should not exceed 30 rounds per minute per gun (two seconds of firing). In extreme cases ten rounds per gun may be fired every 15 seconds.

c. Once again, keep tracking smoothly while you are firing.

d. Release the trigger whenever control of a turret is transferred from one station to another. You don't want the gun to be firing while the turret is slewing around.

e. Protect your own airplane and your formation from cook-offs. When you are not tracking or firing and there is any possibility of a cook-off, stow your turret where it will be safe. Remember there are other airplanes in your squadron that may be hit. Position the guns for maximum cooling when you are not using them.

f. Listen over the interphone constantly and know what is going on in the rest of your airplane. Whenever you have anything to say, be clear and concise. Keep discipline over the interphone.

g. There is so little time to do anything during nose attacks that a certain amount of advance preparation on the ground is necessary on the part of the nose gunner. When in the air, preset the target size you anticipate will attack you, set 40 feet if you don't know, and preset the 1000 yard range previously marked on the range handle. With the station in operating condition, point the sight straight ahead and hold the action switch closed for 10 seconds. This presets the correction with which you will start firing when attacked from the nose. Release the action switch but leave the sight in position to grab it quickly because when you are attacked from the nose you will have just three seconds from the time you first see your enemy until accurate firing is impossible.

h. When you spot an attacker, put the reticle on him and fire. You won't have time to do much more than that. Beware of decoys who drop off to the side to draw your attention away from the next attacker. If the attacker falls off to where he can't shoot at you, open your action switch and stop tracking him to avoid setting up large corrections in the computer which will be errors for the next attacks. As soon as an attacker has passed, reset the 1000 yards range, and set the guns dead ahead to preset your correction for the next attack. If there isn't time, open the action switch, slew back onto the new enemy, close the action switch and fire. Be sure always to open the action switch when slewing.

9. Before Landing.

Before landing the following steps must be taken:

a. Turn the GUN switch on the control box to SAFE.

b. Stow the turret by stowing the sight, holding the action switch closed. Each turret should be stowed by the gunner having the primary control. The right blister gunner should stow the lower aft turret. The upper turrets are stowed at zero azimuth and 45° elevation.

c. When the turrets are stowed, turn off all switches on the control box and then release the action switch. Push in the stowing pins on the sight in both azimuth and elevation and cover the sight.

d. When the pilot announces over the interphone, "Prepare for landing" the tail gunner should start the auxiliary power putt-putt in accordance with Standard Operating Procedure.

e. When the pilot announces over the interphone, "Wing flaps", the right and left blister gunners should watch the flaps and report "Left flap down 25 degrees, sir", or the right flap as the case may be.

f. Fasten your safety belt!

10. After Landing.

After landing you should take the following steps:

a. Disarm your guns, guarding them so no one passes in front of them before they are cleared. Note: During disarming the left gunner should guard the lower turrets while the right gunner clears them. The left and top gunners should clear the upper turrets.

b. Remove the turret dome, open the gun cover, and take out the ammunition belt. Be sure the last round is removed from the chamber!

c. Remove the ammunition cans but leave the receiver alone.

d. Take the guns to armament, empty the ammunition cans and remove all ammunition from the airplane and take it to the armament section, also.

e. The tail gunner should clear the tail mount and run a swab of bore cleaner down the cannon barrel to protect the gun until maintenance men arrive.

f. All gunners should report all malfunctions of the central-station fire-control equipment to the top gunner. The top gunner will keep a record of the status of the equipment, including shortages and malfunctions, noting any repairs and changes made and will report them to the flight engineer.

g. After completing the above steps, gunners should report to Intelligence for interrogation.

E. LENGTH OF BURSTS

There are several factors to consider in arriving at an answer to the question of how long a burst it is practical to fire. The ammunition has a high degree of accuracy. At 600 yards, when fired from an accuracy rifle held in a V-block, it will group in a circle 18" in diameter. When fired single shot, using an aircraft machine gun on a tripod mount, tests have shown a 20" circle of fire. In a burst of 10 or 12 on the same mount the group was approximately five feet. When longer bursts were fired, it was observed that the gun soon lost accuracy, even though it remained relatively stationary in the mount. When over fifty rounds were fired, in one burst, the projectiles tumbled in flight and dispersed over a 75 foot area at 600 yards. When the barrel has been overheated, it will be found that it cannot be relied upon for further accuracy even though the lands and grooves measure up well and the barrel, to all appearances, seems

good. If the exterior of the barrel has a burned appearance, it should be tested by ordnance before further use. When a barrel becomes over-heated it expands to such an extent that the muzzle velocity decreases several hundred feet per second. This decrease continues as the barrel continues to expand, until a point is reached where tumbling of the projectiles takes place and controlled fire is reduced to a few hundred feet. The accuracy of the fire delivered, therefore, depends not only on how steadily the gun is held, but also on the length of the burst, and the condition of the barrel. If a gunner fires short bursts of three to five rounds, constantly using his sights, he will have a tight group and a high degree of accuracy. This is the most effective method of firing your machine guns.

F. ENEMY TACTICS

The importance of search cannot be over-stressed. If the enemy is able to attack unseen his chances of scoring a victory and making a clean getaway are about 100%. In order to do this, he will attack out of the sun or from cloud cover if possible and go to great lengths to intercept our formations going to and returning from the targets. It has long been recognized that surprise affords great advantages, and the Japs are fully capable of pressing every advantage. Many crews have seen and reported enemy fighters turning in to attack but not pressing the attack home. In these cases they have turned off because they have been hit, or they have seen our ships on the alert. Had they seen that we were not on guard, they would have come in pressing the attack. It is imperative for you to be at your station and on the alert during the entire mission. There is a great temptation to watch bombs fall, aircraft go down, and, in general, abandon the field of search assigned. By doing this, you give the enemy the necessary advantage he requires to make a successful attack.

INTELLIGENCE

X. INTELLIGENCE

A. INTRODUCTION

The Intelligence Officer in your outfit has the responsibility of knowing the enemy - what he is like, what his strength is, what his resources are, what he can do to us and what he can't do, and what he can do to prevent you from knocking him out of the war. Particularly, he sees that you get the information that will help you penetrate enemy defenses, identify the target, drop your bombs and return safely to base.

His job is to give you all information possible on the reasoning and thinking of the enemy, on his air force, on his pilots, on his aircraft, and on the aerial tactics he uses. It's his job to teach you all there is to know about escape and evasion, about your behavior if you are captured, and about survival and walkout if you have to bail out over the "Hump" or in occupied China.

He will teach you all he can about antiaircraft, searchlights, and barrage balloons, and will give you the best available estimates of enemy fighter order of battle - its strength and probable location. He will teach you aircraft recognition, not only so that you'll be able to cut down the number of Spitfires and Mustangs we knock out of the sky, but so you'll be familiar with Jap planes. Thus, when you bump into a new one, you'll be able to spot it and report it as such. He will spend a lot of time with you on target and terrain identification, so that you won't fly 1500 miles to a target and drop your bombs on the wrong installation. He will tell you about security and why it's so important to keep quiet about certain things at all times, and all things at certain times. And he will keep you posted on the war so that you will know what's going on in the world and get a picture of what your outfit is doing in relation to the whole war effort.

Just before each mission he will give you all the latest intelligence information relative to that mission at "briefing", and will at the same time give you to carry with you as much pertinent written information as he can within the limits of security. Among other things, at the briefing he will probably ask you to watch for certain types of aircraft, for map discrepancies and for enemy shipping so when you return and are interrogated you can play a double barrelled part in the war effort: That of having dropped bombs on the enemy, and that of having made some observation which will help to complete our picture of what the enemy is, has, and does. In the XX Bomber Command, your observations as reported in interrogation, their accuracy and detail, are probably more important than in any other air force operating today. You are the first to fly over the Japanese homeland; to meet their newest and heretofore secret defenses; to see and photograph their harbors, airfields and industrial installations; and to help your intelligence officers put together the pieces of the picture puzzle that is the enemy. As a result of your efforts he will pass on to other Air Force units, the Army, and the Navy, information of vital importance to their operations. Be on the alert, know what to look for, jot down and remember every detail of importance.

B. THEATRE ORIENTATION MAPS

On the following pages are two maps giving you at a glance the geographical picture of XX Bomber Command operations. Map No. 1 shows the VLR bases in India, the VLR bases in China, the "Hump" area which separates the two and the areas to our South and East. Map No. 2 shows the China bases in their relation to targets in the Japanese Islands, Manchuria, Occupied China, Formosa, and other points that may appear in B-29 bomb sights in future operations. Some of the chief friendly airfields in addition to VLR bases are also shown.

Study these maps carefully as they should answer many questions that may come to your mind.

C. JAPAN

The result of the Jap disregard for truth is that the war, as reported through Jap microphones, has reached a farcical state in the best "Gilbert & Sullivan" tradition. This would be quite humorous except that the Jap is using real bullets in his actual fighting.

We must always remember that Jap propaganda, despite its untruthfulness, is used purposefully. Therefore, when listening to Jap radio programs, or reading Jap propaganda reports, we must ask ourselves, "What is the bill of goods he is trying to sell me?" Jap propaganda is usually funny and ridiculous, but it is not to be laughed off. It is a deadly serious effort on the part of the Jap to defeat us. It is carried on with great energy and persistance, and here and there with guile and cunning. Propaganda is one of the Jap's clumsiest and least effective weapons, but it is a weapon and he is wielding it with all his might.

A great deal of nonsense has been written about the Jap, about the polite hiss with which he speaks, and the polite belch that goes with his eating. The truth of the matter is, that as an individual the Jap is a rather ordinary individual equipped with about the same instincts as the rest of us. But as a nation the Jap IS different. This is not a paradox but a perfectly natural result of the isolation in which the Jap nation has developed, resulting in a set of ideas and customs "queer" by our standards.

As a fighting man the Jap is average to good. He will carry on under the most extreme hardships with a blindly animalistic stubborness. He will fight, when cornered, to the last man with an unparalleled fanaticism. But he is not a "brainy" or imaginative fighter. He can be out-thought, tricked, and beaten. His pilots are good, but not good enough. Now we have him on the run almost everywhere. Even though he is being beaten, and even when starved, sick, and discouraged, he will fight on with the desperation of a cornered rat.

Under the lash of the sword, wielded by utterly ruthless rulers, the Jap nation has been cowed into the most abject regimentation for centuries. So completely have the rank and file of the people been subjected to the few ruling families that they have accepted without question a totalitarian

CONFIDENTIAL

MAP No. 1

ORIENTATION MAP: REAR AREAS TO FORWARD BASES

LEGEND

- ★ VLR Bases
- ■ Heavy Bomber Fields
- ▲ Medium Bomber Fields
- ● Fighter Fields
- ○ Cities

MAP No.2

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way of life far more rigid than anything Hitler ever dreamed of. This way of life has been rationalized and idealized as worship of the descendant of the Gods, the Emperor. But actually it is a device, perhaps the greatest hoax in history, by which one hundred million people are kept in subjection to the wishes of a handful of rulers.

D. JAPANESE AIR FORCES

The Japanese Air Force is hard to understand only because Japanese is hard to understand. Stripped of the Jap hen tracks, they are just another air force. They are NOT independent, but arms of the Army and Navy like our outfits.

The Army Air Force is divided into Air Armies which the Japs call Kokuguns. These are more or less permanently located and are roughly like our "Air Force". Next in line is the "Flying Division" (Hikoshidan) which is the largest tactical unit, something like our Combat Command. Then, parallel to our Combat Wing, comes the "Flying Brigade", a mobile unit under the "Division". Under the Brigade naturally falls the boys who do the work, the "Flying Regiment" (Hikosentai), which is roughly equivalent to our Group and which has 27 aircraft with nine planes per "squadron" (Chutai). Carrying this thing down to almost the last Jap, each squadron is made up of three "flights" (shotai) with three planes each.

The Naval Air Force, according to all reports, are the big leaguers. They have both land-based and ship-based aircraft, with their so-called 3rd Fleet controlling all carrier-based stuff. The organization of this outfit is even more complicated. "Air Flotillas" (Kohusentai) are equivelant to the Air Armies in the land-based organization and these are divided up into "Air Attack Forces" (Kushubutai), their largest land based tactical units. Sometimes as task forces they form "Base Air Forces". The carrier-based outfits are flexible and vary considerably in strength, but their most important unit is the Kokutai which generally has between 27 and 45 aircraft when it starts operations.

You'll run into the Army Air Force in the Southeast Asia Theater, China, Korea, and Manchuria. The Naval Air Force units are primarily assigned to Japan but they're also around in goodly numbers in Formosa, the Philippines and the Netherlands East Indies. There are also a number of Army units in the Philippines being about equal in number to the Navy units there.

Jap first class airfields are mostly comparable to our medium bomber fields. Their second class fields hardly would accept one of our light bombers. That gives you an idea of what to expect of their third class fields and emergency landing grounds. They used to build brand new airfields by the dozens with a 1st or 2nd class field serving as a center for a bunch of "hanger-on" fields. Now they confine their activities mostly to subsidiary strips and runways adjacent to those already built. Large cities and transportation centers generally attract their major fields. Third class and emergency fields may be found anywhere and are associated with their ground forces advances.

Don't discount the Jap Air Force. On the road they've made a poor showing. But they're going to be playing on their home grounds, and they're going to be mad. As far as your team is concerned, treat each opponent as though he were the best in the business. Each Jap is a devil - and even if he's a chump, he may be having a good day and be as hot as hell.

E. JAPANESE FIGHTER AIRCRAFT

1. From Pearl Harbor to Mid 1944

The original decision of the Japenese High Command to sacrifice armor, fire power and sturdiness in combat aircraft for maneuverability and climb is one of the greatest single contributing factors to the staggering defeats suffered by the Japanese Air Force to date. A training manual, published in July 1939, typifies Japanese thinking of that period and the early years of the war. Maneuverability is listed as the No. 1 characteristic that combat aircraft of all types should possess. Speed, range and "excellence in climbing and descending ability" are also listed. There is no mention of armor.

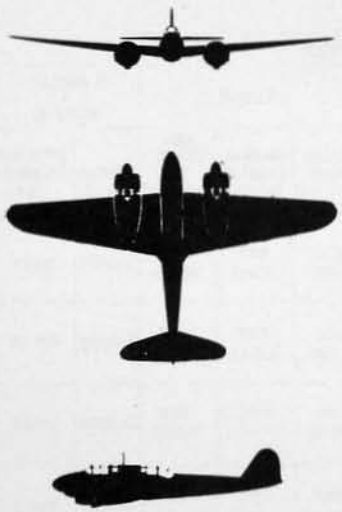
Having conceived a faulty doctrine, the Japanese set about executing it in an admirable fashion. Jap fighters, particularly the Zeke, were the most maneuverable and fastest climbing combat planes in the air. Our fighter pilots were amazed, and for a time, dismayed by the acrobatic efficiency of the Zeke. They thought at first that they, too, had to be acrobatic flyers. They soon learned, however, that their P-40's and P-39's had four advantages which, if employed properly, could overcome the Jap's two advantages which were maneuverability and climb. These four advantages were the diving speed, armor, fire power and overall sturdiness of our fighters. It was then that the fragile, lightly armed and un-armored Jap fighters began to fall in large numbers before the guns of U.S. Navy and U.S.A.A.F. planes.

New Japanese fighters, notably Nick, Tojo and Tony then made their appearance. In addition to being faster and better all around aircraft, certain compromises with the original Japanese doctrine were indicated. Tojo and Tony were heavier and sturdier than any previous Jap single engine fighters, and carried slightly heavier armament. Tony also had light armor to protect the pilot, the first Jap plane to exhibit armor of any kind. These refinements were incorporated in new versions of some older models during late 1943 and early 1944. Today, all Jap fighters carry heavier armament than previously, most of them have some kind of armor, and some of them have tank protection of one variety or another. Japanese planes have not improved to the extent that they compare favorably with U. S. planes in these details, and evidence of the original Jap thinking is still definitely apparent.

These, then, are the Jap fighter planes as we knew them up to the middle of 1944. They remain the chief operational fighters of the Japanese Air Forces today, and are highly maneuverable, fast in climb, fragile, moderately armed and armored, and when compared with first line U.S., British and German fighters, of only moderate speed. Silhouttes appear on a following page and details of their performance and characteristics are shown in Table No. 1.

JAPANESE FIGHTER AIRCRAFT

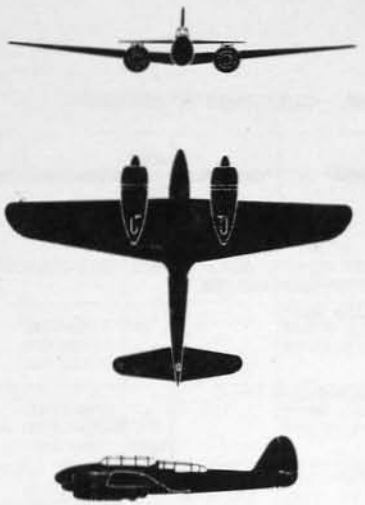
OSCAR 2



NICK 1

TOJO 2

TONY 1



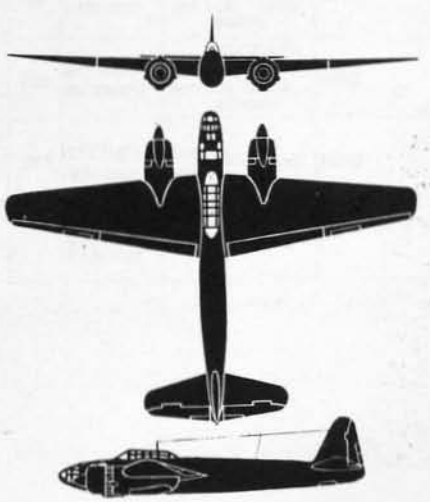
IRVING 12 *

ZEKE 22

ZEKE 32

ZEKE 52

JACK 11



FRANCES 11 **

* NIGHT FIGHTER; ALSO RECCE.
** NIGHT FIGHTER; ALSO MED. BOMBER

RESTRICTED

CHARACTERISTICS AND PERFORMANCE DATA — JAPANESE FIGHTER AIRCRAFT

BLE I

OPERATIONAL INTELLIGENCE, XXI BOMBER COMMAND, INTELLIGENCE SECTION

15 SEPT. 1944

NAME, TYPE, BRANCH AND CREW				ENGINE & HORSEPOWER		CLIMB & CEILING		NORMAL FUEL							MAXIMUM FUEL						FUEL DATA U.S. GALLONS			ARMAMENT — BOMB LOAD — ARMOR			
								SPEEDS			RANGES STATUTE MILES		ENDURANCE HOURS		SPEEDS		RANGES STATUTE MILES		ENDURANCE HOURS									
CODE NAME	TYPE A/C	BRANCH OF A.F.	NO. IN CREW	TYPE ENGINE	MAX. HORSE-POWER	MAX. RATE CLIMB PER MIN.	SERVICE CEILING	MAX SPEED AT OPTIMUM ALTITUDE	NORMAL CRUISING SPEED	MOST ECON. CRUISING SPEED	AT NORMAL CRUISING SPEED	AT MOST ECON. CRUISING SPEED	AT NORMAL CRUISING SPEED	AT MOST ECON. CRUISING SPEED	NORMAL CRUISING SPEED	MOST ECON. CRUISING SPEED	AT NORMAL CRUISING SPEED	AT MOST ECON. CRUISING SPEED	AT NORMAL CRUISING SPEED	AT MOST ECON. CRUISING SPEED	NORMAL	AUXILIARY	MAX.	ARMAMENT*	TOTAL RDS.	BOMB LOAD	ARMOR
AR 2	S/E FIGHTER	ARMY	1	14 CYL 2 ROW RADIAL	1130 AT S.L.	3330'	38400'	342 17500'	252 15600'	178 15600'	792	1050	3.1	5.9	238 15600'	172 15600'	1245	1590	5.2	9.2	152	87	239	2X12.7M(F)	500	2X220 LBS (IN PLACE OF AUX. FUEL)	PILOT-HEAD, BACK, BELOW TANKS PROTECTED (INEFFECTIVE)
I	S/E FIGHTER	ARMY	2	14 CYL 2 ROW RADIAL	1060 AT S. L.	2470'	35300'	357 18500	227 1500'	162 1500'	1060	1375	4.7	8.5							363	MAY CARRY 136 OR 174 GAL.		1X37M(F) + 1X20M(F) + 1X7.92M(T)	20		PILOT-HEAD, BACK TANKS LIGHTLY PROTECTED
2	S/E FIGHTER	ARMY	1	14 CYL 2 ROW RADIAL	1300 AT S. L.	3940'	36500'	376 17200'	248 1500'	174 1500'	565	740	2.3	4.3	231 1500'	166 1500'	810	1050	3.5	6.3	128	69	197	2x7.7M(F) + 2X12.7M(F) OR 4X12.7M(F)	500 1000		PILOT-HEAD, BACK. TANKS LIGHTLY PROTECTED.
I	S/E FIGHTER	ARMY	1	12 CYL INVERT. "V"	1095 AT 5300'	2395'	35100'	356 17000'	257 15000'	188 15000'	1035	1305	4.0	7.0	237 15000'	180 15000'	1465	1795	6.2	10.0	199	100	299	2X7.7M(F) + 2X12.7M(F) OR 4X12.7M(F)	600 1200	1X132 LBS. (IN PLACE OF AUX. FUEL.)	PILOT-HEAD, BACK SELF SEALING TANKS.
E 22	S/E FIGHTER	NAVY	1	14 CYL 2 ROW RADIAL	1120 AT S. L.	3180'	39900'	341 20500'	252 18600'	182 18600'	785	1005	3.1	5.5	239 18600'	176 18600'	1225	1595	5.1	9.1	141	87	228	2X7.7M(F) 2X20M(F)	1000 120	2X132 LBS. OR 5X70 LB. AERIAL BOMBS	NONE
E 32	S/E FIGHTER	NAVY	1	14 CYL 2 ROW RADIAL	1120 AT 7000'	3580'	35900'	348 20600'	256 16600'	188 16600'	790	995	3.0	5.3	245 16600'	184 16600'	1290	1585	5.3	8.6	141	87	228	2X7.7M(F) + 2X20M(F)	1200 200	2X132 LBS. OR 5X70 LB. AERIAL BOMBS	NONE
E 11	S/E-F/P FIGHTER RECCE.	NAVY	1	14 CYL 2 ROW RADIAL	955 AT 14500'	2230'	35400'	278 16000'	204 14000'	153 14000'	640	790	3.1	5.1	204 14000'	157 14000'	1070	1230	5.2	8.1	141	86	227	2X7.7M(F) + 2X20M(F)	1000 120	2X132 LBS.	NONE
NG 12	T/E RECCE. NIGHT FIGHTER	NAVY	3	(2) 14 CYL 2 ROW RADIAL	1280 AT S. L.	2485'	38600'	361 22300'	207 15000'	156	1435'	1780	6.9	11.4							500			1X20M(F) + 2X20M(T) + 2X20M(B)			PILOT PROTECTION

*(F) - FORWARD, (T) - TOP, (S) - SIDE, (B) - BOTTOM

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2. New Japanese Fighter Aircraft

It had been known for some time that the Japanese were experimenting with new aircraft, but it was not until a number of documents were captured at Saipan and other places in the South West Pacific that the full extent and scope of the Japanese program could be evaluated. It is now realized that a new, modern Air Force is in the making which will be a serious threat to the Allies if the Japanese have sufficient time to fulfill their plans.

Both Army and Navy aircraft are being radically improved and a wide variety of experimental types are undergoing tests. Quality and design are described as excellent. Many new models have already been put into service in small numbers. Following are the chief characteristics of the new fighter aircraft:

a. Many are preliminarily assessed as being in the 400 MPH "Plus" class.

b. New engines which develop 1800 to 2000 H.P.

c. Increased gun installations with heavier caliber guns.

d. More effective armor.

e. More effective tank protection.

How many of these new aircraft will become operational in quantity during the remainder of the war is a matter only time can tell. The Japanese will meet tremendous obstacles in mass producing the new types while maintaining existing production. Furthermore, if these obstacles can be appreciably overcome, Japan is still faced with the problem of obtaining an adequate supply of fully trained pilots to fly her aircraft. The fact remains, however, that the basic Jap concept of what characteristics a combat fighter plane should posses has radically changed. At least from the stand point of the aircraft he flys, the enemy will be a more formidable foe in the future. Some of the new planes are already in operation. More and more of them will be met in the coming months.

In many cases, the new Jap aircraft will be encountered first by B-29 crews in missions over the Japanese Islands, and it will be your responsibility to report fully and completely the recognition features and performance data observed. The Navy and the AAF are hungry for any and all information on these aircraft, so report everything you see no matter how small or inconsequential it may seem. Table 2 lists most of the known information on these new and experimental fighters. Your Group S-2 will give you additional data as it becomes available.

F. JAPANESE FIGHTER TACTICS

1. The Jap Fighter Pilot

Japanese fighter pilots have displayed very marked differences in ability. At first, in the months following Pearl Harbor, Jap pilot ability was reported

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PRELIMINARY CHARACTERISTICS AND PERFORMANCE DATA - NEW JAPANESE AIRCRAFT

TABLE 2

OPERATIONAL INTELLIGENCE - XX BOMBER COMMAND, INTELLIGENCE SECTION

DESIGNATION		TYPE	CREW	DIMENSIONS			POWER PLANT		PERFORMANCE — NORMAL FUEL					FUEL DATA		ARMAMENT	BOMB LOAD	ARMOR	15 SEPTEMBER 1944
CODE NAME	JAP NAME			SPAN	LENGTH	HEIGHT	TYPE ENGINE	HORSE-POWER	CLIMB (F.P.M.)	SERVICE CEILING	MAX. SPEED (OPT. ALT.)	RANGE	ENDURANCE	NORMAL	MAX.				COMMENTS
											NAVAL AIRCRAFT								
SAM II	REPPŪ M-50	S/E CAR. FIGHTER	1																CARRIER BASED FIGHTER - REPORTED TO HAVE 25-30 MM WING GUNS. THE EXP. CAR. BASED FIGHTER - MAY EVENTUALLY REPLACE ZEKE 52.
JACK II	RAIDEN	S/E FIGHTER	1	35'5"	31'7"	12'10"	14 CYL RAD. (KASEI 23)	1875	4,100	39600	407	*** 508	*** 2.2	*** 109	224.4	WINGS - 4 X 20 MM OR 2 X 20 MM + 2 X 7.7 MM - FUS.	2 X 77	NONE	SHORT RANGE DAY OR NIGHT FIGHTER UNPROTECTED TANKS.
GEORGE II	SHIDEN	S/E FIGHTER	1				18 CYL RAD. (HOMARE 21)	2000			400 EST.					WINGS - 4 X 20 MM FUS. - 2 X 7.7 MM + OR 2 X 12.7 MM		3 PLATES 1/4"	SELF-SEALING TANKS. LAND BASED VERSION OF THE REX II.
LUKE II	KYOKU (17 EXP.)	FIGHTER	1				14 CYL RAD. (KASEI 24?)				400 PROB.								REPORTED TO HAVE 35-40 MM FUSELAGE GUNS.
REX II	KYOFŪ MOD. II	S/E FIGHTER F/P	1				(KASEI 13)												FIGHTER-SEA PLANE, POSSIBLE REPLACEMENT RUFE.
NORM II	SHIUN MOD. II	S/E REC. F/P	1				14 CYL RAD. (KASEI 24)												HI-SPEED RECCE. SEAPLANE
PAUL II	ZUIUNA MOD. II	S/E RECCE FLOAT PLANE	2				14 CYL. RAD. (KINSEI 54)												KINSEI HAS M G SYNCHRONIZER. CAN BE USED AS A DIVE BOMBER.
MYRTLE II	SAIUN	S/E CAN RECCE.	3	41'	36'7"	12'9"	18 CYL. 2-ROW RAD. (HOMARE 21)	2000			391	1845 (MAX.) (2990)		358	549	1 X 7.9 MM		PILOTS BACK (1-3/8")	TANKS PROTECTED.
FRANCES II	GINKA OR HAKKŌ	T/E BOMBER	3 OR 4	65'7"	49'3"	17'5"	2 X 18 CYL 2 ROW RAD. (HOMARE 11)	1820			402	* 374 (MAX. 775)	* 3 1/2 HRS 7 1/4 HRS	997	1565	2 X 20 MM OR 2 X 7.7 MM	1 X 1763 OR 2 X 551	PILOTS SEAT ONLY (3/8")	USED FOR LEVEL DIVE, OR TORPEDO BOMBING. SELF-SEALING TANKS. ALSO MODIFED FOR USE AS A NIGHT FIGHTER.
GRACE II	RYŪSEI A 80	S/E CAR. ATT. PLANE					18 CYL RAD. (HOMARE 11)												CARRIER BORNE - POSSIBLE REPLACEMENT OF KATE. PROBABLY FAST AND MANEUVERABLE WITH HIGH RATE OF CLIMB.
(17 EXP.)	J3K1	PROBABLY DESIGNED BY KAWANISHI, SHOULD BE IN ADVANCED DEVELOPMENT STAGE.																	
(18 EXP.)	TENRAI	BELIEVED TO BE A T/E "OTSU" FIGHTER. NOT LIKELY TO APPEAR IN SERVICE THIS YEAR.																	
(18 EXP.)	JIMPŪ	DESIGNED AS AN ANTI-FIGHTER AIRCRAFT. " " " " " " " "																	
(18 EXP.)	DENKŌ	DESIGNED AS A NIGHT FIGHTER. NOT LIKELY TO BE OPERATIONAL IN THE NEAR FUTURE.																	
											ARMY AIRCRAFT								
FRANK I	KI 84	S/E FIGHTER	1	37'1"	32'4"	11'2"	18 CYL RAD. (HA 45)	1970	3780	39,000	422	** 930	** 4 1/4 HRS	185	359	2 X 37 MM + 4 X 20 MM	NONE	BULLET-PROOF WINDSHIELD	POSSIBLY WILL REPLACE OSCAR AND/OR TOJO CONSIDERED TOPS AMONG ARMY PLANES.
ROB I	KI 64	S/E HI-SPEED FIGHTER					INLINE (HA 201)				500 (DOUBTFUL)								MAY EVENTUALLY REPLACE TONY, MAY BE A DEVELOPMENT OF TONY.
STEVE I	KI 73	S/E HI-SPEED FIGHTER					18 CYL RAD. (HA 42)	2000											PERFORMANCE MAY BE COMPARABLE TO FRANK I.
PAT I	KI 74	S/E FIGHTER					(HA 221)												LONG RANGE, HIGH SPEED FIGHTER.
CLARA I	KI 70	2 E R					2-18 CYL RAD. (HA 42)	2000											PRESUMABLEY REPLACING DINAH.
EDNA I	KI 71	2 E R					2-14 CYL RAD. (HA 33)												
(EXP.)	KI 90	T/E - S/S FIGHTER	1	TWO ENGINE SINGLE SEAT FIGHTER. NOT LIKELY TO APPEAR IN SERVICE THIS YEAR. BELIEVED TO BE VERY FAST.															

PLUS ADDITIONAL EXPERIMENTAL MODELS, FOR BOTH NAVY AND ARMY, ON WHICH THERE IS LITTLE OR NO DATA.

* CALCULATED ON THE BASIS OF 467 GAL NORMAL FUEL AND 974 OVERLOAD.

** WITH NORMAL FUEL, 75% MAX VEL.

*** ON THE BASIS OF 75% MAX VEL. AND 109 GAL FUEL (ONLY FUSELAGE TANK), WING TANKS (47 GAL) NOT USED UNDER NORMAL LOAD CONDITIONS.

as excellent. Then toward the latter part of 1942 reports came in from all theatres that the newer Jap pilots were far inferior to the original crop, most of which were then no longer flying, except possibly with their ancestors. Since that time, however, the Jap has been able to put some crack pilots in the air, which accounts for the disparity in pilot ability being encountered at the present time. The good pilots appear to be in the minority, but as a bomber crew never knows the quality of its opponent until combat is actually joined, the safe rule is to assume he is better than good. This is particularly true of missions over the Japanese Islands where the cream of the enemy pilots are or will be based. On the whole, Jap Navy pilots are rated superior to Jap Army pilots.

The evidence is strong that Jap fighter pilots aren't in the same league with U.S. airmen when it comes to gunnery, despite a trend toward improvement on the part of the Jap. Here again, however, there are good ones and poor ones, and the bomber crew that doesn't give its opponent the benefit of the doubt is worse than foolish.

It is pretty generally agreed the average Jap pilot has plenty of intestinal fortitude but lacks ingenuity and judgement. He had been taught to fly and fight in certain ways, which he almost always follows, whether they are called for or not.

2. Jap Fighter Tactics Against B-29's On Daylight Missions

Jap tactics against the B-29 are in the embryonic stage and have not as yet fallen into definite patterns. This is caused by several factors. The superior speed of the B-29 as compared to other heavy bombers has been a tough tactical nut for the Jap to crack in that it calls for a finer degree of timing on pursuit curves, and makes it more difficult for the fighters to position themselves properly. Consequently, Jap attacks in many cases have been carried out in a haphazard, somewhat catch-as-catch-can manner. Furthermore, the Jap has attempted to feel out the defensive fire of the B-29 in order to determine the best means of attacking it. The best fighter maneuver against any bomber formation is a well planned and executed attack coordinated by two or more fighters. Coordinated attacks against the B-29 have been very much in the minority because of the difficulty of coordinating attacks against a fast moving target. More coordinated attacks will undoubtedly be experienced in the future as Jap knowledge of the B-29 increases. It can be expected that Jap tactics against the B-29 will become more crystalized and take on more definite characteristics as additional missions are run.

3. Enemy Tactics During A Typical Daylight Mission

Jap fighter tactics during a typical B-29 mission are set forth here for background information. The Primary Target was Anshan, Manchuria and it was attacked during daylight hours by B-29 formations varying in size from 4 to 16 aircraft.

A few sporadic attacks occured en route to and from the target, but 90 per cent of the total were encountered in the immediate target area. Participating in the mission were 109 B-29's of which 84 were intercepted by Jap fighters who

made a total of 248 attacks. The attacking force was composed chiefly of Tojos, Nicks and Oscars. Of the attacks in the target area, 58 per cent occurred before, and 42 per cent after, "bombs away".

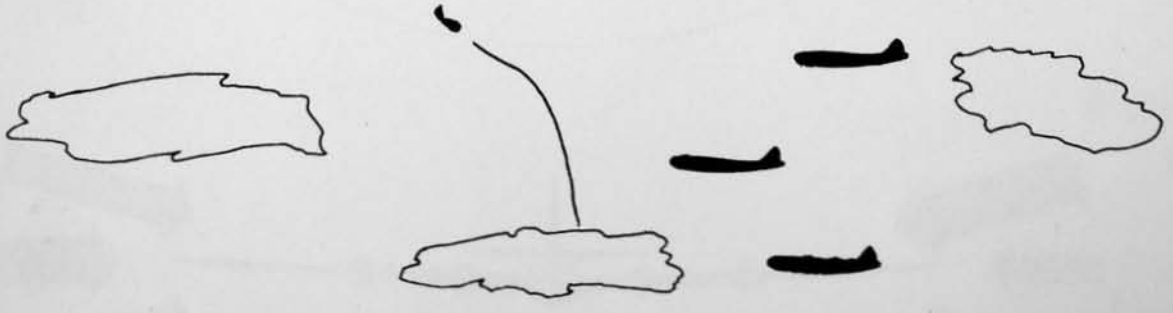
Because of adverse weather conditions, B-29 formations were loose, allowing sufficient space for Jap fighters to wage attacks against inside planes. In previous missions where tighter formations were flown, enemy pilots concentrated attacks against the lead and wing planes. In this mission, however, the distribution of attacks was haphazard.

Forty-two per cent of the enemy attacks came from the front quarter (11, 12, and 1 o'clock). The Jap has shown a preference for the frontal approach in all recent B-29 daylight missions, and the above distribution is typical. As to level of approach, in the Anshan Mission 41 per cent of the attacks were high, 32 per cent low and 27 per cent level, which indicated a change from the two previous B-29 missions where enemy pilots showed a preference for the low approach. This is one of the fluid and changing aspects of Jap tactics against the B-29 and is probably a result of Jap experimentation as to the best methods of attacking our aircraft. The exhibit on the following page illustrates diagramatically the direction and level of attacks for the Anshan mission.

The enemy opened fire in only 52 per cent of the encounters, which indicates he is experiencing difficulty in timing attacks against the B-29. Our aircraft opened fire in 77 per cent of the attacks, fire being withheld in a number of encounters because of the danger of hitting another B-29 in the formation. Eight B-29's were damaged, none seriously, as a result of enemy air opposition and none of our aircraft were destroyed. Claims listed 11 enemy aircraft destroyed, 9 probably destroyed and 31 damaged.

Enemy pilots were more aggressive and pressed more attacks to close quarters than in any previous mission, with 63 per cent being closed to 500 yards or less. A few were pressed to distances of 50, 35 and 30 yards. Normally, Jap pilots have not been so eager. A variety of breakaway maneuvers was used by the enemy, but dives and split S's were seen more often than any of the others which included rolls, climbs, banks and chandelles. Jap pilots made good use of clouds in many of his breakaways, particularly fast dives into cloud banks.

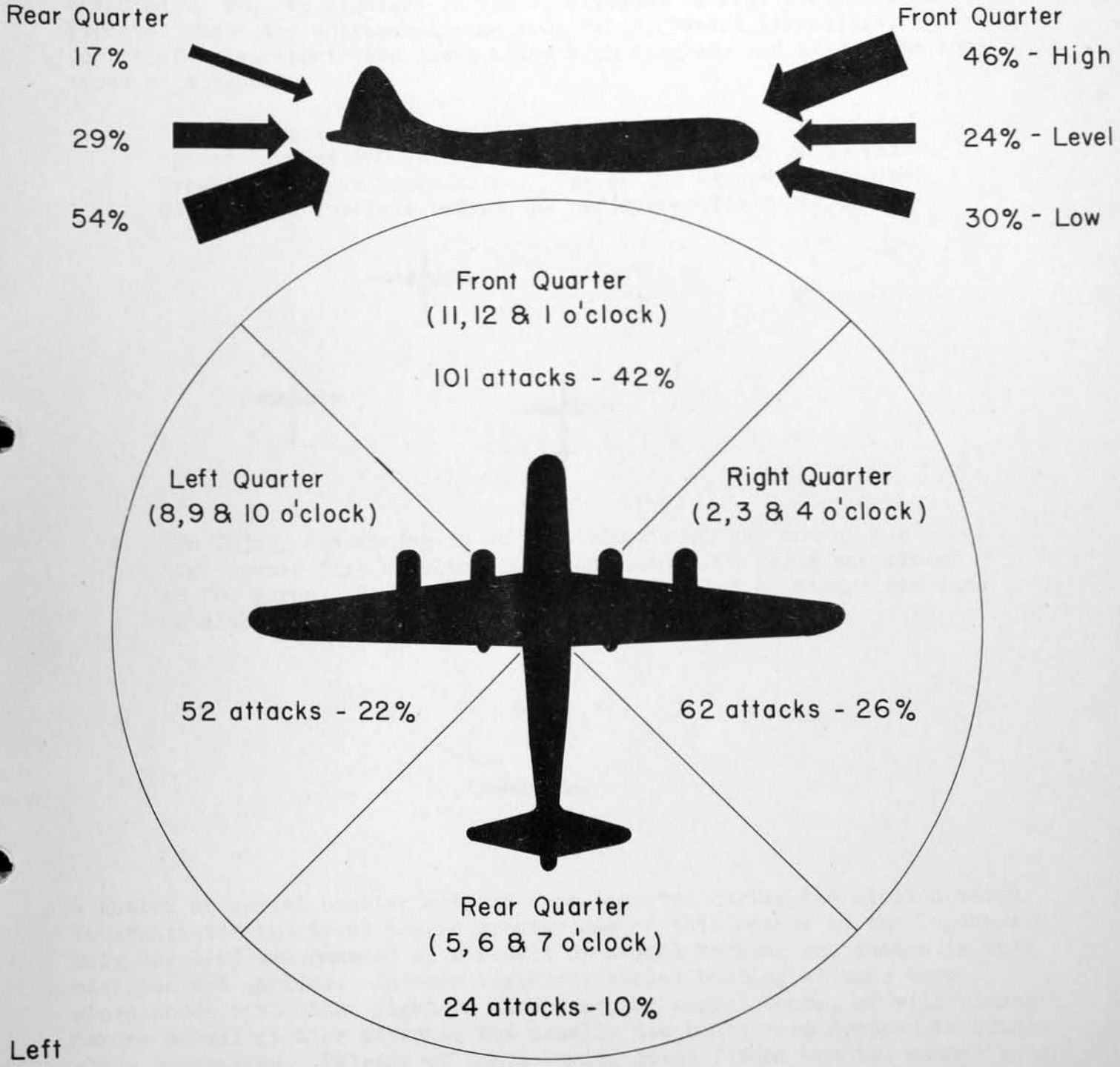
We see then that the typical Jap fighter attack came from either 11, 12, or 1 o'clock high, was pressed to about 300 yards and broke away in a fast dive, as shown in the following diagram.



CONFIDENTIAL

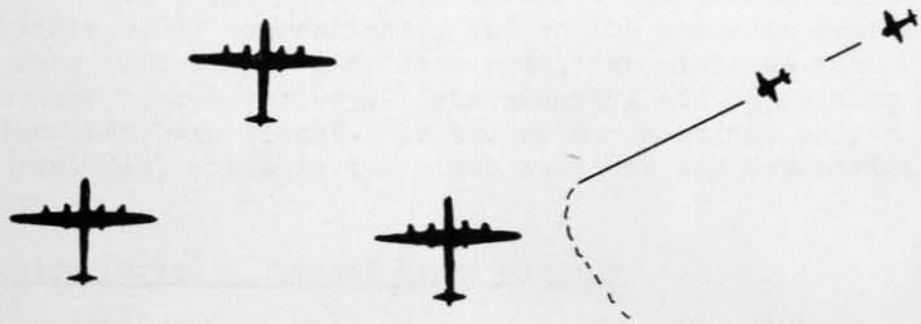
DIRECTION AND LEVEL OF ATTACKS

Mission No. 9

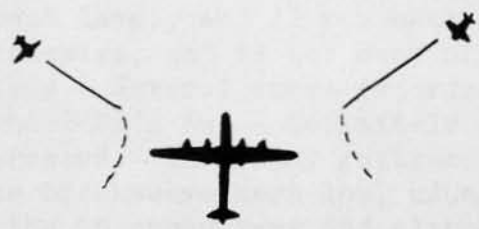


Most of the coordinated attacks experienced in the Anshan Mission were executed by two Jap fighters in trail, although several attacks were reported where the approaches came from two different directions. Excerpts of crew reports are given below with diagrams and illustrate both types of attacks.

a. Two Tojos attacked in trail from 2 o'clock low. The enemy opened fire at 800 yards, and pressed the attack to 50 yards, breaking away in power dives. One of our aircraft sustained hits in the fuselage behind the radio operator's position.



b. Two Tojos, one coming in at 11 o'clock high and one at 2 o'clock high opened fire simultaneously at about 1000 yards and closed to 300 yards. Our aircraft returned fire but no damage was done on either side. The Tojos broke into sharp dives.



A number of aerial bombing attacks were reported during the mission which substantiates the trend toward greater use of this weapon by the Japanese. Only one B-29 was damaged as a result of aerial bombing and damage in this case was not serious. In some instances aerial bombing attacks were coordinated with other fighters also dropping aerial bombs, or with planes making normal fighter attacks; but usually the bombs were dropped in single plane encounters. Release of bombs during level flight was the method used most often, although some cases of dive bombing tactics were reported, and also of planes releasing their bombs while in banking turns. In all cases, except one from the rear quarter, approaches were made from the front quarter between 11 and 1 o'clock. Release was made usually from a distance of 250 to 300 yards above the B-29's although a few releases at 600 to 700 yards were also observed. In the case of dive bombing releases, the enemy fighters on some occasions continued their dives through the formations. Accuracy of aiming seemed to be better than in previous missions as many near misses were recorded. A variety of types of aerial bombs was used by the enemy and consisted of both the phosphorous and fragmentation types. Many of the

bombs did not explode within sight of the crew members.

4. Jap Fighter Tactics Against B-29's - Night Missions.

The Japanese as yet do not have proficient airborne radar equipment, at least in operational use, and there have been no indications of the employment of "Ground Controlled Interception" (GCI) equipment. If and when the enemy develops this equipment the picture of night tactics against B-29's will in all likelihood change appreciably. At the present time, however, his efforts have been largely confined to the target areas where our formations are picked up by searchlights, and to the sporadic contacts he has been able to make with his more or less primitive airborne radar which is of the Air-Surface Search variety. Consequently, air opposition to B-29 night operations has been slight. In two of our missions only a few enemy attacks were recorded, while in two other missions air opposition was non-existent.

5. Enemy Tactics During A Typical Night Mission

The following data pertains to tactics encountered during a night mission against Palembang, Sumatra. Only eight B-29's were intercepted resulting in a total of 26 attacks by the enemy, none of which did any damage to our aircraft.

Varying from daylight attacks where the majority of the passes originate from the frontal quarter, attacks in this case were distributed quite evenly from all directions around the clock. Of the encounters, 48 per cent were low, 40 per cent level, and 12 per cent high. In general, the Jap pilots were not aggressive, and 69 per cent of the attacks terminated between 500 and 1000 yards. Several crews reported that concentrated machine gun fire from the B-29's had a definitely deterrent effect against attacks being closely pressed. The enemy returned fire in 22 of the 26 encounters. Most of the breakaways were low, usually sharp dives. B-29's returned fire in 16 of the 26 encounters and although no official basis for claims existed, crews believe that several enemy aircraft were at least damaged.

6. Enemy Rockets

One crew sighted a twin-engine fighter firing rocket projectiles which were about one yard long, dark red in color and released in pairs. The trajectory was relatively flat and there was no trail or "comet's tail"; rather, the projectiles appeared to be aglow along their entire length. They moved together for a distance of 400-500 yards after release, at which point they appeared to veer apart, drop and die out. No bursts were observed and fire was inaccurate. Similar use of Japanese rockets has been reported from other missions, and it is likely that their employment will increase in the future.

Observations were also reported by several crews of explosions which closely resembled Fourth of July fireworks. Reddish orange balls about the size of baseballs suddenly appeared "out of no-where". They came in fours, threes, twos and singly and upon exploding broke into four or five fragments that flew in all directions. The explosions were never closer than 400 yards

and were always accurate as to altitude. One of our aircraft was followed almost continuously for 350 miles by these bursts, which indicates they must have been aerially released in this case, but evidence exists that this same type of weapon is also fired from ground installations.

Reports are being received from all theatres of increased use of rockets by the Japanese. Apparently they are experimenting with many different types, both ground and air released. Observations of rocket fire should be reported completely and fully to the Group S-2's during mission interrogations.

7. Other Jap Tactical Characteristics

Listed below are several additional characteristics of enemy tactics with which you should be familiar and guard against.

a. Use of Sun and Clouds. Like the German, the Jap is a master at taking advantage of the sun and clouds. These two sources of attack should be searched constantly.

b. Use of "Pacer" Planes. The Jap often flies a plane parallel to our bomber formations and out of gun range, relaying speed and altitude information to antiaircraft installations on the ground.

c. Aerobatics. Jap fighter pilots often provide a free side-show of aerobatics at safe range from our formations. The purpose of this display is to impress our crews with Jap flying ability, and to divert our gunners attention away from attacks developing in another direction.

d. Feints. The enemy sometimes feints a pass to distract attention away from an attack developing on the remote side. They also have been observed to make several feints and then carry the same feint through to an actual attack.

e. Smoke. On some occasions the Jap fighter pilot will feign damage by causing his engine to emit black smoke, then will return in a few minutes from another direction to continue the attack.

f. Captured Allied Aircraft. It is known that the Japanese have some operational Allied aircraft in their possession and there is some evidence they have been used in combat in a few instances. It is established that the Japs have small numbers of the B-10 B, B-17 C, Blenheim IV, Hudson 1-V, P-36, Hurricane II, F-2A, P-40 B & C, and possibly C-47 aircraft.

g. Attacks on Stragglers. All Jap pilots are indoctrinated with the tactics of concentrating on stragglers, cripples, and segregated planes. They are quick to spot a weakness such as an inoperative turret or a feathered prop. The isolated or crippled plane is the choicest of all targets to the Jap, and he will use every trick in the tactical book to destroy it.

8. Sources of Information on Enemy Tactics

Detailed reports of Jap fighters tactics against B-29's are published after every XX Bomber Command mission in Enemy Tactics Bulletins and in the Air Intelligence Digest. Your Group S-2 will make this information available to you, and will keep you up to date on the latest enemy tactical developments.

G. JAPANESE ANTIAIRCRAFT ARTILLERY

1. Types of Equipment

Antiaircraft fire or flak (Flugzeug abwehr Kanone or cannon for use against aircraft, i.e., antiaircraft gun) are terms designating any fire from ground weapons directed against our aircraft. Antiaircraft fire is classified by the type of weapon from which it originated.

a. Heavy Antiaircraft Fire. Fire from weapons of 75mm (approximately 3" in diameter) or greater caliber. Projectiles do not have tracer elements but are equipped with time fuzes which at some predetermined point in the sky initiate bursts evidenced by mushrooms of smoke.

b. Automatic Weapons Fire. Fire from any weapon firing tracer ammunition. The guns are relatively light and quite mobile and are characterized by a high rate of fire of about 120 to 700 rounds per minute maximum. They fire a small projectile fitted with a self-destroying element and with a percussion type fuse which bursts on impact. Ball, tracer, or armor piercing ammunition is usually fired from 20mm and 25mm weapons and from machine guns the fire from which should be reported as "machine gun fire" whenever possible rather than "automatic weapons fire". Twenty millimeter and 25mm guns also fire H.E. ammunition equipped with super-sensitive fuses which cause the projectile to explode on impact. This ammunition is also standard for 27mm and 40mm guns. It has been reported the Japanese use a time fuse feature on their 40mm antiaircraft gun which results in an increase in the maximum altitude and range as compared to that of the 40mm gun used by the United States and the British.

Automatic weapons are designed to offer effective opposition against low flying planes directed against troop concentrations, airfields, lines of communications, etc. To do this they are desinged for mobility, rapid tracking in azimuth and elevation, and high rates of fire. These guns are fitted with some form of on-carriage sight, speed ring, or slant-plane-linkage, and it may be the Japanese use some form of a director with their 40mm gun just as we use the M5 director to provide accurate fire at maximum ranges. Directing fire against a target by tracer control, although effective at minimum ranges, becomes very inaccurate for ranges over 450 yards because of the inability of the average individual to maintain vision at greater distance.

c. Small Arms Fire. Fire from individual weapons of ground troops directed against aircraft at very low altitude. Ammunition is tracerless and fire can be identified only through direct observation of actions of ground forces.

2. Standard For Reporting Antiaircraft Fire

Type of Weapon	Accuracy	Intensity
Heavy Antiaircraft (75mm or larger)	Accurate: Bursts in close proximity to plane and/or hits obtained. Inaccurate: Bursts beyond danger area and no hits obtained.	Intense: Many bursts in several areas at a rate of 5 to 10 per second. Moderate: Bursts in several areas at a rate of about 3 per second. Meager: Not more than one burst per second in one area.
Automatic Weapons (20mm, 25mm, 40mm)	Accurate: Tracer streams in apparent close proximity to plane, and/or hits obtained. Inaccurate: Tracer streams well away from the plane and no hits obtained.	Intense: Many weapons in action and air full of tracers. Moderate: Six to 20 weapons firing at once. Meager: Few dispersed weapons, less than 6 firing at once.
Machine Guns (7.7mm to 13.2mm)	Same as AW	Same as AW
Small Arms (individual weapon in hands of troops)	Accurate: Hits obtained. Inaccurate: No hits obtained.	Intense: Many weapons firing at once. Moderate: Up to 20 weapons firing at once. Meager: Few dispersed weapons firing at once.

3. Description of Heavy Antiaircraft Guns and Fire Control Equipment

Because of the characteristics of operations of this Command, antiaircraft opposition will normally consist of fire from heavy antiaircraft artillery, that is, weapons of 75mm or greater caliber. Refer to Figure 1, "Tabulation of Japanese Antiaircraft Artillery Guns"; and to Figure 2, "Graphical Summary". These weapons are not as mobile as automatic weapons for they require more time to emplace in preparation for fire. Although the Japanese have the 75mm M88 and M11 and the 105mm M14 which are tractor drawn and considered mobile, it might be said the majority of guns or heavy antiaircraft weapons are used in a semi-mobile or static sense. These weapons fire a heavier shell ranging from 12.7 pounds for the 75mm (3"/40 caliber) to 50.6 pounds for the 127mm (5"/40 caliber) Type 89 dual purpose gun, and have a corresponding decrease in the maximum rates of fire of from 25 rounds per minute for the 75mm M88

JAPANESE ANTIAIRCRAFT ARTILLERY GUNS

Source: Information Intelligence Summary, No. 44-21, 10 July 1944, p.6, "JAPANESE ANTIAIRCRAFT WEAPONS."

Key **	Caliber	Type	Muzzle Velocity, FPS	Weight Projectile, LBS	Rate of Fire, RPM		Maximum Fuze Range-ft.	Effective ceiling in feet
					Max	Pract.		
4.	75 mm.	Model 88 (1928) Mobile Gun, T.D.	2360	14.3	25	15	30000	22500
7.	75 mm.	Model 11 (1922) Mobile Gun, T.D.	2000	14.5	20	12	20000	15000
5.	3"/40	Model 10 (1921) Dual Purpose Naval Gun	2240	12.7	20	12	26000	18000
2.	105 mm.	Model 14 (1925) Heaviest Mobile Gun, Tractor Drawn	2300 2450?	35.2	15	10	36000	24000
*	120 mm. 4.7"/50	Dual Purpose Naval Gun	2600	45	15	10		25000
1.	127 mm. 5"/50	Dual Purpose Naval Gun	2900	63			41000	33000
3.	127 mm. 5"/40	Type 89 Dual Purpose Naval Gun, Twin Mount Director Controlled, Electrically Operated	2370	50.6	16	8 per bbl	33000	25000

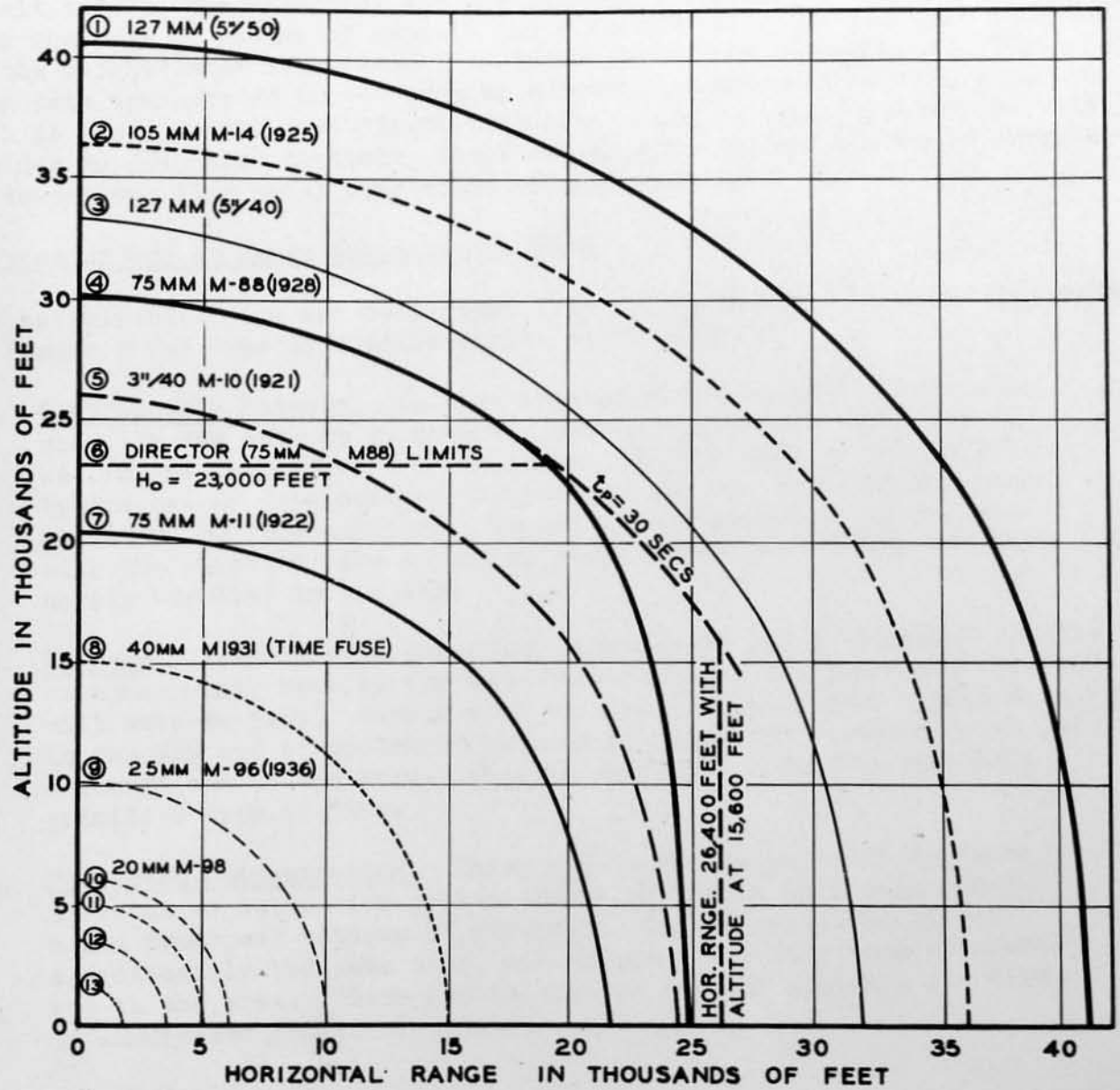
* Not shown on curve, "Approximate fire envelope, Japanese Antiaircraft Guns."

** Key to fire envelope shown in Figure 2.

RESTRICTED

APPROXIMATE FIRE ENVELOPES - JAPANESE ANTI-AIRCRAFT GUNS

BASED ON INFORMATION RECEIVED UP TO AUGUST 1944



⑪ 13.2 MM M-93 (1933) AND 12.7 MM M-90 (1930) MACHINE GUNS; ⑫ 7.7 MM MACHINE GUNS M99 (1939) HOTCHKISS TYPE AND M-92 (1932); ⑬ 6.5 MM MACHINE GUNS - NO TRACER OR A/A SIGHT. PREPARED BY: ANTIAIRCRAFT OFFICER, OPERATIONAL INTELLIGENCE, INTELLIGENCE SECTION, HQS. XX BOMBER COMMAND.

RESTRICTED

3.06

FIGURE 2

to eight rounds per minute for the 127mm Type 89. No tracer element is used as the shells are equipped with time fuses designed to provide bursts in the air at some predesignated time along the trajectory, the maximum fuse setting generally being 30 seconds.

Heavy antiaircraft guns are designed to offer effective fire against high flying bombers and utilize fire control instruments to determine firing data. These instruments generally consist of a heightfinder which measures and transmits altitude to the director, and the director which by measuring and combining the rate of change of azimuth and elevation with the altitude obtained from the heightfinder translates this information into firing data. This firing data transmitted to the guns as azimuth, quadrant elevation, and fuse length is based on the past flight line of the plane. The Japanese probably use radar to determine altitude, slant range, azimuth, and elevation permitting them to deliver fire under conditions of poor visibility.

4. Types of Gun or Heavy Antiaircraft Fire

Heavy antiaircraft fire can be divided into the following three classifications. (See Figure 3 for type of evasive action to be taken.)

a. Continuously Pointed. In this type of fire gun sites fire individually and attempt to keep the bursts "on target" continuously as long as the aircraft is in range. Firing data is determined by the use of fire control instruments and can be delivered either as "seen" or "unseen" fire. Bursts should appear to move along with the aircraft like a belt of antiaircraft fire being continuously unrolled in the sky.

b. Barrage. In this type the enemy attempts to lay a "curtain" of fire at some point, usually the Bomb Release Line, through which aircraft will have to pass. Bursts will constantly appear over a wide area in the sky and at prolonged periods of time, not necessarily while aircraft are in the area. This is the least effective and most primitive type of fire.

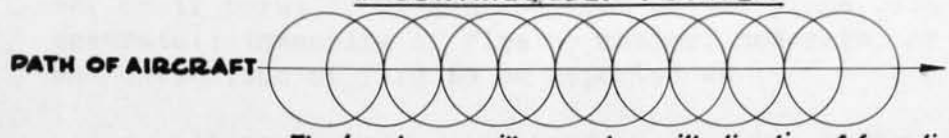
c. Predicted Concentration. This type is basically short barrages directed at successive points in the sky which have been determined from past actions of aircraft. Bursts should appear at approximately the same time, and should occur only when aircraft are in the area. There should also be gaps of distance and time in successive groups of bursts.

5. Interrogation

Because of the long range characteristics of the aircraft assigned to this Command, operations will generally be carried out against enemy territory about which little definite information is available regarding the locations, size, and types of antiaircraft defenses used by the Japanese. Because of the lack of frequent and complete photo cover crew observations and interrogations on antiaircraft fire become more valuable to this Headquarters,

TYPES OF ANTI-AIRCRAFT FIRE
WITH
CORRESPONDING EVASIVE ACTION

1. CONTINUOUSLY POINTED



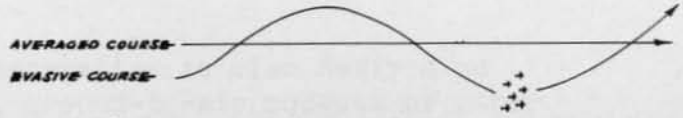
The burst area will move along with direction of formation like a belt of A.A. fire being constantly unrolled in the sky.

THIS IS THE MOST DANGEROUS TYPE OF FLAK, AND IS USED BY A.A. GUNNERS IN PREFERENCE TO PREDICTED CONCENTRATION & BARRAGE TYPES OF FIRE. EACH BATTERY FOLLOWS THE FORMATION INDEPENDENTLY WITH ITS FIRE CONTROL EQUIPMENT (DIRECTOR, HEIGHT FINDER AND RADAR) CONTINUOUSLY TRANSMITTING FUTURE DATA TO THE GUNS. THIS FUTURE DATA IS PREDICTED BY THE DIRECTOR OBSERVING THE PRESENT POSITION, AND THEN FIGURING AHEAD A CERTAIN AMOUNT, BASED ON THE DIRECTION AND SPEED OF THE AIRCRAFT. THIS PREDICTION CAN BE DONE ONLY FOR RECTILINEAR FLIGHT WHICH IS EITHER (1) CONSTANT ALTITUDE, CONSTANT SPEED, & STRAIGHT LINE FLIGHT, OR (2) CONSTANTLY CHANGING ALTITUDE OR (3) FLIGHT ON A CONSTANT CURVE. AS BELOW:

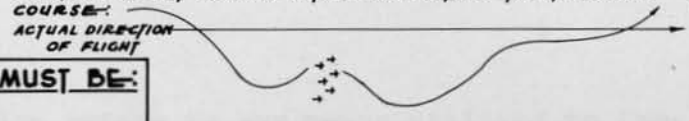
GUNS WILL FIRE CONTINUOUSLY AS LONG AS THE TARGET IS IN RANGE, OR AS LONG AS THE DIRECTOR IS ABLE TO PREDICT FUTURE DATA. BURSTS WILL APPEAR CLOSE TOGETHER BUT NOT NECESSARILY AT THE SAME TIME. WHEN A FORMATION IS UNDER FIRE FROM A LARGE NUMBER OF GUN POSITIONS THE APPEARANCE OF FLAK WILL BE SIMILIAR TO A PREDICTED CONCENTRATION, WITH THE EXCEPTION THAT THE BURSTS WILL MOVE ALONG WITH THE FORMATION. NO GAPS BETWEEN LARGE NUMBERS OF BURSTS.

"SEEN" CONTINUOUSLY POINTED FIRE WILL BE ENCOUNTERED DURING PERIODS OF GOOD VISIBILITY. IT IS MORE ACCURATE THAN "UNSEEN" FIRE WHICH IS DIRECTED BY RADAR DURING TIMES OF CLOUD, DARKNESS, WHEN SEARCHLIGHTS ARE NOT AVAILABLE, OR ANY OTHER TIME THE GROUND DEFENSES ARE UNABLE TO SEE THE FORMATION. CORRECTIONS CAN BE MADE TO "SEEN", BUT NOT TO "UNSEEN" FIRE.

EVASIVE ACTION: IF CAUGHT IN THIS TYPE OF FIRE, MAKE TURNS OF 20 TO 30 DEGREES, CHANGE ALTITUDE AT LEAST 1000 FEET, CONTINUE ON THIS NEW COURSE FOR AT LEAST 30 SECONDS, THEN MAKE ANOTHER TURN, CHANGE OF ALTITUDE, ETC. NEVER TAKE EVASIVE ACTION SUCH THAT THE AVERAGE OF THAT ACTION WILL INDICATE YOUR COURSE, AS:

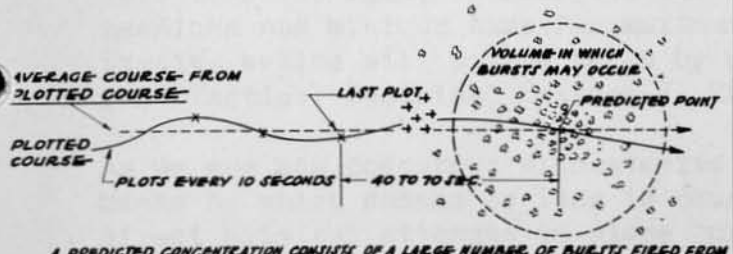


A DIRECTOR WILL BE ABLE TO AVERAGE OUT SUCH CHANGES AND WILL PREDICT ON A STRAIGHT LINE, THE RESULT BEING THE FORMATION IS STILL IN DANGER, DUE TO DISPERSION AND PROBABLE ERROR OF THE BURSTS. CORRECT EVASIVE ACTION SHOULD TAKE THE FOLLOWING COURSE:



EVASIVE ACTION MUST BE:
1. IRREGULAR
2. BOLD
3. PLANNED

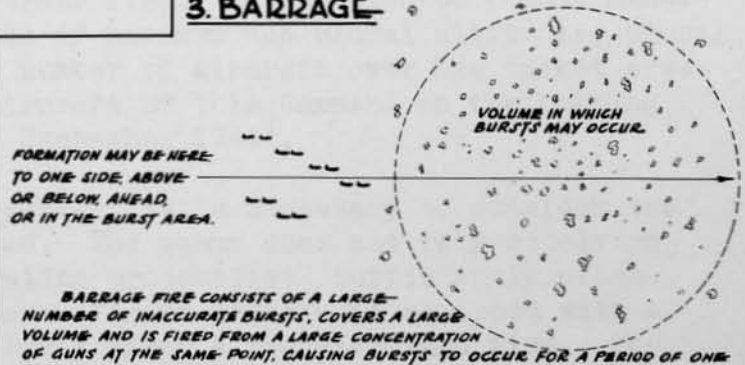
2. PREDICTED CONCENTRATION



A PREDICTED CONCENTRATION CONSISTS OF A LARGE NUMBER OF BURSTS FIRED FROM A LARGE NUMBER OF GUNS AT A FUTURE POINT IN THE SKY. BURSTS APPEAR SIMULTANEOUSLY (WITHIN 2 TO 6 SECONDS) AND NORMALLY ARE ACCURATE, ALTHOUGH THE BURST AREA MAY INCLUDE A FAIRLY LARGE VOLUME. USUALLY USED AGAINST AVENUES OF APPROACHES, DURING NIGHT, OR PERIODS OF POOR VISIBILITY, UNDERCAST, OR WHEN INDIVIDUAL FIRE CONTROL EQUIPMENT AT THE GUN POSITIONS IS NOT FUNCTIONING. IT IS AN EMERGENCY SYSTEM OF FIRE, BASED ON PLOTTING THE PATH OF THE FORMATION AT SOME CENTRAL LOCATION. THE FUTURE POINT DETERMINED FROM THESE PLOTS IS THEN TRANSMITTED TO SEVERAL GUN POSITIONS.

EVASIVE ACTION: IF THIS TYPE OF FIRE IS EXPECTED, MAKE TURNS OF 20 TO 30 DEGREES, CHANGING ALTITUDE AT LEAST 1000 FEET, HOLDING THIS NEW COURSE NOT MORE THAN 50 SECONDS, FOLLOWED BY ANOTHER TURN, LOSS OR GAIN OF ALTITUDE AND SO ON. IF CAUGHT IN THIS TYPE OF FIRE FOLLOW THE ABOVE EVASIVE ACTION IN THE DIRECTION THAT WILL EXPOSE THE AIRCRAFT TO DANGER THE SHORTEST LENGTH OF TIME.

3. BARRAGE



BARRAGE FIRE CONSISTS OF A LARGE NUMBER OF INACCURATE BURSTS, COVERS A LARGE VOLUME AND IS FIRED FROM A LARGE CONCENTRATION OF GUNS AT THE SAME POINT, CAUSING BURSTS TO OCCUR FOR A PERIOD OF ONE TO TWO MINUTES. NORMALLY USED AGAINST AVENUES OF APPROACH, DURING NIGHT, PERIODS OF POOR VISIBILITY, UNDERCAST, OR WHEN INDIVIDUAL FIRE CONTROL EQUIPMENT IS NOT FUNCTIONING. IT IS AN EXTREME EMERGENCY TYPE OF FIRE, QUITE PRIMITIVE, BUT DANGEROUS IF A FORMATION IS FORCED TO FLY THROUGH IT.

EVASIVE ACTION: IF CAUGHT IN BARRAGE FIRE TAKE NO EVASIVE ACTION. THIS WOULD ONLY INCREASE THE TIME EXPOSED. IF BARRAGE FIRE APPEARS AHEAD, EITHER GO ABOVE, BELOW, TO ONE SIDE, OR TURN BACK. IF THIS IS NOT POSSIBLE TAKE THE SHORTEST ROUTE THROUGH THE BURSTS, EXPOSING THE AIRCRAFT FOR THE SHORTEST LENGTH OF TIME.

Prepared by: A.A. OFFICER, XX BOMBER COMMAND

FIGURE 3

higher headquarters, and other units.

Information desired through crew observations concerning the various phases of enemy antiaircraft opposition consists of the following:

a. Heavy Antiaircraft Fire. Locations and geographical coordinates where fire was encountered; time and duration of encounter; altitude; extent of undercast, CAVU to 10/10's; color of bursts; accuracy of fire (considered accurate if plane is struck, rocked, or if burst is within 150 feet of the plane, otherwise inaccurate); intensity of fire as meager, moderate, or intense; and deviations of fire to be reported as

Above	Ahead	Left
Level	Abreast	In Line
Below	Behind	Right

Types of fire encountered as continuously pointed, predicted concentration, or barrage; evasive action taken, the reasons, and results; and information of any enemy aircraft on the same course and altitude as your plane which may have been reporting data to antiaircraft installations; are types of information desired.

b. Other Antiaircraft Defenses. Information is also desired on automatic weapons, searchlights, ground-to-air rockets or other new ground weapons the enemy may be using, smokescreens, barrage balloons, and the efficiency of black-outs.

6. Evasive Action

Evasive action as used in this discussion refers to any means utilized to lower the effectiveness of enemy antiaircraft fire. In addition to combat maneuvers to evade flak, it includes the use of maximum and plural altitudes, plural headings and minimum time for maximum number of aircraft over the target area. Evasive action will not be taken by aircraft of this Command on the bombing run (Tactical Doctrine, Section V, 22 September 1944).

As we are now concerned with evasive action, it is necessary to consider the means by which damage or loss is caused. The enemy does not rely solely on direct hits but attempts to place bursting projectiles sufficiently close to the aircraft to cause damage or loss. The projectile is equipped with a time fuse element which causes it to burst after a predetermined time. The chances of a shell hitting an aircraft and bursting at the same instant being almost negligible. Damage is normally caused by the fragments of the shell and ammunition is designed so that it breaks up into many very small fragments and a small number of rather large fragments. These fragments travel outward and upward at considerable velocity near the burst point, but are quickly slowed by air resistance, and the force of gravity.

The bursting characteristics of Japanese antiaircraft ammunition is not known, although it is possible they are similar to German and Allied ammunition. The German 88mm. shell breaks up into a large number of fragments, about 1500 of them each weighing more than 1/50th of an ounce, and about a dozen each

weighing more than one ounce. These fragments leave the bursting shell at an average velocity of 2750 feet per second which is in addition to the velocity the shell has just prior to bursting. If an aircraft is hit by fragments that have force enough to pass through the skin, the aircraft is likely to have approximately 40 holes when the shell bursts 200 feet away and approximately five holes when the shell bursts about 400 feet away. When an aircraft receives a single fragment hole the shell most probably burst at a distance of about 600 feet.

7. Value of Evasive Action

From a study of the opposition that the Japanese antiaircraft gunner has offered, it appears that his fire is generally erratic, inaccurate, and of less intensity than would be expected from his known concentration of guns. Since evasive action is of value only when antiaircraft fire is accurate and concentrated in a relatively small volume, evasive action taken by individual aircraft or formations of aircraft on the spur of the moment is of little value against the inaccurate and sparese fire that has so far been encountered. Evasive action to achieve maximum value must be deliberately planned before any fire is encountered.

8. Recommended Evasive Action Against Heavy Antiaircraft Guns

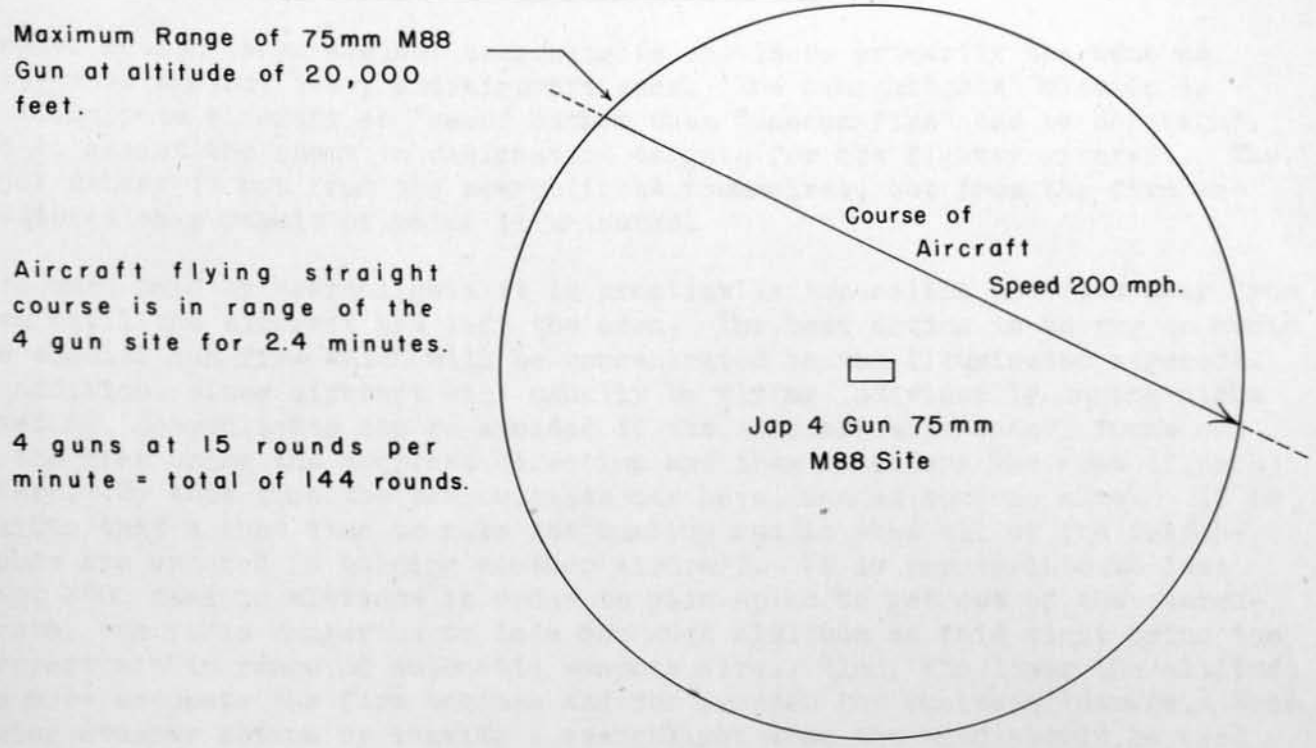
So far it appears that the enemy is using two main types of fire, (1) Barrage (or a modification of barrage known as predicted concentration) and, (2) continuously pointed.

Because of the prevailing inaccuracy of Japanese heavy antiaircraft fire at altitudes of 20,000 to 28,000 feet, violent action taken to evade a large number of inaccurate bursts over a wide area in the sky is of little value. Evasive action taken under these conditions only exposes the aircraft and crew to danger for a longer period of time as illustrated in Figure 4. However, if accurate and compact groups of bursts believed continuously pointed and definitely directed against an aircraft or a formation are encountered or expected (not during the bomb run), evasive action should be taken if at all possible. This action should consist of a turn of one degree per second and a change of altitude at the rate of 500 feet per minute when in formation, or, when not in formation, of a turn at the rate of two degrees per second coupled with an altitude change at a rate of 1000 feet per minute. The locations of bursts should determine whether a dive or climb is to be followed.

These initial combat maneuvers should be followed by subsequent changes in altitude and course that are IRREGULAR, BOLD, AND PLANNED. The maximum length of time any one turn or change of altitude is maintained can be determined by the rule: time in seconds equals altitude in thousands of feet. For example, an evasive course would be held for not more than 30 seconds at 30,000 feet.

When a barrage or predicted concentration type of fire is encountered, the fire volume should be avoided if possible by going around it.

STRAIGHT AND LEVEL COURSE



EVASIVE COURSE

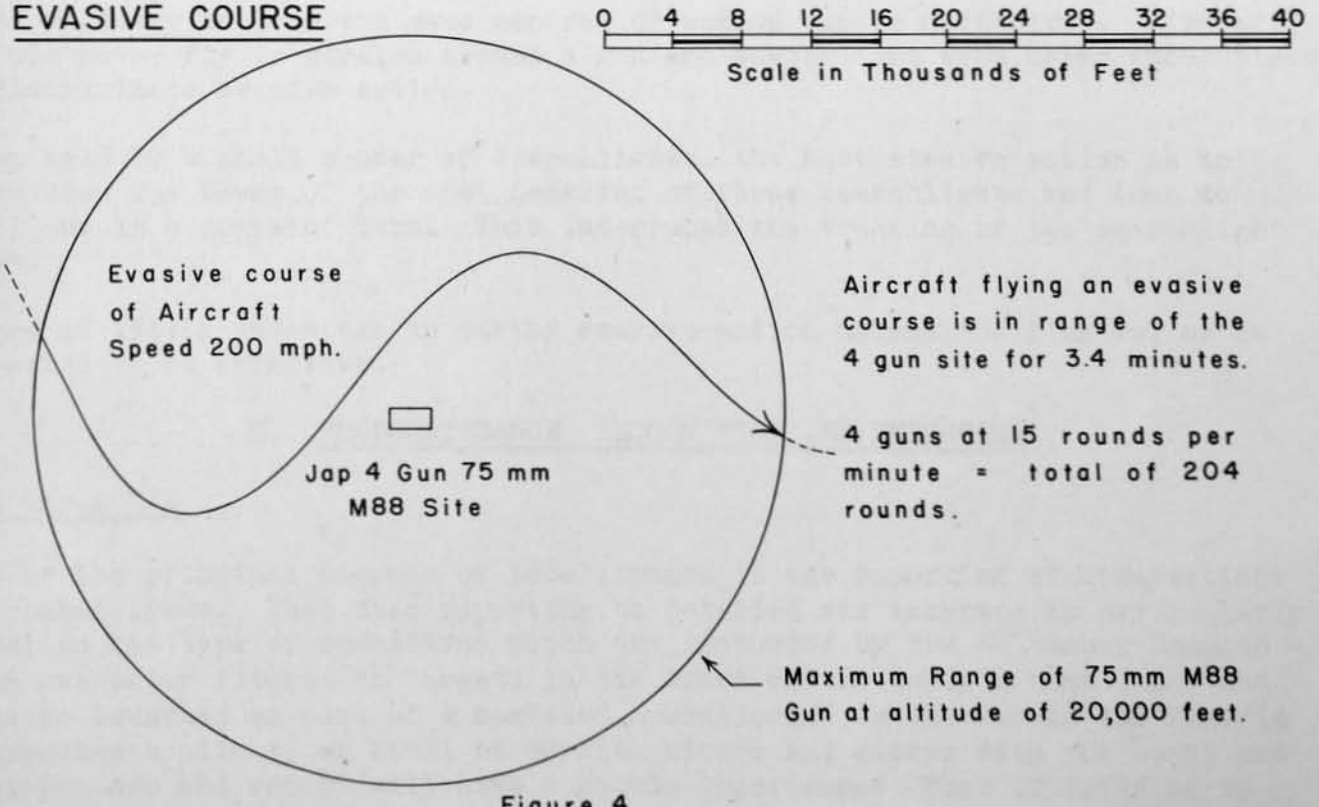


Figure 4

Increase in Number of Rounds Fired when Evasive Course is followed

Evasive action taken at the target during the bomb run will not consist of combat maneuvers, but rather of those planned maximum and plural altitudes, plural headings, and minimum time for the maximum number of aircraft over the target area.

9. Recommended Evasive Action Against Searchlights

Evasive action taken against searchlights should be primarily the same as that taken against heavy antiaircraft guns. The searchlights' mission is to illuminate aircraft so "seen" rather than "unseen fire" can be delivered, and to assist the enemy in designating targets for his fighter aircraft. The major danger is not from the searchlights themselves, but from the fire encountered as a result of being illuminated.

When once held by searchlights it is practically impossible to break away from them until the aircraft has left the area. The best action is to try to avoid the ensuing gun fire which will be concentrated on the illuminated aircraft. In addition, since aircraft will usually be flying individually during night missions, searchlights can be avoided if the aircraft when coned, turns out of the area using the shortest direction and then re-enters the area if necessary. By this time the searchlights may have engaged someone else. It is obvious that a good time to make the bombing run is when all of the searchlights are engaged in holding another aircraft. It is permissible to lose about 2000 feet in altitude in order to gain speed to get out of the searchlights, but it is dangerous to lose too much altitude as this might bring the aircraft within range of automatic weapons fire. Also, the lower the altitude, the more accurate the fire becomes and the greater the chance of damage. When taking evasive action by leaving a searchlight area the wind should be used to increase the ground speed, and a fix made on some star or constellation so that whatever happens the same general direction can be maintained. Aircraft should never fly in circles around a gun and searchlight area using thoughtless indiscriminate evasive action.

When held by a small number of searchlights, the best evasive action is to dive down the beams of the most menacing of these searchlights and then to pull out in a downwind turn. This interrupts the tracking of the searchlight crew.

There is little advantage in taking evasive action unless the flak is, or is expected to be effective.

H. RECONNAISSANCE, RECOGNITION AND REPORTING

The Three R's

One of the principal sources of intelligence is the reporting of observations by combat crews. That this reporting be detailed and accurate is particularly vital to the type of operations which are conducted by the XX Bomber Command - long overwater flights to targets in the heart of the enemy's home land, and attacks launched as part of a combined operations. As the war in the Pacific approaches a climax, we shall be working closer and closer with the Navy, and what you see and report will have a double importance: That of building up

a strategic picture regarding the enemy, and of influencing immediate tactical operations by the Navy and/or other cooperating air forces, such as the 14th AF. For these reasons Reconnaissance (looking for something of importance), Recognition (knowing what you are looking at) and Reporting (telling accurately what you have seen and where and when you saw it) are so closely associated that they must be thought of together.

To give you actual examples of what has happened in connection with the "three R's", read the following stories:

a. After the first Yawata daylight mission, good use of the three R's resulted in heavy destruction of Japanese shipping by U.S. Navy submarines as per the following radio from our Naval Liaison Officer, "Field day enjoyed by our gals (submarines) as result of accurate reporting by your crews of Jap vessels."

b. On a recent mission one of our crew reported 80-100 twin engine aircraft on a Japanese field at Nanchang. An urgent radio was sent to General Chennault with this hot news, and the following morning he dispatched a strafing mission against this enemy base. We received the following radio that evening "No enemy aircraft found at Nanchang on our raid today" -- the crew had mistaken revetments for twin engine aircraft.

c. On another mission recently we reported a sighting of six destroyers, which, from later pictures, turned out to be P.T. boats.

We build up our order of battle information from the reports of the types of aircraft you encounter, and we identify new operational types for the first time from what you tell us. This may have a vital effect on our planning as well as that of other forces attacking Japan. We correct our notoriously inaccurate maps from what you tell us. Rivers change their courses, and the height of many mountains are incorrectly charted. What you tell us about Jap performance and aerial tactics may have a good deal of bearing on the size and type of formations to be flown by our own Command and other B-29 combat units. We learn about the locations of airfields, friendly and enemy, from your observations.

Practice looking--there's an art to it; know everything there is to know about friendly and enemy aircraft and naval vessels. Get in the habit of jotting down yourself what you've seen, or calling the navigator on the inter-phone; remember that accuracy is vital. And when you're telling your story to your S-2 don't exagerate - be accurate! It doesn't do us any good to have you tell of 50 Japs in the target area when only 30 were really there, but it does help enormously if we can really <u>know</u> exactly what the enemy throws at us.

I. JUNGLE SURVIVAL

In order to attack the Japanese from India bases, you first will have to fly over both jungle and ocean. Because of the possibility someday something might happen to force you down in the jungle of the "Hump" area, a few pertinent points regarding jungle survival are included here. "Survival" is a broad topic, and it is impossible to cover more than the high spots in this manual. Numerous booklets on this subject are available to you in your intelligence office, and your own life may well depend on the care with which you study them.

1. Equipment.

The greatest boon to jungle survival is proper clothing and equipment. All necessary clothing and equipment is furnished for your use, but it is up to you to see you posses all of it prior to starting on a mission. The most important single item of survival equipment is your parachute kit. You will also be issued an E-3 kit, a handy plastic container which fits into your pocket and includes a chocolate bar, compass, matches, gum, halazone tablets for purifying water, benzedrine tablets for helping you to remain awake during an emergency, and several other valuable items. Also a money belt containing silk maps covering the area over which you fly, money, and a blood chit will be issued to you. In addition, you'll have a "Pointie-Talkie", which is a booklet that will allow you to make yourself understood to literate Chinese or jungle natives. Before you leave on a mission, it is imperative you have your gun belt, with trench knife, .45 automatic, bandage and full canteen attached. Although your parachute kit contains a plastic water bottle, it is no substitute for a real canteen, and although a man who has walked out of the jungle will remark that his .45 was the least useful of all his equipment while in the jungle, he will also recall no doubt that it was a great morale factor. A vest has been designed to carry all items not carried in the parachute pack. Some vests are available now; a new one, less bulky, is in the process of manufacture.

By far the most important item of clothing to consider is your shoes. GI shoes are a must, for you will probably lose any other type of shoes when your chute jerks open. If by pure good fortune they stay on, they will not withstand the rough treatment given them in walking over rugged, moist jungle soil. Wool socks should be worn, and several extra pair stuffed in your parachute pack. When in the jungle, socks should be washed and changed daily, for care of the feet is paramount. Prior to bailing out, it's also well to tuck a GI fatigue cap or peaked flying cap into your pocket, for otherwise you will not have one upon reaching the ground.

2. The Jump.

When the signal is given to jump, it is essential all crew members jump in as rapid succession as possible, preferably while the plane is flying in a circle, so all will land as close together as possible. In the jungle, even a quarter of a mile is a considerable distance to cover in order to assemble. During your descent in your chute, try to spot any trails or a village below, so you can head toward them after landing. Trails are often found along the

tops of ridges, and can easily be seen from the air. If on landing, you are suspended in a tree, look below before you release your parachute pack, so you do not drop it where its recovery is impossible. You may not be able to recover much of your parachute if it is strung up in a tree, but always try to get as much as possible loose, including the shroud lines, before cutting yourself free. Once down, it may prove difficult to climb up to get your chute which will prove invaluable in many ways serving as a tent, hammock, bandage, tourniquet, protection against leeches, or a means of barter!

3. On the Ground.

The first thing to do after landing, is to pause to rest and collect your senses. Try to join forces with the others who jumped. You will find your voice does not carry far in the jungle, but in order to let others know where you are, try beating with a heavy stick, on a tree or a piece of bamboo which has a slot down the side. Both methods will make a sound that will carry a long distance.

Never attempt to blindly cut across the jungle on a direct compass course. If you do, you will soon find you have tired yourself out and have made practically no progress. Instead, try to locate a trail and follow it. All man-made trails lead to villages. Animal trails usually lead to a stream, which if followed will usually lead to habitation or at least to a larger stream that leads to a village. It is best to follow streams "downstream". Do as little hacking at the vegetation as is absolutely necessary, for swinging a machete is an endless and tiring task. Many times, vegetation need simply be parted to allow passage.

4. The Natives.

Although many stories have been told about the wildness of the native inhabitants of the "Hump" area, we have a great deal of evidence to support our claim that these natives will give you every help, and guide you back to safety. Native tribesmen in the "Hump" consist mostly of Nagas, Kachins and Chins. Especially now that the Japs have been driven out of North Burma and they need no longer fear reprisals from the Japs, the natives are eager to aid downed flyers because of the reward they receive for a flyer's safe return. The ATC, 10th Air Force and numerous other organizations long have been operating over the "Hump", and have enlightened a great many natives concerning white men. Therefore, natives in the "Hump" area may be trusted, but this does not include those natives further south, close to Jap lines and influence. However, it is important to remember to respect native traditions. Natives are essentially children; their feelings are easily hurt. Never use violence unless in self-defense, and stay away from their women and temples. Because of the nasty habit some tribes have of stringing cords across a trail, which act as triggers for poisoned arrows, or digging pits for traps along a trail, never approach a village at night. Always make camp before dusk.

5. Water.

Water is the least of your worries in the "Hump". Streams abound in the hills and springs dot the mountains. Bamboo and thick, overhanging vines are a

source of water; but vines which excrete a heavy, milky sap are to be avoided. Always fill your canteen when the opportunity presents itself, and to make sure it is pure, add two halazone tablets.

6. Food.

Food, too, is plentiful in the jungle, although to the uninitiated, it may be difficult to recognize. In general, it is best to avoid fruits of bright color, those which contain a milky sap, or taste bitter. All others are safe. Bamboo shoots found near clumps of bamboo are not only very nutritious but very tasty when cooked. The taro is an edible root found at the base of a vine resembling a morning glory. When baked, it tastes like a sweet potato. All native villages have small vegetable gardens from which you will be fed. Always cook your food. A section of bamboo makes an excellent container in which to cook food, or carry it. Monkeys are plentiful in the jungle and are tasty and easily caught. If you see a monkey eating something, you will realize it's safe for you. Anything which is freshly killed is safe to eat. It may not be tasty, but it will sustain life, and that includes even grubs and ants.

7. Signaling.

Your parachute kit contains a signal mirror. By its use you can attract the attention of passing aircraft, of which there are many flying the "Hump". You will also have signal panels, and instructions on how to use them. There is a very efficient rescue unit operating in the "Hump", which has rescued large numbers of men who were forced down. This has largely been possible because of sightings made of signals from the ground.

8. Jungle Enemies.

No man downed in the jungle need fear wild animals. They will avoid you if you don't bother them, and the chance of being bitten by a poisonous snake is practically negligible. Your worst enemy in the jungle will be malaria. Protect yourself as much as possible from mosquitoes at night, and take atabrine regularly.

9. Hints.

One final word of advice. To the uninitiated, the Burma jungle is a formidable place, and the thought of spending several weeks in it, perhaps alone, is apt to be terrifying. Actually, the chance of coming out alive after going down in the jungle is almost 100%. Many men have lived for months, by themselves or by the aid of natives, in the jungle and came out none the worse for their experiences. The more you learn about the jungle, the greater your chances for survival therein. Knowledge engenders confidence, and confidence will prevent succumbing to fatal demoralization. Paramount rules to follow when down in the jungle are: DONT RUSH ... THINK THINGS OUT BEFORE ACTING ... DONT FEAR THE JUNGLE.

10. Medical Advice.

a. When bones are broken.

(1) Never move the person unless absolutely necessary.
(2) Immobilize by splint the broken bone.
(3) Give one tube of morphine for pain or weakness. To administer, pinch up the skin and push the needle in hard all the way at a 45 degree angle. Repeat every six or eight hours for pain.

b. When bleeding.

(1) Use sterile dressing or cleanest material and apply pressure at the site of bleeding.
(2) Use tourniquet above bleeding. Release every 20 minutes for 20 seconds.
(3) Keep the head level or lower than hips and give as much fluid as possible. Tea is good. NO ALCOHOL.
(4) Give morphine once if the person is weak or very apprehensive.

c. When burned.

(1) Keep burned area clean.
(2) Apply Gentian Violet Ointment or any other burn ointment. Cover with sterile dressing or cleanest available cloth.
(3) Give one tube of morphine for pain or weakness. Repeat every six or eight hours for pain.
(4) Give as much fluid as possible. NO ALCOHOL.

d. When bitten by snakes.

(1) Never run. Be as quiet as possible. Cause free bleeding. If you have no cuts in your mouth, try to suck the poison from the wound.

e. When to use sulfa drugs.

(1) If a broken bone is sticking through the skin.
(2) If a person is badly burned.
(3) If there is a bad cut.
(4) If you are having frequent or bloody bowel movements. DETAILED DIRECTIONS AND DOSAGES ARE ON EACH PACKAGE OF SULFA DRUGS.

J. OCEAN SURVIVAL

1. General.

If you have been forced down at sea and are afloat in a raft, the following information will prove of value. Once aboard the raft you are comparatively safe for the time being. If the distress procedure has been properly

carried out, especially the radio procedure, you can expect help within a comparatively short time. This may depend, of course, on the place of ditching. In any event, a distressed crew can be assured a search will be instituted and every effort made to discover and to rescue them.

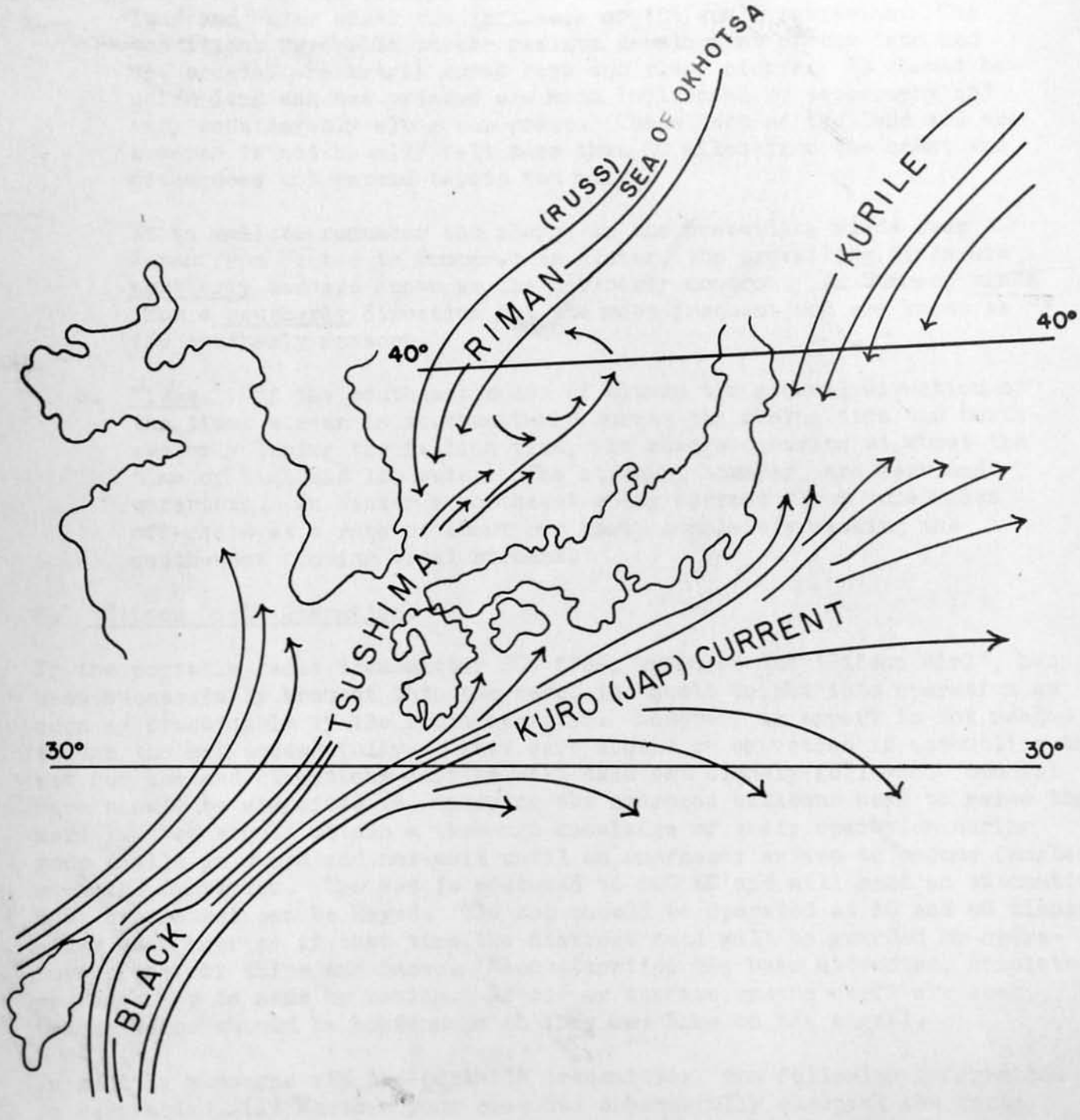
Meanwhile, you must continue to help yourself. Every effort must be made to relay your situation and position to land bases or nearby ships by portable radio. In addition, you must be ready to help search planes and craft by signaling with the various means provided. It is also important that the available food and water be rationed, morale be maintained, and exposure prevented.

2. Ocean Navigation.

It is desirable, of course, to reach land when possible; however, if the ditching has been near enemy territory and the sail can be used, a course should be set for a friendly base, otherwise, use the sea anchor provided to prevent drifting in an adverse direction. If the proper instruments and charts have been brought from the plane, it may be possible to navigate successfully for long distances in the proper direction. Assuming though, the proper equipment is not brought from the plane to the raft or the navigator is not capable of navigating, to pursue a general course four factors must be considered: First, location of ditching; second, the rate of speed of the ocean current; third, the winds; and fourth the tides.

a. Currents. The current which runs from along the south and southeastern coasts of Formosa to South Kyushu is called the Kuroshio current, and during August has a flow of from five to sixty miles a day. That branch of the Kuroshi current flowing along the south coast of Japan and often running to the southeast coast of Kyushu attains rates of from 60 to 100 miles a day during the month of August. This branch runs predominately north eastwardly to latitude 40 degrees north at all times of the year, but southerly currents may be experienced within the main body of the current. The width of the Kuroshio between Formosa and the Ryuku Archipelago is about 100 miles. However, in the latitude of 30 degrees north it broadens to approximately 500 miles during the Summer. The Kuroshio current is usually five to fifteen degrees warmer than the waters bounding it on either side, with a bit higher differential as it nears the coast of Japan. In August, the water is about two degrees cooler than the air.

b. Winds. At Kyushu, in the Summer, the prevailing winds are normally from the southeast and south during the hours from midnight to 1000, and from the south and west-southwest from noon until 2200 hours. However, at Kumamoto during the Summer there is a tendency for northerly winds in the morning, and for southwesterly winds in the afternoon. Near the coast the wind is influenced by the land and sea breezes and often the actual wind experienced is not that expected from the general pressure gradient existing. It should be remembered that during the day time under suitable conditions, a sea breeze tends to blow on shore. This breeze increases during


(RUSS) SEA OF OKHOTSA
RIMAN
KURILE
40°
40°
TSUSHIMA
KURO (JAP) CURRENT
30°
30°
BLACK

the forenoon gradually reaching its maximum development in the afternoon usually from about 1500 to 1700 hours, but sometimes it breaks as early as 1400. This breeze decreases during the evening.

The land and sea breezes are caused by the unequal heating of the land and water under the influence of the sun's radiation. The conditions favorable to the maximum development of the land and sea breezes are bright sunny days and clear nights. It should be noted land and sea breezes are much influenced by topography and vary considerably along the coast. The effect of the land and sea breezes is not usually felt more than 20 miles from the coast and often does not extend beyond ten miles.

It is well to remember the change in the prevailing winds over Japan from Winter to Summer. In Winter, the prevailing winds are northerly and are known as the northerly monsoon. In Summer, winds from a southerly direction are the most frequent and are known as the southerly monsoon.

c. Tides. Off the southeast coast of Kyushu the general direction of the tidal stream is southwesterly during the rising tide and northeasterly during the falling tide, the change occuring at about the time of high and low water. The streams, however, are weak and uncertain. In Winter a northeast going current flows some miles off-shore at a rate of about one knot, completely masking the south-west flowing tidal streams.

3. "Gibson Girl" Operation.

If the portable radio transmitter SCR 578A, known as the "Gibson Girl", has been successfully brought into the raft, it should be put into operation as soon as practicable by the radio operator. However, an expert is not needed to use the set successfully. Great care should be exercised in assembling the set for use and directions carried with each set closely followed. Special care should be exercised in employing the hydrogen balloons used to raise the aerial. You should obtain a thorough knowledge of their operation during your drills on shore and not wait until an emergency arises to become familiar with the operation. The set is pretuned to 500 KC and will send an automatic SOS, or the set can be keyed. The set should be operated at 15 and 45 minutes after each hour as at that time the distress band will be guarded by operators of nearby ships and bases. When attention has been attracted, complete messages may be sent by keying. If air or surface rescue craft are seen, transmission should be continuous so they may home on the signal.

In sending messages via the portable transmitter, the following information is desirable: (1) Whether your crew has successfully occupied the rafts, and their condition; (2) the time and place of ditching; (3) whether search planes or boats have been seen and if so at what bearing, distance and time; and (4) the position of the raft if known with time, rate, and direction if sailing.

4. Signal Aids.

Under some weather conditions it is difficult for a raft to be seen from the air or from the bridge of surface craft. When a friendly plane or boat is sighted you and your crew must make every effort to attract attention. At the same time, it is important to escape the attention of enemy craft. For this, the yellow and blue tarpaulins provided with life rafts can be used to advantage. The yellow side readily can be seen from the air when carried either as a sail or spread over the rafts. If an approaching plane or boat is enemy, the blue side should be turned up making the raft harder to spot. It is, admittedly, hard to distinguish approaching planes or boats but a sharp lookout should be maintained so the appropriate side of the paulins can be turned up even at the last minute.

The flourescent seamarker in your emergency equipment provides a means for staining the water and is visible for several miles. If carefully spread on the surface and not used indiscriminately the stain will last longer.

The whistles provided are a valuable means of attracting attention and should be kept readily accessible. Short, sharp blasts are best. The very pistol of great value, especially at night, can be used only if you keep the cartridges dry. Don't waste them but wait until a plane or boat is heard or sighted.

5. Exposure.

Every means of preventing exposure should be employed. In the case of high seas, the tarpaulins should be rigged to keep water out of the raft. The bailing bucket should be used constantly if the raft is shipping water and efforts made to keep dry. In the case of cold wind or rain, the tarpaulins can be used for protection. It is advisable to stay out of the water unless absolutely necessary. In northern climates where cold and wind add to the dangers of hunger and thirst, wetting by salt water will greatly add to your rigors. In southern climate, dips in the sea present a danger from attacks by sharks and greatly add to sunburn which can be extremely dangerous in tropical or subtropical areas. You should keep yourself covered when possible.

6. Exercise.

Some exercise is desirable and can be taken in the cramped quarters of the life raft. It will improve circulation and relieve strain and fatigue from remaining for long periods in cramped quarters. The main aim of exercise is movement at frequent intervals. The joints on the extremities of the body should be exercised first, then the shoulders and hips. The exercises should be performed slowly, one contraction and subsequent relaxation taking approximately six seconds. Breathing exercises are not recommended because they cause undue strain and increase hunger and thirst. The airplane commander should ensure exercises are being taken before intense cold or stiffness sets in. Small doses of exercise at fairly frequent intervals has been found best. The effects of sailing or fishing will assist in the question of exercise.

7. Rationing.

As soon as you are aboard the raft or rafts, the airplane commander should take careful stock of the amount of food and water on hand and make plans for rationing. The amount and plan of rationing may depend on many factors such as the distance from land, the possibility of quick or delayed rescue, weather conditions, condition of crew, etc. The airplane commander, or elected leader if the airplane commander is unable to perform the duties, should carefully calculate the possibilities and time of rescue and make his rationing accordingly.

For the preservation of life, water is more valuable than food. It is of greatest importance for drinking water available in the plane to reach the raft and for care to be taken to avoid its loss. Remember fish can supplement the supply of both food and water. If a long stay in the raft is even probable fishing operations should be started soon, but be sure all objects captured from the raft - fish, foul, or seaweed - are equitably distributed. The capture of rain water is highly important and no opportunity should be lost to augment the supply of drinking water. Under no circumstances should sea water be taken internally.

8. Morale.

If the crew is kept busy during waking hours exercising, fishing, taking rations at regular intervals and keeping close watch, morale will maintain itself. After a few days however, nerves begin to fray and it is then the good example of each man will aid the behavior of his fellow. The need for food and drink will increase, but the rationing plan must be adhered to. The effect of continually having something to do is most favorable and the airplane commander should make every effort to see all hands are employed by delegating certain duties to each. Also, when two or three life rafts are tied together with a fairly short rope, crew members can be of mutual assistance and a higher morale maintained. Too, the job of search craft will be facilitated. Don't let the raft without the portable radio drift out of sight! Remember crews have been rescued from the cold North Sea after as long as fourteen days and from the Mediterranean after eleven days. In the South Pacific, some American crews have made sensational records, one having survived thirty-four days adrift. By keeping up morale, carefully rationing supplies and adding to them when possible, by avoiding exposure as much as possible and by meeting situations as they arise, the crew of a plane down at sea can keep itself alive indefinitely and stand every chance of rescue.

K. AIR SEA RESCUE

It is the policy of this Command to provide the fullest and best air-sea rescue arrangements possible for every over water mission. Both surface vessels and/or submarines and/or patrol aircraft will be utilized depending upon the mission track. Full information as to location, code names, radio frequencies and call signs of all rescue craft will be given at the final briefing. Both the U.S. and British Navies as well as the RAF have been most cooperative to date, and as our sea and land forces move closer to the Japanese inner zone, even more rescue craft will become available. There will always be certain areas in which no surface craft or submarines can operate due to enemy mine fields or shallow water.

1. Standard Operating Procedure.

A SOP has been set up for air-sea rescue in conjunction with U. S. submarines, and every crew member should be thoroughly familiar with the procedure which follows:

a. Submarines will guard and transmit on 4475 KC and will also monitor 500 KC. Crews will use the following procedure in case of distress:

(1) Contact the nearest submarine on 4475 KC (voice) in plain language giving the distress call, and try to ditch near the submarine.

(2) If unable to ditch in the immediate vicinity of the submarine, the aircraft will on 4475 KC (voice) in plain language give the following:

(a) Number of miles from the predetermined and assigned geographical reference point.
(b) Code name of the submarines.
(c) True bearing of the plane from the reference point using three numerals.
(d) Example: Fifteen (15) miles Lulu Lady Two Four Zero (240). The Flight reference point will be a geographical position, preferably a point on land, as designated by XX Bomber Command in original request for lifeguard submarines.

b. While the submarines will be requested to operate at definite coordinates, for security reasons in the plain language broadcasts from the aircraft to the submarine, position must be described as bearing and distance from the specifically assigned geographical position rather than from the submarine.

c. Unless under enemy attack the submarines will remain surfaced at all times during the mission so they may be used for navigational check points and for quick sighting in case of distress. For homing purposes the submarines will turn their IFF on after our ETA over the primary target. Submarines will remain at their stations until released by XX Bomber Command thru the Naval Liaison Officer.

d. Aircraft orbitting survivors on the water should if possible orbit or "zoom" the spot, perpendicularly to the approach course of the submarine.

e. The submarine should notify the orbitting plane as soon as the survivor or survivors are sighted, so that orbitting plane may depart.

f. The aircraft desiring a submarine to follow him toward a survivor should circle the submarine twice and then fly off toward the survivor.

g. Because of low "height of eye" of submarines, sea markers dropped by planes are hard to detect. Do not use markers unless it becomes necessary for the orbitting plane to depart, and then use smoke if possible.

h. If the survivor is in a position which, due to the proximity of enemy shore batteries, or, due to strafing by enemy planes, prevents the submarine from approaching on the surface, the submarine will attempt to pick up survivors by approaching submerged and using the following method tow the raft with its periscope to a position where the submarine can surface.

(1) Approach will be made from upwind. In early stages, when the periscope is first sighted, survivors should attempt to hold position to assist the approach of the submarine. If there is danger of a miss, survivor should attempt to get in position ahead of the direction of movement of the periscope. Remember a submarine cannot back when submerged, so if you miss the periscope the submarine will have to make another complete circle which will take considerable time.

i. Submarines on search at night will fire one green very star at frequent intervals. The reply from our life rafts or aircraft in the water will be one red very star. When the submarine sees our red very star, they will acknowledge with two green very stars.

j. All B-29 crews are instructed to report immediately the position and time of any ditching, so base Headquarters can rebroadcast to submarines this information.

L. ESCAPE & EVASION

1. General.

As a crew member serving in a combat theater, you will frequently be flying over enemy territory. Consequently, it is imperative that you be familiar with the subject of Escape and Evasion.

First, you must remember all information given to you during briefings concerning this subject is SECRET, and must be guarded as such. There are organizations in the field whose job is to help escapers and evaders. These organizations have been functioning with success since the war began, and thousands of men have been successfully recovered from enemy territory. The continued success of these organizations depends on the security mindedness of all combat crew members. Should the enemy learn who they are and how they operate, not only will their continued operations be jeopardized, but the hazards of escape and evasion will become considerably increased.

2. Unoccupied China

Once across the "Hump" and in China you can be assured of every type of aid possible from the Chinese inside our lines. But before considering the Chinese themselves, it is advisable to describe a territory termed the "Ee Wren" Country. When you have crossed the "Hump" and are over the rugged terrain northeast of Likiang (pronounced Lee-jong) you will be over what was formerly termed the "Lolo" Country. Before Captain Mullen of Air Ground Aid Section - China entered this country some months ago, it was thought that white men stood little chance of ever getting out of it alive. As a result of Captain Mullen's extended journey, during which he paved the way for 100% recovery of Americans down in that territory, you can be assured of every assistance on the part of the natives, a kind of Mongolian people. They will guide you into Nationalist China where you can obtain transportation back to a U.S. base.

The country is rugged, and it is difficult for search planes to spot you. There are no roads and consequently the matter of getting out will entail some hardship, particularly walking over rough country, but you can be assured of assistance from the natives and of getting out safely. If injured in this country it is possible to drop supplies and even a doctor to you, for there is a rescue service covering this as well as other areas. This territory is <u>not</u> enemy territory - simply rough country inhabited by a somewhat primitive people. To date we have had several crews return from this area, none the worse for their experiences. The Ee-Wrens, like all of the more primitive people, are extremely curious. They will touch your equipment, try it on, wear your gun, and try on your boots. Don't misunderstand them as they are not relieving you of your property; only satisfying their curiosity. Let them do this, but when it is satisfied, demand the equipment back. Don't use force to recover items, simply gesture that you want it returned. It is always best to deal with their "King".

In other unoccupied Chinese territory the Chinese will be found to be exceedingly friendly. The experience of crews who have gone down and have been helped by the Chinese has been that the Chinese considered them almost Gods - certainly heroes. Crews have been accorded royal welcomes. In many cases, the Americans had to almost use force to break away from the generous Chinese, who treated them to banquets, gifts, and showered kindness upon them. No apprehension need be felt by crew members as to the type of treatment they will receive from the Chinese; it will be excellent.

3. <u>Occupied China</u>

Occupied China is not occupied by the Japs to the extent the term might imply. Actually, the country is held very thinly and there are vast areas inside "occupied" China in which there are no Japs whatsoever. The prime aim of the Japs in China is to control all facilities for transportation and communication. As a consequence, they have taken over important ports, cities, railroads, highways and places of any commercial value. It naturally follows that the Japs are found in level, easily accessible country. Their strength is in the plains and along rivers, railroads and highways. An evader, therefore, should avoid those places, and head for the rugged, mountainous terrain, where he will come in contact with friendly Chinese who will aid him.

In North China, are found the so-called "Communists". These people have been actively engaged in fighting the Japanese since 1937 and are well organized. They dominate or influence areas that are hilly, rough and not so productive as other sections. In the event it is necessary to bail, try to do so over that type of country, where you may easily contact them. When in the hands of the "Communists", remember they know the country and can get you out. They have already proven their willingness and ability to aid Americans. They will feed, shelter, and clothe you.

The "Communists" have two armies; the 8th Route Army and the new Fourth Army. The former operates north of the Yellow River, and the latter to the south of it, as far as the Yangtze Valley. If you should go down north of the Yellow River, you should contact a native and raise your right hand, extending the thumb and index finger, keeping the other three fingers closed. This is the symbol of the 8th Route Army, which in Chinese is pronounced "BAH LOO JUN". If South of the Yellow River, use the symbol of the Fourth Army, which is the upraised hand with four fingers extended. It is said "SHIN SUH JUN". It is very important to remember this, for the sooner you contact one of these armies, the greater your chances of evasion.

Puppet troops are occasionally used by the Japs to garrison towns. It is well to remember the Japs have often had trouble with puppet troops, and if you should ever fall into their hands try to bargain with them. It is entirely possible that you can convince them to let you escape, for they are only half-heartedly fighting for the Japs, and have been known to even oppose them at times.

During the briefing prior to each mission, your S-2 will cover areas in which it is safe to bail out, and which are dominated by guerrillas or "Communist" army forces. You should be familiar at all times with the location of the battle lines. The odds of returning, if forced down in Occupied China, are excellent. Of all personnel going down behind enemy lines, who have walked away from their crashed plane, 95% have been safely returned to their base. This is a remarkable record, but it can be increased by your paying particular attention during specialized briefings on Escape and Evasion.

In conclusion, bear these points in mind about Occupied China. To successfully evade capture,

a. Stay away from cities, railroads, rivers and populous areas.
b. Head for mountainous areas and attempt to contact guerrilla forces.
c. Trust the guerrillas and do as they direct.
d. Don't discuss your experiences upon your return with anyone except an authorized intelligence officer.

4. Instruction You May Expect.

During your ground school work you will receive instruction from intelligence officers on such subjects as: How to behave under Japanese interrogation should you be captured; what to expect from the Japanese in the way of treatment; the best time to attempt escape, and instruction in the use of E and E aids. You will also receive instruction in how to go about contacting help in enemy

territory, should you be forced down, and what aid you may expect to receive. You can implement this instruction by careful study of the B.E.E. (Bulletin on Escape and Evasion published by the XX Bomber Command) which contains the latest information we have on survival, escape, and evasion. In addition, prior to each mission, your intelligence officer will point out safe areas along the route flown, and where to head for in each particular area, to make the easiest evasion.

M. SECURITY

1. General.

You now find yourself in a theatre of war in which exist many political conditions, customs and religious beliefs that are probably unfamiliar to you. As a result, the part you as an individual are playing in the over all scheme of security and safeguarding of information and material takes on new complexities. It will require some study and thought on your part to put forth a good performance in the drama of security which is going on about you twenty-four hours a day, and in which you become involved in many acts of your everyday life. Discussed briefly below are the security matters which you will find to be of major importance in your efforts to help your organization inflict the greatest punishment on the enemy. Think these things over. There is a good reason behind all of them, and, if you understand the reasons and work along with security, you will be a more valuable member of your outfit.

2. Mission Information.

The most important information you have, which enemy agents desperately want, is the names of targets we plan to attack. Among the dozens of civilian workers on your base there may be enemy agents. They have watched your planes being loaded with bombs. They know you are going on a mission, but they don't know where. Don't tell them. After briefing keep your mouth shut on the name or location of the target and the time of attack. Don't even tell your own mechanics. In their natural enthusiasm they may talk after take-off when you are still hours from the target. Give the enemy agent credit for being able to relay a bit of hot news quickly back to his headquarters, because he has done it. When you are briefed on a target which is later cancelled, you must be especially careful not to talk. If the enemy knows you have been briefed on target X, they will get ready for you at that point and a possible future mission there will get a hot reception. It boils down to this: If you talk you are sticking out your own neck.

3. Personal Bearers.

Be discreet in the subjects you discuss within earshot of your bearer or any other civilian employee. It is not suggested that all these people are potential spy material, but indirectly they may very easily act in the capacity of a spy. Civilians in India and China have at least one point in common with us - they like to get together and discuss the local news. Consequently, your bearer, who is probably observing and comprehending much more of your

conversation and activity than you give him credit for, gathers with his friends around the equivalent of the bar in Joe's tavern and discusses all the bits of classified information you dropped while cleaning up for supper. The enemy agent, who is no fool, realizes that Joe's Tavern is a wonderful source of information and joins the gossip. Result: You may have ruined the element of surprise in a carefully planned operation and possibly cost the lives of some of your friends.

4. Identity Checks.

Don't form the habit of accepting an unknown person at face value. The enemy agent may not be swarthy skinned and dressed in native garb. He may look like Cpl. Joe Smith from North Dakota or Capt. Bill Brown from New York City. It has happened that way. Form the habit of being suspicious of unknown persons whom you may find in vital areas of your bases, especially around your planes. Check the identity of persons before giving them any classified information if they are not personally known to you.

5. Miscellaneous.

Be cautious in any possible encounters with fortune tellers. Better still avoid them entirely. Experience has shown that such people are apt to be more interested in collecting information than in disseminating it.

Don't give your official signature except for official purposes. You may be asked to sign your name in a little book carried by a child to whom you have just given "Baakshees" for a charitable organization. Don't sign it. Relatives of military personnel have been blackmailed and field orders have been forged.

Keep your weapons and ammunition in a secure place. Stolen arms and ammunition bring fabulous prices from certain parties who are not at all interested in your well-being, and the temptation to steal is great.

Be diplomatic in your relations with your Allies. It's true you may not always agree with them, but you won't shorten the war by telling them so.

Be skeptical of rumors and speculations. The enemy would like nothing better than to see us spread false information around until we reached the point where we distrusted our Allies or became jittery over the thought of a devestating new secret weapon. The fact is, the enemy would enjoy this so much that he is very happy to start harmful rumors and speculations himself. Check the source of the next rumor you hear.

6. Security References.

Listed below are references and briefs of the XX Bomber Command security memoranda which will be of special interest to you, as a member of a combat crew.

a. Memo 46-3, "Security Provisions Prior to Departure for the United States," 26 May 1944. This one tells you that when you go back to the States

you cannot disclose to the public any information which concerns the War Department, the Army or any of their activities within any theater without first securing a clearance from the War Department Bureau of Public Relations or from appropriate Public Relations Officers of the various U.S. Army installations. This refers to disclosing such information through books, magazines, radio lectures, newspapers, etc.

b. Memo 46-4, "Identification", 22 April 1944. This memo outlines identification systems used in various restricted areas of the Command. These restricted areas include flying fields, headquarters buildings, bomb dump areas, briefing rooms, war rooms and other vital base installations. American officers should at all times be prepared to identify themselves with WD AGO Form 65-1, enlisted personnel with their dog tags. Flying fields of this Command are closed to all planes except those assigned to the XX Bomber Command. Civilian employees will under no circumstances be allowed to enter the aircraft parking areas.

c. Memo 46-7, "Landing at Other than XX Bomber Command Bases by Tactical Aircraft", 5 June 1944. If a B-29 lands at a base not under the jurisdiction of this Command, the Airplane Commander is responsible for placing a guard on the ship to keep away persons not authorized to enter it or inspect it. Servicing will be accomplished under the supervision of appropriate crew members. A crew member must at all times remain with the plane as a guard.

d. Memo 46-8, "Material Carried in Aircraft on Tactical Missions", 9 June 1944. This one quotes pertinent paragraphs from AAF Regulation 45-4 and from Memoranda 55-4, Headquarters AAF, IBS, CBI, outlining the particular classified material which will not be carried on tactical missions, to preclude the possibility of its falling into enemy hands.

e. Memo 46-10, "Disposition of Personal Arms and Ammunition", 14 June 1944. Enlisted personnel will keep their arms and ammunition stored in Unit Supply Rooms unless their immediate superior officer requests that they be retained for use in the performance of their duties. Issuance of arms will be made from Unit Supply Rooms in the event of an emergency. Officers will retain their weapons and are responsible for their proper maintenance and safe-keeping.

f. Memo 46-11, "Inspection of Tactical Aircraft", October 1944. This deals with visitors who wish to look over the B-29. Tactical Group Commanders will establish their own base ground rules covering the policy to be followed in these cases. A member of each aircraft crew will at all times stay with his ship in the capacity of a guard, keeping away all persons unknown to him.

g. Memo 46-13, "Personal Photographs", 4 October 1944. Tells you to be discreet in the use of personal cameras. Don't take pictures of gun emplacements, bomb dump areas, power or maintenance

installations. Don't take panoramic views of military installations as these would give the enemy a lot of valuable data if he got hold of them. You can take pictures of a B-29 with as many as twelve people appearing in the picture. Shots of B-29's are to be taken only of the outside of the plane. Be careful that your photos don't include any interior equipment, such as that in the bombardier's compartment. To get your personal film developed and printed (when paper is available) turn it in at your Post Exchange. When you mail pictures in personal correspondence mark on the face of the envelope, "Photos Enclosed".

h. Memo 46-18, "Personnel Authorized to Work on Tactical Airplanes", 23 June 1944. The only persons who are allowed to perform maintenance work on B-29 aircraft are duly authorized military personnel assigned or attached to this Command and its units, duly authorized military personnel of units assigned to support this Command, and approved civilian technicians.

i. Memo 46-21, "Airborne Troops and Saboteurs", 18 July 1944. It is possible that the Japs might attempt to drop airborne troops and saboteurs in the vicinity of our airfields. If you should observe any activity which you think falls in this category, take note of the number of parachutes and the area into which they fell, contact the base commander or his executive officer, inform him of what you saw, then stand by for further orders.

j. Memo 46-22, "Discussions of Landings of B-29 Aircraft", 5 August 1944. Do not discuss, in any way, the landings of our planes at any field or at any place, except when it is necessary in the conduct of official business.

k. Memo 46-27, "Stowage of Classified Aircraft Cargo", 11 October 1944. Be very careful to stow all classified material in aircraft in such a way there is no possibility of its falling out of the ship in flight. If you should happen to lose any classified material in this way be sure to report the fact to your Group Intelligence Officer at the earliest possible moment giving sufficient information to assist him in finding it. This is important, because classified documents have on a number of occasions fallen through open bomb bays of ships in flight.

7. Conclusion.

Many leaks of vital information which may cost lives come about due to lack of knowledge on security measures and underrating the importance to the enemy of the knowledge you have of military matters. Become acquainted with the reasons for security which are, in reality, simply the application of common sense. Security does not exist for the purpose of creating additional problems for you, even though this may sometimes appear to be the case. It exists for the purpose of safeguarding your equipment and your life.

N. CENSORSHIP MADE EASY

You can't write it if it concerns operations. Censorship is common sense. You can mention having participated in a combat mission before it is officially announced but nothing further. You can say you have flown the "Hump" after the flight is completed, but you can't mention what type aircraft you made the flight in. You can mention B-29 but you can't give any information about its characteristics or performance. You can take exterior pictures of B-29 aircraft but be careful of the background. You can mention visits to Calcutta after your return but you can't mention how long it took you to get there or compromise the distance in any other manner.

The "CBI Roundup" and the "Command Post" are precensored papers and can be mailed home. Your proper return address will not mention the term XX Bomber Command if the address contains a unit designation of a lower echelon or of an attached organization of this Command.

Remember to avoid writing operational information. When in doubt don't write it. Complete instructions on censorship are available to you and it is your responsibility to keep apprised of censorship regulations.

O. TERRAIN AND TARGET IDENTIFICATION

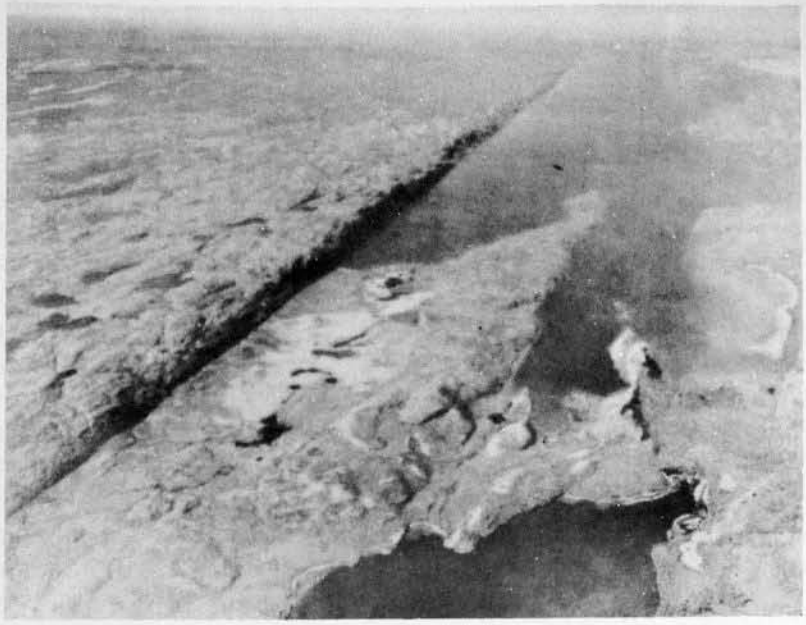
1. Terrain In General.

Every target has its particular characteristics determined by terrain features which are the check points for its identification. These should be known so thoroughly by combat crews that every enemy target becomes as familiar to them as though they were flying over their home town. In like manner, and equally as vital in accomplishing a successful mission is to be able to get to and from the target area. Distances are great and much of the region along the routes is new. It is important, therefore, to know the terrain over which a flight is made. All landforms - mountain chains, expansive plains, dune-covered deserts, great valleys with large meandering streams, rugged inundated shore lines or smooth shore lines where the land glides gently under the sea, have their unique features. These features, such as peaks, hills, ridges, cliffs, landslides, valleys, lakes, swamps, rivers, off-shore bars, and many others together with numerous man-made features, are the check points that will be the guides to and from as well as in and around every target.

Some of the more important terrain features that will serve as reliable check points are the following:

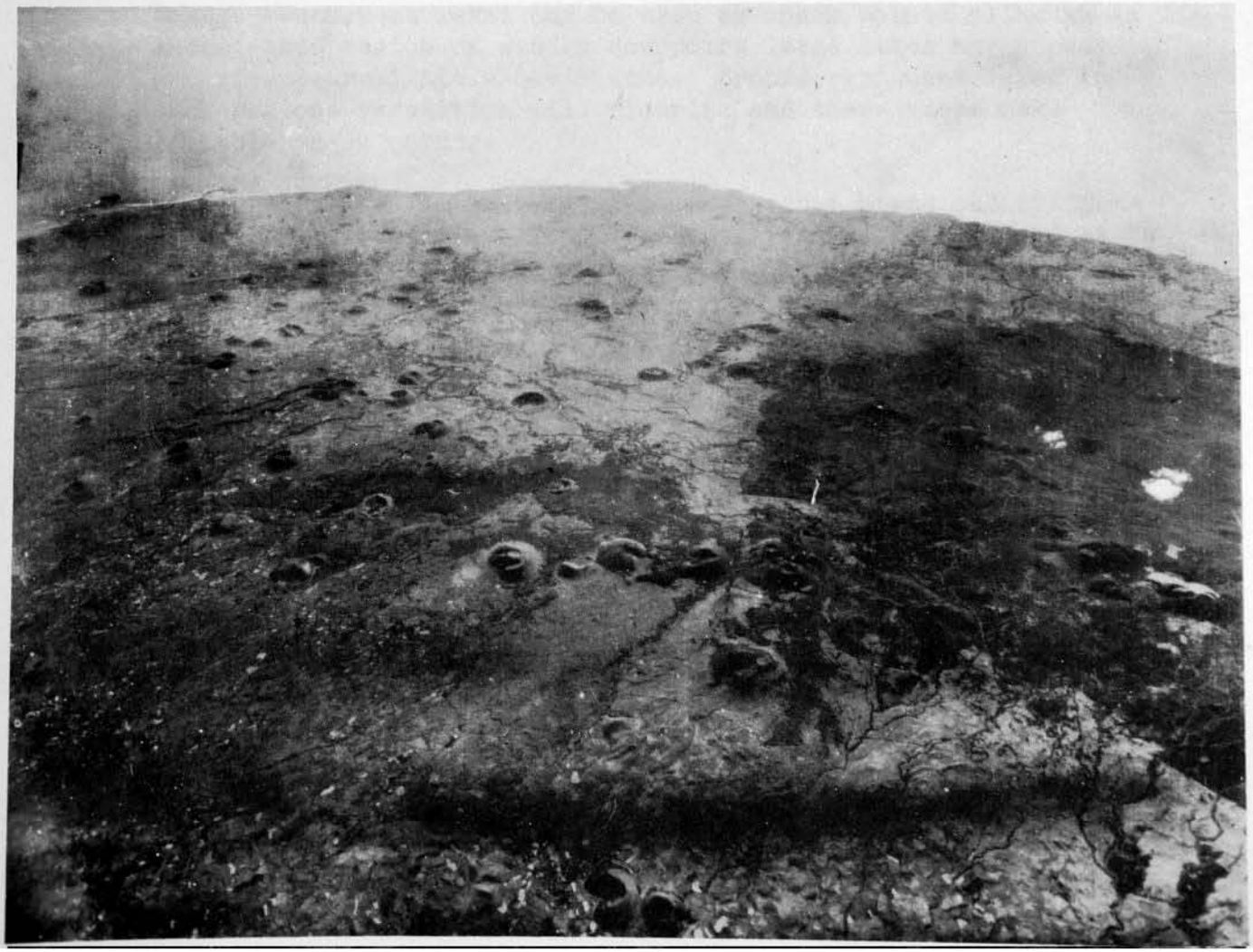
a. Breaks in the Earth's Crust. From the air, these breaks show up as long, continuous, nearly straight cliffs that cut across the usual terrain features.

b. Volcanoes. These may be easily recognized because of their nearly conical shape.



FAULTS, or breaks in the earth's crust, show up as continuous, nearly straight cliffs that cut across the usual terrain.

VOLCANIC CONES shown in this picture of Saishu Island's south coast, are characteristic of certain regions.



c. Large Landslides. They appear as great scars of bare rock on the sides of mountains.

d. Streams. Important stream junctions and islands not eliminated by high water are good check points. It should be determined, however, whether streams are permanent or temporary. During flood seasons permanent streams will appear differently than during the normal flow of water and large streams may occur in what are normally dry valleys. When a stream is old it develops great sweeping bends or meanders. Sometimes as in the case of Bangkok, these are outstanding check points. Other important features associated with streams are terraces and deltas. Knowing the direction streams flow may be very helpful in navigation. As streams join, especially when having a tree-like pattern, they form an acute angle that points down stream. If waterfalls are present, the crest of the falls will form a regular line across the stream and the turbulent water and mist will appear as light irregular streaks strung out downstream. The same thing is more or less true for rapids. If islands are present the blunt ends will be pointed upstream. When resistant rocks are present or if artificial structures are built out into a stream silt will be deposited on the down-stream side. One of the best clues is shown where the stream bends. On the down-stream side of the bend the stream undercuts the bank and forms a steep cliff while on the up-stream side sediments are deposited and form a flat light colored beach.

e. Lakes. Permanent lakes can be used as check points although in a semi-arid region of sudden downpours large lakes may appear and disappear within a day's time. Around permanent lakes in such regions vegetation will flourish and these cases make reliable check points.

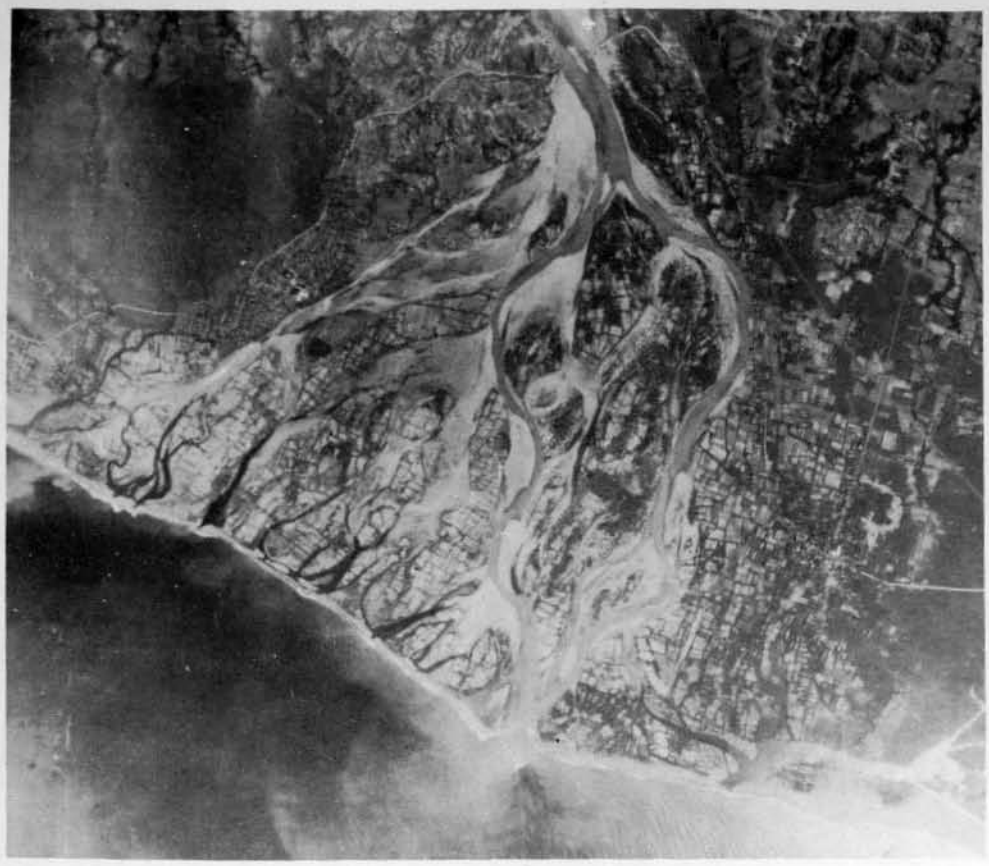
f. Peaks, Mesas and Hills. Mountain peaks that stand out by themselves, flat-topped erosional remnants (mesas) or isolated hills such as the granite hills on the flat Yangtze Delta, all can serve as very useful landmarks.

g. Shorelines. Shorelines that have been uplifted are straight and usually have a sandbar just off the beach. These offshore bars and the breaks or inlets in them are the best check points. Shorelines that have been submerged are very irregular. Drowned valleys, forming good harbors, peninsulas, islands, stack-like rocks, steep cliffs, narrow beaches and straight or curved sand bars in the mouths of the bays are principal features.

2. Man Made Features.

Nearly everything that man builds has an unnatural appearance from the air. He scars the landscape with open-cut mines, highways, railroad lines, power lines, canals, etc., and within a target area, no matter how densely it may be built up, certain buildings and other structures are constructed to serve

STREAM JUNCTION shown by these old meandering rivers plus highway bridge and ford alongside are typical check points that can be used where there is an old stage of erosion.



STREAM NETWORK branching over surface of this delta forms typical patter at river mouths. Deltas make good check points.

UNDERCUT BANKS (see arrows) on down-stream side of bends and white sand on the up-stream side tell that this early mature stream flows to left.

STRAIGHT SHORELINE and offshore bar on Formosa's West Coast show main features of shoreline of emergence.

IRREGULAR SHORELINE at Keelung is a young submerged type. Deep harbors, cliffs, peninsulas and islands are usual.

a specific purpose and they stand out from the rest. A roundhouse, a railroad station, a power plant, a castle, a traffic circle and many others are easily recognizable and may be used as check points in the vicinity of the target even more advantageously than terrain features. A list of the more important man-made features that are particularly significant is as follows:

Railroads
Roads and trails
Tunnel entrances
Rice fields
Power lines
Pipe lines
Oil fields
Canals
Bridges
Ferries
Fords
Tailings from mines
Open cut mines
Cuts and fills
Deforested areas
Fences and walls
Forts
Lighthouses and beacons
Wharves and docks
Reservoirs
Parks and cemetaries
Important road intersections
Railroad crossings
Traffic circles
Race tracks
Baseball diamonds
Significant buildings

Most of the usual man-made features can be rather easily recognized. The straight courses and sweeping curves of railroads distinguish them from roads. Improved roads are generally wider and have fewer turns than secondary roads or trails. Reservoirs are located in the hilly area around a target. The water appears variously, depending on the relative positions of the sun and the airplane. If not in line with the reflected rays then the water will appear dark. Canals and ditches are even in width and frequently have trails on either side. Important locks in a canal may be significant features of them. Canals or moats sometimes completely encircle portions of cities and their patterns may be used to recognize certain towns or cities along the course to a target. When moats are present around palace or other grounds they serve as striking check points at a target. Powerlines or pipelines appear as wide and straight swaths through wooded areas.

The ability to recognize various types of targets and the many different installations within them can be accomplished only by a study of aerial photographs and flow-charts of typical and enemy industry such as iron and steel plants, oil refineries, shipbuilding facilities and aircraft factories.

3. Location And Identification Of The Target.

In the long run, success or failure in bombing depends on the ability of the crew to locate and identify the target. A thorough study should be made of the general region, the island, or the province where the target is located. If, for example, the target is in Manchuria one should have a complete mental picture of the eastern Appalachian-like mountains, the interior plains country with its Mississippi River-like drainage system and the western mountain system not unlike that of the Rockies. This will be of great value in understanding how the target's location fits into the terrain pattern.

Crews should study the terrain along the course to the target and know thoroughly the geographic location of the plains, plateaus, mountain ranges, main streams, important canals, lake areas, and types of shorelines.

On the approach to the IP all possible check points at least 100 miles out should be pre-determined and all similar features in the vicinity should be thoroughly studied in order to avoid any possible confusion. The same should be done for the target approach. If the approach leads across a shoreline, then every feature of that shoreline should be studied to avoid any chance of misidentification. All possible check points along the approach should be thoroughly studied and committed to memory so that on the approach no more than a glance at a chart or a photograph will be necessary, and if the target vicinity is obscured, offset bombing can be accomplished by synchronizing on some check point in front of the target.

Familiarity with the outline of the target will prevent any loss of time in spotting it. It may have the form of a rectangle or triangle. It may resemble an octopus or some other familiar animal or object. Equally as important is knowing the target's location in the target area. In what part of the city is it? Is it along side of an airfield? What is its location in relation to all the check points in the vicinity?

In the target itself the location and function of every installation should be so firmly fixed in the bombardier's mind that there will be no doubt in recognizing the aiming point. The same should be done for all neighboring installations so that if the target is covered with smoke the bombardier will know on what points the lateral cross-hair of the bombsight will fall and still cut through the aiming point. This may eliminate the need for offset bombing.

It should be remembered that the careful study of a target can be accomplished only by using all available maps, charts, photographs, models, and other objective data.

FLYING EQUIPMENT

XI. FLYING EQUIPMENT

The personal and emergency equipment described in this chapter was developed and provided for you because you can't do your assigned job without it. The success of the mission actually does depend on every one of these things and a great many more. Ignorance or neglect of any essential detail may mean inefficient individual performance, an aborted mission, and casualties.

Some of the equipment like life vests, oxygen equipment, altitude clothing, among other things, help protect you against forces of nature which you have challenged by operating out of man's natural element. Other equipment, including flak suits, flak helmets, and first aid kits help protect you against the forces of the enemy. Much of the equipment is already long familiar to you, and you are inclined to take it for granted. For example, your heavy awkward parachute or your uncomfortable life vest may seem like a highly overrated nuisance, if you've never had to use it.

It is obvious that none of this stuff is a Little Daisy, Sure-Fire, Never Fail, Good Luck Charm that will shield you from all harm like a magic cloak. But it offers considerable aid and protection if you exercise intelligence and care in the use of it. The amount of good it will do you, or to put it more plainly, your chances of coming home safely, is directly proportionate to your knowledge of equipment and procedures. The ultimate responsibility for emergency equipment and procedures, along with responsibility for all other operations during flight is that of the airplane commander. Don't take it for granted that all your crew members are well versed in emergency matters. Check each man and see that he knows what he is supposed to know; the safety of every man on the airplane depends on it.

Before each flight, assemble the crew and inspect the equipment of each man to see that he has with him everything required on the flight. The Personal Equipment Officer will furnish the airplane commander with a check list like the one reproduced on the following page. The required items of equipment for the mission will be noted in the left column. Then the airplane commander will check off these items as each man exhibits them for inspection. Only by using the check list can there be assurance that nothing is overlooked.

A. OXYGEN SYSTEM AND EQUIPMENT

Your airplane was designed to operate just as well at high altitude as at low altitude. Your body wasn't! All organisms require oxygen to support life. At ground level you get plenty of oxygen from the surrounding air, which is packed down by the weight of the air above it. As you go higher there is less air above you. Therefore, the air you breathe becomes thinner, and your body is less able to get the required amount of oxygen out of it. At 10,000 feet your body is getting barely sufficient oxygen, and you begin to lose efficiency. Somewhere above that altitude, varying with the individual, you'll become unconscious, and then, unless you get some extra oxygen quick ... that's all brother!

In a pressurized cabin you can increase the air pressure so that you are breathing air of a simulated lower altitude. As long as the cabin altitude is below

RESTRICTED

COMBAT CREW PERSONAL EQUIPMENT

CHECK LIST

TIME: _____
DATE: _____
AIRPLANE MODEL AND NO. _____
PILOT'S NAME: _____

	Pilot	Co-pilot	Engineer	Bombardier	Navigator	Radio Operator	Upper Gunner	Right Gunner	Left Gunner	Radar Operator	Tail Gunner	Other	
( ) Jacket, electrically heated													
( ) Trousers, electrically heated													
( ) Gloves, electrically heated													
( ) Shoes, electrically heated													
( ) Jacket, intermediate													
( ) Trousers, intermediate													
( ) Jacket, winter flying													
( ) Trousers, winter flying													
( ) Gloves, summer or winter													
( ) Mittens													
( ) Shoes, flying													
( ) Helmet, flying													
( ) Headset													
( ) Oxygen mask													
( ) Microphone													
( ) Bail-out cylinder													
( ) Parachute													
( ) Parachute first-aid kit													
( ) Parachute emergency kit													
( ) Life vest													
( ) Flak helmet													
( ) Goggles													
( ) Sun Glasses													
( ) Pistol, cartridges, clips													

NOTE: Only checked ( ) items received this mission.

10,000 feet, you're OK. But remember, when the cabin altitude goes above 10,000 feet, you need oxygen. Therefore, your airplane has an oxygen system to meet the requirements of your body and allow you to function normally.

The equipment provided is excellent, simple to operate, and safe for flights up to extremely high altitudes. But it is not safe unless you understand it thoroughly and follow the rules regarding its use strictly. You can't take short-cuts with oxygen and live to tell about it!

The lack of oxygen, known as anoxia, gives no warning. If it hits you, you won't know it until your mates revive you from unconsciousness, if they can. Therefore, you must check the condition and operation of your equipment with extreme care, and continue to check it regularly as often as possible during flight.

1. Oxygen System.

Due to the fact that three of the fuselage compartments have cabin air control, whereby pressure equivalent to 8000 feet altitude is maintained within the compartments from 8000 feet up to 30,000 feet, oxygen equipment is not used extensively. However, because depressurization may be necessary as a result of enemy action, or when the aircraft is on fire, or when preparing to abandon the aircraft, all crew members must have oxygen equipment ready at hand and be prepared to use it.

The B-29 has a low pressure, demand type oxygen system. This system is the safest and best oxygen system known, if properly used. The system will function at altitudes up to 40,000 feet and a crew of eleven can remain at 25,000 feet about 4 1/2 hours in the early model aircraft equipped with fourteen oxygen cylinders, and from six and one-half hours to seven hours in the latest aircraft which are equipped with eighteen bottles. This, however, is the most uneconomical altitude, and the supply will last longer either above 30,000 feet or under 20,000 feet than it does between 20,000 and 30,000 feet. The duration of the oxygen will also vary with the requirements of the individuals, their activity, the temperature, charge of the system, and type of regulator.

The following chart shows the hours of available oxygen in later model B-29's equipped with G-1 cylinders. In the early model B-29's, the oxygen equipment consists of five separate low-pressure oxygen systems. Two systems supply the right and left stations in the forward cabin. These two systems may be coupled together by means of the oxygen shutoff valve at the engineer's stations, this making the oxygen in one system available to all forward stations in the event of loss of bottles in one of the systems. The rear pressure cabin is also supplied by two systems, interconnected in the same manner, with the shut-off valve located at the forward end of the gunner's compartment. The fifth system, consisting of two bottles, supplies only the tail gunner.

In the later model B-29's, the demand oxygen system is supplied by eighteen, type G-1, low pressure shatterproof oxygen cylinders. The entire system is filled from one filler valve located on the outside of the fuselage underneath the front left spar. The installation consists of a two bottle distribution system for the tail gunner, and a sixteen bottle system supplying thirteen

HOURS OF AVAILABLE OXYGEN

AIRCO REGULATORS TYPE A-12								
ALT. IN FEET	GAGE PRESSURE							
	400	350	300	250	200	150	100	50
40,000	11.3	10.7	8.8	7.1	5.3	3.6	1.7	E
35,000	8.8	7.6	6.3	5.0	3.7	2.5	1.2	M
30,000	6.4	5.6	4.7	3.7	2.8	1.8	.9	E
25,000	6.3	5.4	4.4	3.6	2.7	1.8	1.2	R
20,000	7.0	6.0	4.9	4.0	3.0	2.0	.9	G
15,000	8.5	7.3	6.0	4.8	3.7	2.4	1.2	E
10,000	14.5	12.5	10.3	8.3	6.2	4.1	2.0	N
5,000								C
SEA LEVEL								Y
REGULATOR IN AUTO MIX "ON"								

PIONEER REGULATORS TYPE A-12								
ALT. IN FEET	GAGE PRESSURE							
	400	350	300	250	200	150	100	50
40,000	11.3	10.7	8.8	7.1	5.3	3.6	1.7	E
35,000	9.0	7.7	7.1	5.1	3.8	2.6	1.2	M
30,000	6.7	5.8	4.8	3.8	2.9	1.9	.9	E
25,000	6.6	5.5	4.7	3.7	2.8	2.6	.9	R
20,000	11.7	10.0	8.2	6.6	5.0	3.8	1.8	G
15,000	11.4	9.7	8.1	6.5	4.8	3.3	1.5	E
10,000	11.6	9.7	8.0	6.4	4.8	3.7	1.5	N
5,000	8.5	7.3	6.0	4.8	3.6	3.2	1.1	C
SEA LEVEL	9.0	7.7	6.3	5.1	3.8	2.6	1.2	Y
REGULATOR IN AUTO MIX "ON"								

oxygen stations in the front pressurized compartment, the gunner's compartment and the radar compartment. Each of the thirteen oxygen stations is supplied from two distinct distribution lines. Loss of one line or its associated cylinders still leaves each station with an alternate source of oxygen. The entire system is equalized by the use of crossfeeds controlled by automatic check valves. In the event of partial destruction of the system, all stations still functioning, have equal access to the remaining oxygen supply.

2. Oxygen Mask.

Your oxygen mask is an item of personal issue. Take care of it. It's as important as your life. Before you use the mask in flight, have it fitted carefully by your Personal Equipment Officer, or his qualified assistants. They will see that you have the right size, that it fits perfectly, and that the studs to hold it are properly fixed to your helmet. Then bring it in for re-checking whenever necessary. The straps will stretch slightly after a period of use. It's a good idea to have the fit rechecked regularly whether you think it needs it or not.

Draw your mask before each mission, and return it to the supply room afterward. Equipment personnel will check it for repair and cleaning. But don't assume that this procedure relieves you of the responsibility of your own regular inspection and care of the mask. Before each mission, make the following checks on your mask:

a. Look the mask and helmet over carefully for worn spots or worn straps, loose studs, or evidence of deterioration in facepiece and hose.

b. Put the helmet and mask on carefully. Slip the edges of the facepiece under the helmet.

c. Test for leaks. Hold your thumb over the end of the hose and breathe in gently. The mask should collapse on your face, with no air entering. Don't inhale strongly, because a sharp, deep breath may deform the mask to cause a false seal or a new leak.

d. Clip the end of the regulator hose to your jacket in such a position that you can move your head around fully without twisting or kinking the mask hose or pulling on the quick-disconnect. Get the personal equipment section to sew a tab on your jacket at the proper spot.

e. See that the gasket is properly seated on the male end of the quick-disconnect fitting between mask and regulator hoses. Plug in the fitting and test the pull. If it comes apart easily, spread the prongs with the proper spreader tool or knife blade. Note: This is only a temporary adjustment. As soon as possible report the difficulty to the equipment men and let them replace the fitting if necessary.

f. General Tips.

(1) Watch carefully for freezing in the mask from the water vapor in your breath at extremely low temperatures. If you detect freezing, squeeze the mask.
(2) Don't let anyone else wear your mask except in emergencies.
(3) Keep it in the kit between flights, and keep it clean.
(4) Report anything wrong with the functioning or condition of the mask when you turn it in after the flight.

3. Oxygen Regulator.

A demand regulator is mounted at each station in the plane. There are two types of demand regulators, the Airco and Pioneer. You may find either one on your plane. They look slightly different but the principle of operation is the same in both. A demand regulator is one that furnishes oxygen on demand or when you inhale. No oxygen comes out when you exhale.

The regulator has an Auto-Mix mechanism controlled by a lever on the side of the cover. When the lever is in the ON position, oxygen furnished below 30,000 feet altitude is mixed with air. The dilution is controlled automatically by an aeroid to furnish the correct amount of oxygen which your body requires for a given altitude. Above approximately 30,000 feet the air inlet closes and you get 100% oxygen although the lever in the regulator is still in the ON position. With the lever in the OFF position, 100% oxygen is furnished at all altitudes. This wastes oxygen. Never turn the lever to OFF except in the following cases:

a. To give 100% oxygen to a wounded man below 30,000 feet.

b. If there is poison gas or carbon monoxide in the plane.

c. If the airplane commander prescribes breathing 100% oxygen all the way up to high altitude as a protection against the bends.

To operate the emergency valve turn the red knob on the intake side of the regulator in the direction indicated on the regulator face. Caution: Never pinch the mask hose or block the oxygen flow when the emergency valve is turned to ON. This action breaks the regulator diaphram.

Turning the emergency valve to ON causes the oxygen flow to by-pass the demand mechanism and to flow continuously into the mask. It is extremely wasteful of oxygen. Leaving the valve ON, bleeds the entire oxygen supply to the station in a short time. Never turn the emergency valve to ON, except:

a. To revive a crew member.

b. In cases of excessive mask leakage.

c. Just before momentary emergency removal of your mask at high altitudes, as in vomiting. In such a case unhook one side of the mask and hold it as close to your face as possible.

Make the following checks before each flight: First, check the tightness of the knurled collar. It should be so tight that movement of the regulator hose

will not turn the elbow. Second, open the emergency valve slightly and see that there is a flow of oxygen. Be sure to close it tight again.

4. Flow Indicator.

The flow indicator on the oxygen panel winks open and shut as the oxygen flows. The blinker may not operate normally at ground level with the Auto-Mix lever at ON, as the blinker operation depends on the flow of oxygen. Therefore, before the flight, plug in your mask, turn the Auto-Mix lever to OFF and see that the blinker works as you breathe. Be sure to move the lever back to ON before flight. Note: The blinker does not work when the emergency valve is ON.

Watch your flow indicator during flight. It is the only indication you have that the oxygen is flowing regularly. If it fails completely, use your portable equipment, notify the pilot, and plug in at another station if possible.

5. Pressure Gage.

Before flight, check the pressure gauge on your panel. When the system on your plane is full the pressure should be between 400 and 425 pounds per square inch. Also check your gauge against the gauges at other stations. There may be some variation between stations because of different tolerances in the gauges, but if yours varies more than 50 pounds per square inch from the others, report it to the airplane commander.

The regulator does not work properly when the pressure is below 50 pounds per square inch. If you need oxygen at this pressure, use your portable equipment until you can descend.

6. Walk-Around Equipment.

Two types of walk-around assemblies are furnished on the airplane. One large yellow type D-2 cylinder is provided for each of the following crew positions: pilot, copilot, engineer, navigator, upper and right gunners and radar operator. The remainder of the crew positions have the smaller green type A-4 cylinders. Both types of assemblies are equipped with gauges and regulators. The regulators furnish 100% oxygen on demand.

Before each flight, check to see that your walk-around bottle is within easy reach. Look at the gauge, and if the pressure is 50 pounds per square inch or more under the pressure of the airplane system, recharge the bottle. There is a recharging hose at each station. Snap the hose fitting on the nipple of the regulator. Push it home until it clicks and locks. When the bottle has filled to the pressure of the plane system, turn the hose clamp clockwise and remove hose fitting. Suck on the outlet of the bottle to see that it gives an easy flow of oxygen. You can also carry out this recharging operation while your mask is plugged into the bottle you are filling.

When the cabin is non-pressurized, always use a walk-around bottle if you disconnect from the airplane system. Hold your breath while you are switching

to the bottle. Clip the A-4 bottle to your jacket, and carry the D-2 bottle in the sling provided for it. The duration of the walk-around oxygen supply is variable. Don't depend on it to last very long, regardless of what you have heard about the capacity. Keep watching the gage, and recharge the bottle when it needs it. Always recharge walk-around equipment after use.

7. Bailout Cylinders.

The bailout cylinder is a small high-pressure oxygen cylinder with gauge attached, which furnishes a continuous flow of oxygen. The cylinder comes in a heavy canvas pocket provided with tying straps. Have this pocket sewed and tied securely to the harness of your parachute. Before flight, check to see that the pressure of the cylinder is at 1800 pounds per square inch. Plug the bayonet connection on the hose into the adapter on your mask.

If you have to bail out at altitude, connect your mask to a walk-around bottle, and make your way to the proper exit. Just before jumping, open the valve on the bailout cylinder and disconnect your mask from the walk-around bottle. For further information on bailout at high altitude see section F on Parachutes in this chapter.

B. COLD WEATHER CLOTHING

Since emergencies or climatic conditions on some missions may require the use of more protective clothing, the subject of cold weather clothing will be covered. To date, because extreme cold temperatures have not been encountered and heat from compression has kept the cabin fairly warm, electrically heated flying suits and heavy winter clothing have not been worn. Also, later model B-29's have been equipped with heat exchangers which assist in defrosting and heat cabin air from exhaust shroud heat, thus keeping most crew positions in the airplane fairly warm. Some crew positions, such as the tail gunner's and radar operators, are not materially helped by the heating system; consequently these crew members should wear heavier clothing, particularly winter flying boots.

Protection against cold is a vital problem in high altitude flying. At times frostbite has caused more casualties than combat. Most cases of frostbite occur because flyers don't appreciate the seriousness of the problem or because they misuse the equipment furnished for their protection.

One of the difficulties is that many crew members don't know what frostbite actually is, until they experience it. The name is deceiving. It doesn't sound particularly dangerous, and to many men frostbite means the nonserious numbness which you often feel on face or hands in moderately cold weather. Actually, frostbite involves the complete freezing of body tissue. Depending on the degree of cold and time exposed, the results of frostbite range from serious incapacitating sores to death. Loss of fingers and toes is frequent in high altitude crews who are careless about their clothing.

Adequate heating of all the stations on airplanes is impractical. Therefore, your clothing is your main protection against frostbite. And the clothing provided really protects you, if you exercise care in the use of it. Your basic cold weather flying suit is the electrically heated suit. When this

suit is insufficient, add the intermediate flying suit over the electric apparel. Remember to wear extra gloves also when you add extra clothing.

Follow these precautions concerning the use of cold weather clothing:

a. Keep Your Clothing Dry.

Moisture freezes and greatly reduces the effectiveness of all clothing as protection against the cold. Before a mission, dry your skin with a towel and then dress slowly. Don't dress so early that you have to stand around for some time with heavy clothing on. The resulting prespiration will soak into the suit and freeze later. If it's raining, wear to the plane a raincoat and galoshes over your flying equipment and let the ground crewmen take them back. Caution: When using the electric suit keep the rheostat at the lowest comfortable heat. Don't climb hot. It will mean perspiration and freezing at higher altitudes.

b. Wear Proper Underclothing.

Under the type F-2 electrically heated suit wear woolen underwear with long sleeves and legs, and a woolen shirt. When you get the F-3 electrically heated suit wear it over normal GI clothing for the theatre in which you are operating. Wear the intermediate flying suit over the F-3. With either electrical suit wear wool socks, electrically heated felt liners over them, and then your flying boots.

c. Wear Your Gloves.

Always wear rayon gloves under your electrically heated gloves, and never remove your gloves in low temperatures if you can help it. With your gloves on practice all operations which you may be required to do in flight, so that you won't have to expose your hands.

d. Keep Your Clothing Clean.

Keep your clothing clean, particularly your underwear. Soiled clothes lose their insulating qualities. And here's a tip: Wash your own clothes rather than hire a native washwomen. She'll mangle them, literally! Have all holes in your clothing sewed up immediately. Even a small rip can admit enough cold air to be dangerous.

e. Don't Wear Tight Clothing.

Constriction of circulation hastens frostbite. During flight be sure to ease the restriction of tight sweat belts or parachute harness often enough so that circulation of blood is not cut off.

f. Wear Your Goggles.

Wear your goggles at all times during the mission. They are excellent protection against cold, flash burns, and solid fragments.

C. LIFE PRESERVER VEST

WEAR YOUR VEST AT ALL TIMES ON FLIGHTS OVER WATER.

When the vest is first issued to you, put it on and inflate it by mouth valves to adjust the fit of the straps. Don't waste a carbon dioxide cartridge to do this. With the vest inflated the waist strap should be fairly tight and the crotch strap snug. Deflate by opening the mouth valves and rolling up the vest. Keep the ends of the mouth valves bent down, or cut them off flush with the retaining loop, so they won't poke you in the eyes when the vest is inflated. Wear the collar of your jacket over the collar of the life vest. Wear the life vest under your parachute harness. Keep the CO_2 ripcords looped up over the inflators so that they will not catch on something and accidentally inflate your vest during flight.

Before each flight inspect both carbon dioxide (CO_2) inflators. Always check the mouth inflator valves to see that they are closed. If the valves are even partly open the CO_2 goes right on through and out when you pull the cords for emergency inflation. Life vests must be inspected every six months. Check the date stenciled on the vest and see that your vest is turned in for inspection at the proper time.

Whenever you are wearing the life vest, tie your parachute first aid packet to the vest strap, not to your parachute harness. When you bail out into the water you lose the chute and you might need the packet.

There is a sea marker tab on each life vest. When rescue planes approach, release the dye by pulling down on the tab. Stir the chemical around to color as large an area of the water as possible.

D. FLAK SUITS AND HELMETS

Flak suits consist of an armored vest and apron assembly. They are not personal issue, and should be delivered to the plane before the flight and picked up afterward for inspection. You couldn't carry one anyway, with everything else you're lugging. Report to the pilot if you don't find a flak suit in the plane for you. Wear the suit when you approach the target area. It's heavy but it's guaranteed that you won't notice the weight when the fight begins to get hot.

The flak helmet is personal issue. If you have worn both your flak suit and flak helmet on the mission, you have a good chance of returning the helmet to the supply room personally after the flight.

E. FIRST AID KITS

1. Aeronautical First-Aid Kits.

Five aeronautical First-Aid Kits are carried in the airplane in the following locations:

a. Above the flight engineer.

b. On the door of the navigator's cabinet.

c. On the seat pedestal of the upper gun sighting station.

d. On the rear compartment auxiliary panel, forward of the bunk area.

e. In the tail gunner's compartment.

Each Aeronautical First-Aid Kit contains:

Iodine swabs
Adhesive gauze bandages
Halazone tablets
Burn-injury set
Morphine syrettes
Sulfa tablets
Sulfa powder
Small Carlisle first-aid dressings
Scissors
Tourniquet

2. Arctic First-Aid Kit.

The Arctic First-Aid Kit is located in the rear pressurized cabin and contains:

Halazone tablets
Absorbent cotton
Burn ointment
Burn-injury sets
Iodine swabs
Ammoniated mercury ointment
Morphine syrettes
Salt tablets
Sulfa tablets
Sulfa powder
Adhesive gauze bandages
Compress gauze bandages
Aspirin tablets
Aloin compound tablets
Sodium bicarbonate and peppermint tablets
Bismuth subcarbonate tablets
Protein silver tablets
Multivitamin capsules
Sulfaguanidine

3. Jungle First-Aid Kit.

The Jungle First-Aid Kit is located with the Arctic First-Aid Kit in the rear pressurized cabin, and contains:

Halazone tablets
Insect repellent
Suction kit for snake bite
Iodine swabs
Morphine syrettes
Salt tablets
Sulfa tablets
Adhesive gauze bandages
Aspirin tablets
Aloin compound tablets
Atabrine tablets
Sodium bicarbonate and peppermint tablets
Sulfaguanidine

4. Battle Splint and Dressing Kit.

Two Battle Splint and Dressing Kits are carried. One is located behind the copilot's seat and the other in the rear pressurized cabin. Each Kit, Battle Splint and Dressing, contains:

Gauze bandages
Small Carlisle first-aid dressings
Large Carlisle first-aid dressings
Serum albumin units for treatment of shock
Basswood splints
Adhesive tape
Safety pins

5. Blood Plasma Kit.

Two Blood Plasma Kits are carried. One is located on the ceiling above the flight engineer's head, and the other in the rear pressurized cabin. Each Blood Plasma Kit contains two complete sets of apparatus for the administration of plasma or serum albumin, concentrated from plasma.

6. Parachute First-Aid Packet.

One Parachute First-Aid Packet is issued to each man. Tie the packet to the strap of the life vest when wearing the vest. If you are not going to use the life vest, tie the packet to the shoulder strap of the parachute harness, well down on the lower part of the strap. The Parachute First-Aid Packet contains:

Tourniquet
Small Carlisle first-aid dressing
Sulfa powder
Morphine syrette
Sulfa tablets

7. Life Raft First-Aid Kit.

A Life Raft First-Aid Kit is included in the accessory kit of each life raft. This kit contains:

Morphine syrettes
Iodine
Burn ointment
Compress bandage
Sulfa powder
Sulfa tablets

8. Parachute First-Aid Kit, Frying Pan Insert.

A Parachute First-Aid Kit, Frying Pan Insert, contains:

Atabrine tablets
Benzedrine sulfate tablets
Halazone tablets
Burn-injury set
Iodine swabs
Salt tablets
Sulfa tablets
Adhesive gauze bandages
Compress gauze bandages
Curved needle, with 120 inches carpet and button thread (for clothing repair)
Cake soap
Compressed tea tablets

F. PARACHUTES

All crew members are required to wear their parachutes at all times during flight. Have your parachute harness correctly fitted and tacked by a competent parachute maintenance man. Check the harness fit each time you put it on. Shoulder and chest straps should be snug and without play. The chest buckle should be 12 inches below the chin, and the leg straps snug. In fact, the harness should be comfortably tight when you stand up.

Pre-Flight Check. Inspect your parachute carefully before each flight. You never know when you may have to use it. Check the date of the last inspection. The packing interval should not exceed 30 days in this climate. See that an inspection check has been made within the last ten days and entered on the AAF Form 46 in the chute. See that the opening elastics are tight and that the corners of the pack are neatly stowed with no silk visible. Check the pack cover for oil, grease, dirt, and worn spots. If you find any, turn the chute in. Good care of your chute will pay dividends if you ever have to use it.

G. DITCHING EQUIPMENT

1. Life Rafts.

There are two 5-man life rafts carried in the airplane, in the left and right raft compartments atop the fuselage. After ditching the radio operator pulls both raft releases, located on either side of the tunnel opening in the forward pressurized compartment. Pulling the handles automatically releases the rafts from the compartments and inflates them. If the internal mechanism jams you can open the compartment by external release levers located on top of the fuselage next to the compartment doors. A third raft is carried inside the fuselage, and will be thrown out of the rear hatch by crew members and inflated by pulling a ripcord on the CO_2 cylinders.

Don't jump from the plane into the rafts - you'll go right through. If a raft inflates inverted don't jump on it to right it. You'll only push out the air underneath and make it harder to turn the raft over. It may be possible for two or more men to right the raft from the wing. This may also be done by getting into the water, climbing up on one side of the raft and pulling on the handline attached to the opposite side of the raft. Remember, however, that it is better to keep dry, if possible, especially in cold weather.

Fend the rafts off the wings of the plane while launching and boarding them. Wing flaps are usually torn loose in ditching and jagged edges of flaps or wings can easily puncture rafts. When all men are aboard, tie the rafts together to keep them from drifting apart.

2. Raft Accessory Kits.

An accessory kit is furnished with each raft. Kits are normally secured inside the raft case. Stowage difficulties make it necessary to keep the kits inside the fuselage, separate from the rafts. In that case, certain crew members must be designated to take the raft kits along when leaving the plane. This step must be included in ditching drill.

Keep the separate items of equipment securely in the kit or tie them to the handline of the raft so they won't be lost if the raft capsizes. It is important to keep signaling equipment accessible, because the opportunity to use this equipment is sudden and short. The Accessory Kit contains:

Oars
Sea anchor
Sail
Rations
Bailing bucket
Shade and camouflage cloth
Drinking water
Line
First - aid kit
Inflating pump
Puncture plugs
Signal mirror
Flashlight
Fishing tackle
Jacknife
Whistle
Sea marker
Repair patch kit
Wrist compass
Signal kit

3. Emergency Radio.

Set the emergency radio set into operation as soon as weather permits. The kit is contained in two cases, strapped together, which are brought out of the plane after the ditching by a designated crew member.

Complete instructions for operating the radio are included in the kit. When you use the radio, try to keep the antenna out of the water, or your signals won't be heard. If possible, be sure to send during the three minute international silent periods, at 15 and 45 minutes past the hour.

4. Signals.

Twelve drift signals are stowed under the navigator's table and the drift signal chute is in the door just behind the navigator. Take the signals with you.

5. Hand Axe.

One hand axe is secured on the navigator's control stand next to the fire extinguisher and another on the aft compartment auxiliary panel. These axes may be useful in breaking out of the plane after ditching or crash landing.

EMERGENCY PROCEDURES

XII. EMERGENCY PROCEDURES

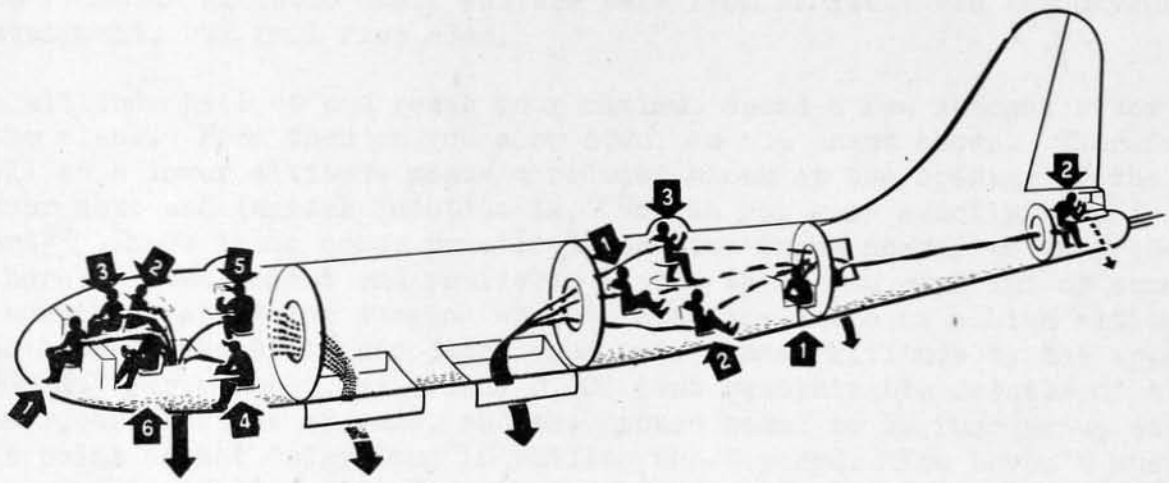
A. BAILOUT

In any bailout it is the airplane commander who decides whether or not a bailout is necessary. First, he will give a series of short rings on the alarm bell, and then order "prepare to abandon ship" as early as possible so you will have time to prepare. The warning will be given when an emergency first appears. If it develops that the pilot can handle the emergency safely without bailout, the preparation order will be cancelled later.

The pilot will give the actual bailout order by interphone and a steady ring on the warning bell. Do not leave the plane until you are ordered out! Each crew member must know when, where, and how he is to leave the airplane. The only way to assure that abandonment will be carried out safely and properly is to go through often repeated bailout drills on the ground. Every step of an actual bailout must be practiced in dry-runs. Don't forget to include simulating the destruction of designated instruments by specific crew members.

1. Emergency Exits During Flight.

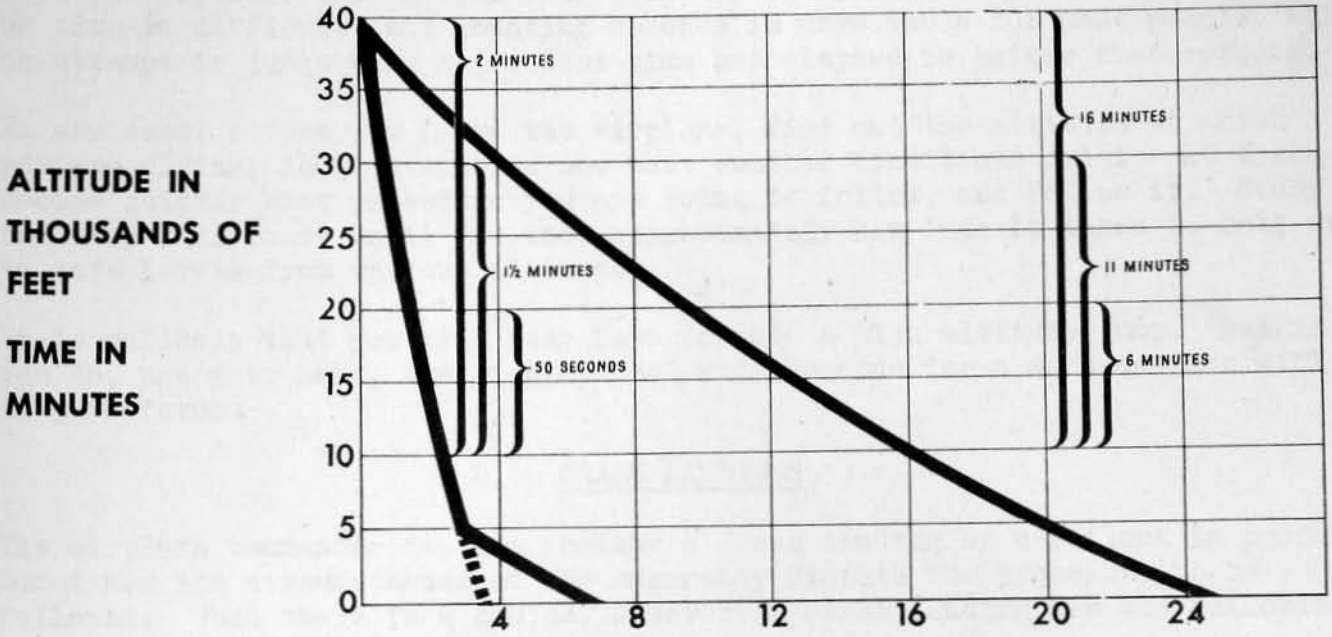
Crew members in the forward compartment can bail out through the nose wheel well when the landing gear is down or out of the forward bomb bay. Those in the rear compartment may drop out of the aft bomb bay or the rear entrance door. The tail gunner can bail out the window at his side or the rear entrance door. The following diagram shows the exit sequence and the escape hatch used by each man. Learn your part and practice the coordinated procedure with the whole crew.



2. High Altitude Jumps.

In most cases when you bailout, your first concern after you re away from the plane is to get the chute open. There is a time, however, when to delay opening your chute for a while has definite advantages. That time is when you bail out somewhere between 40,000 and 10,000 feet. By using this free fall maneuver you can minimize the hazards of: (1) Intense cold, (2) lack of oxygen, (3) enemy gunfire, and (4) excessive opening shock.

The accompanying chart shows you the length of time it takes you to get down to the relative safety of 10,000 feet in a parachute, as compared to the time it takes by free fall.



Remembering that frostbite can occur in a matter of seconds at high altitude, you can see that it is a good idea not to dawdle through that danger area in an open parachute, but to get to lower altitude quickly by falling free. The same advice applies with respect to lack of oxygen. Even if you are using a bail-out oxygen bottle, it is possible to exhaust the supply of oxygen in the bottle before you reach an altitude where you are safe from anoxia. Use the oxygen bailout equipment, but fall free also.

In a high altitude bailout you reach your maximum speed a few seconds after leaving the plane. From then on you slow down, as the chart shows. Therefore, a free fall to a lower altitude means a reduced shock at the opening of the chute. Your next and logical question is, "How do you know exactly when to pull the ripcord?" There is no good, practical, one-two-three answer to that question. However, here is some honest and realistic advice which you may find of some help. A workable method for judging when to open the chute in a high altitude jump is to look at the earth and judge your approximate altitude by the appearance of the ground. For example, at around 5,000 feet recognizable details of the earth appear, the horizon spreads, and the ground seems to be rushing up at you. After that point do not delay long in pulling the ripcord. You haven't much time left. One limitation of this method is difficulty in seeing the ground because of weather conditions. Clouds at high altitudes are usually broken masses. If you can not see the ground but notice that broken clouds become a solid layer below you, wait until just before you enter the solid cloud formation and then pull the ripcord. These unbroken undercasts do not extend up to great altitudes, and when you enter one you are usually low enough to open your chute safely. Note: This procedure applies to bailout at high altitudes into clouds. Use judgement in following it. For example, if you bail out in clear atmosphere, and far below you can see a low undercast, pull the ripcord before you get into the undercast. It might just cover the top of a mountain.

There are times when the above procedure is inapplicable. For example, on a dark night visual references are useless. Or, you may be unable to fix your vision on ground reference points because your body is spinning. In such circumstances, if you have no other guide for estimating the proper time to pull the ripcord, depend upon your sense of the passage of time. Judgement of time is difficult, and counting seconds is unreliable for most people, but an attempt to judge when sufficient time has elapsed is better than nothing.

In any case, before you leave the airplane, find out the altitude at which you are flying; look outside to see what weather conditions exist; and then decide quickly what procedure you are going to follow, and follow it. Study the free fall chart until you know approximately how long it takes to fall free to safe levels from various altitudes.

It is unlikely that you will ever have to make a high altitude jump. But if you do, use your head, try to keep cool and the odds for a safe descent will be in your favor.

B. CRASH LANDINGS

The airplane commander decides whether a crash landing or a bailout is preferable. Sometimes the circumstances of the emergency dictate the procedure to be followed. When there is a choice, however, a crash landing has the following advantages:

a. The crew can remain together for mutual support.

b. Searchers can spot the outline of the airplane more easily than they can see individual signals.

c. The airplane provides fuel, shelter, equipment and tools.

If possible make the decision to crash land early enough to give the crew time for adequate preparation. The pilot should notify the crew to start preparation by appropriate alarm signal and by ordering "Prepare for crash landing" over the interphone. Successful crash landings, like successful ditchings, depend on the crew's familiarity with the proper procedures. Frequent dry-run drills are essential.

The general procedure for crash landings is similar to that for ditching. However, crash landing positions in the gunners' and radar compartment are considered safe since deceleration isn't so rapid as in ditchings and since such hazards as the surge of water through the pressurized doors, if they collapse, and through the nose, if it caves in, don't exist. In the ditching procedure, positions in these compartments have been eliminated. The following outline and Figure 3 cover the positions to be assumed in crash landings.

1. Crash Landing Positions.

Pilot	Normal position.
Co-pilot	Normal position.

Flight Engineer	Normal position.
Radio Operator	Sitting position next to Flight Engineer.
Navigator	a. Two gun forward turret. Normal position in navigator's seat, with safety belt fastened. Slides seat full forward. Faces forward with legs braced. Rest head on arms on table with pad protecting head. b. Four gun forward turret. Folds table top up and moves navigator's seat to rear. Assumes sitting position on floor with back well cushioned and braced against panel under navigator's table. Hands are clasped tightly behind head, knees flexed.
Bombardier	Moves to gunners' compartment and assumes sitting position on floor with back cushioned and braced against front pressurized bulkhead.
Top Gunner	Assumes sitting position on floor in gunners' compartment with back cushioned and braced against front bulkhead.
Left Gunner	Remains in normal flight position.
Right Gunner	Proceeds to rear unpressurized compartment, opens escape hatch, and assumes sitting position facing aft, on floor with back cushioned and braces against rear pressurized bulkhead.
Radar Operator	Assumes sitting position in radar compartment on floor with back against armor plate bulkhead on right side of entrance. Before taking position he opens the rear door of the pressurized compartment and fastens it securely to prevent it from closing and jamming shut.
Tail Gunner	Can remain in normal flight position or proceed to the rear unpressurized compartment, assuming a sitting position on the floor with his back against the rear pressurized bulkhead, hands and cushion behind his head.

Don't relax your braced position until the airplane has come to a complete rest.

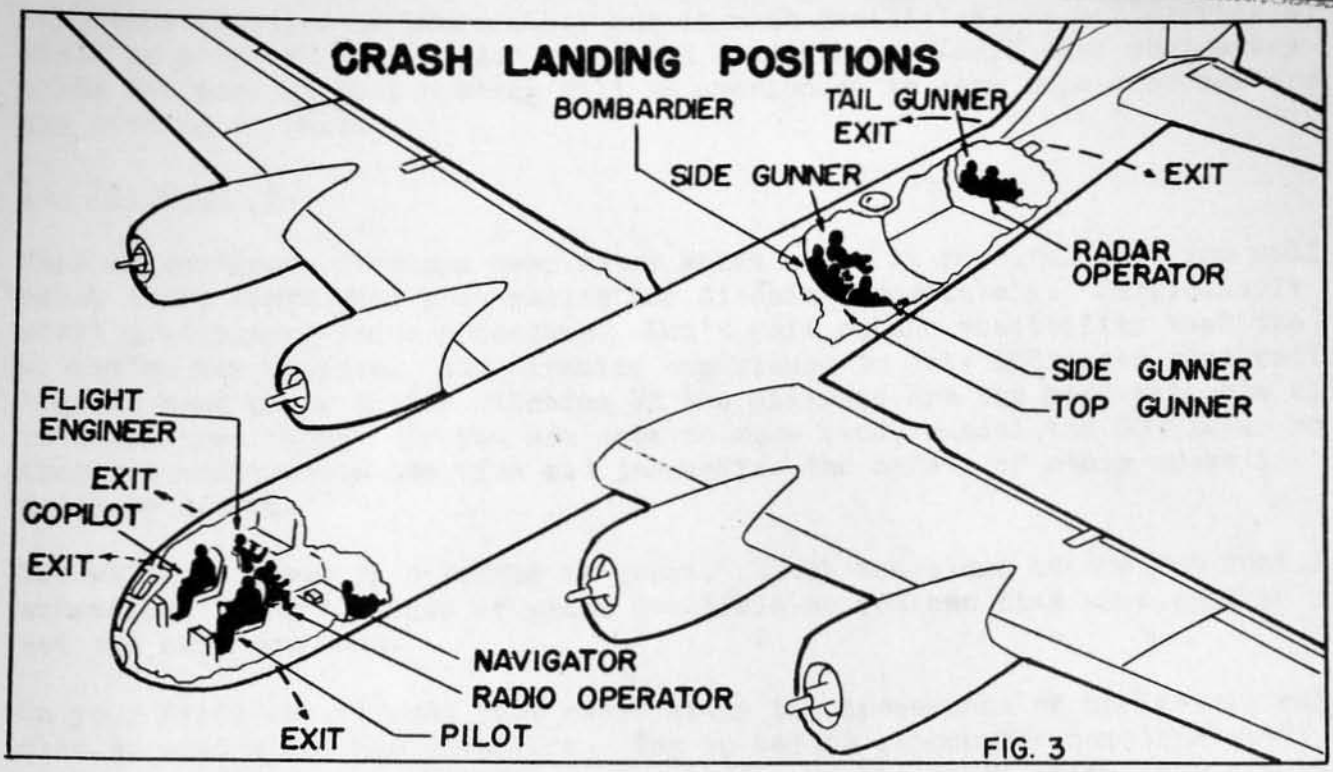


FIG. 3

2. Procedure after landing.

Usually the question of staying with the plane or destroying and leaving it will be answered for you in pre-mission briefings. If you leave the airplane be sure to take with you all the equipment you might need on your way back to a base. Also dismount and either destroy or take with you any highly secret equipment. All first aid, signaling and sustenance kits, any extra rations and everything else which might contribute to safety and comfort should be packed along with you.

C. DITCHING

Ditching is the forced descent of land planes on water. It is extremely hazardous but the experience of many bomber crews has proved that it can be done successfully. The crew has two main problems in ditching. One is adequately bracing against the terrific impact of the water landing. The other is getting out of the airplane with the equipment they must take along before the plane sinks. The length of time a bomber will float is measured in seconds, not minutes.

The ditching will come off successfully only if you are so thoroughly drilled in the proper procedures that your reaction is automatic. If proper ditching procedure is followed, a minimum of confusion results and nothing is omitted which might contribute to the safety of the whole crew. Successful ditching depends on constantly repeated drills. As often as time permits, the whole crew must practice together the coordinated steps in the ditching procedure. Wet ditching drill involving the actual launching and boarding of life rafts

in a body of water is preferable, but if such facilities are not available, drill in your own plane under simulated conditions. Learn also what every other man does so that nothing will be overlooked in case some crew members are missing or hurt.

1. Preparation.

When an emergency develops over water which makes it doubtful that you will reach land, start your preparation for ditching immediately. Particularly start preliminary radio procedure. Don't wait on the possibility that the situation may improve. All ditching experience to date indicates that radio signals sent prior to the ditching of the aircraft are the most valuable aid to searchers. Note: If you are able to make land, cancel the SOS later so that you won't waste the time and jeopardize the safety of other crews in needless search.

The value of power in ditching is great. Ditch the plane before the fuel is exhausted. Keep a margin of speed available so you can pick your spot to set the airplane down.

On your first few flights over water study the appearance of the sea in relation to wind speed and direction. Try to become thoroughly familiar with surface conditions as an index to the wind. During every over-water flight keep wind direction, wind speed, and the condition of the sea constantly in mind so that you will be prepared if ditching becomes necessary.

a. Waves move downwind, except close in-shore. Waves break downwind, but remember that the foam from the wave crest appears to slide down the back, or windward, side of the breaking wave. This often makes the direction of the break difficult to judge from altitude.

b. Spray from wave crests is blown downwind.

c. Swell is a rising and falling of the sea surface. It does not indicate wind direction.

d. Smoke from surface vessels drifts with the wind. The trail of the smoke, however, is caused by wind plus the ship's forward motion. In this case wind direction is somewhere between the forward path of the ship and the smoke trail.

e. Wind lanes are alternating strips of light and shade which appear on the surface of the sea. They lie parallel to the direction of the wind, but in a steady wind it is difficult to tell from which direction the wind is blowing down the lane.

f. Wind Speed.

A few white crests	10 - 20 mph wind
Many white crests	20 - 30 mph wind
Streaks of foam along water	30 - 40 mph wind
Spray from crests	40 - 50 mph wind

Wind speed can be judged fairly well by the roughness of the sea. However, the wind will be stronger than the appearance of the sea suggests if it is freshening, blowing off a nearby shore, running with the tide or swell and during heavy rain. Breaking waves may be due to shallow water and such circumstances should not be used in calculating wind speed and direction. Strength of the wind can be estimated from the conditions of the sea fairly accurately through use of the above table.

2. Handling of the Airplane in Ditching.

The following three points should be kept in mind on the ditching of landplanes.

a. The approach path should be as flat as possible.
b. The forward speed should be as low as possible.
c. The rate of descent should not exceed 200 feet per minute.

It is necessary to remember that landplanes cannot be put down on water with the intention of planing along the surface like a seaplane. The fuselage of landplanes is not strong enough for this.

Although there has been some dispute over the use of flaps in ditching, it is now agreed that flaps can be used to advantage. Flaps should be lowered to reduce the speed at which the plane can approach and touch down. The stall speed difference between flaps up and full flaps down is over twenty miles an hour and it is not probable that safer contact could be made at the higher speed. With full flaps the maximum lift is obtainable with the fuselage at approximately 8° to the water which is a 12° angle of attack of the wing. This allows the body to touch first in the region of the rear turret with the propellers still clear of the water. The flaps will touch at approximately the same time, but will break immediately and have no effect upon the airplane's actions.

The landing gear should be kept in the retracted position during a landing at sea. If down, the landing gear will act as a terrific drag as it contacts the water first and may flip the plane over or cause heavy damage.

Assuming that symmetrical power is not available, the normal glide approach speed should be used. This will insure control and some margin of speed after flattening out and permit the pilot to choose the best spot for ditching. The pilot should hold off until he loses all excess speed above a stall.

If the sea is calm and there is little wind, the plane should be put down along the top of a swell. With wind of any strength, however, the plane should be landed upwind near the top of an oncoming wave or swell. It is always desirable to land along the top of a swell but when such landing will mean a strong cross wind, it should be rejected in favor of an upwind landing. If because of wind, the ditching is made across the swell, the plane should be put down on an upslope towards the top. There will be situations when the pilot must choose a compromise landing. And there will be situations, of course, where the pilot will have no choice in this matter because of damaged controls or other reasons. Although in some cases a downwind landing cannot be avoided, it is always dangerous.

Use of power in ditching.

a. If the power is symmetrical, such as, if the two inner motors are operating, both engines can be used to the full if necessary to flatten the approach, reduce speed and retain control.

b. If the power is not symmetrical, for instance with number two and four out, it will be possible to use some power adjusting the throttles so that little rudder is needed.

c. The value of power in a descent at sea is so great that when it is certain that land cannot be reached, the pilot should always try to bring his plane down before the fuel is entirely exhausted.

It is advisable to hold the tail down slightly so that the nose will not come down into the water with enough force to cave in the bombardier's compartment. If the airplane alights tail down, there will be a jolt as the tail strikes, followed by a severe impact and violent deceleration. If you come in too fast on a calm sea, there will be a tendency to bounce; hold the control column back hard. In a sea with average size waves, the tail will touch the crest of the wave first. Keep the nose up so the forward part of the airplane will touch the next wave crest approximately under the center of gravity.

3. Crew Procedure.

This is a recommended crew procedure which has been worked out after a study of narratives covering ditching of four B-29's in our operations and discussions with personnel involved in ditchings and crash landings. It has been difficult to evaluate some of the ditching positions because of the four ditchings, two aircraft landed nose into a swell rather than along the top of the swell; in a third an explosion occurred; and in the fourth, the B-29 landed on the smooth water of a lake. Also in each ditching, except the lake landing, an unfortunate accident occurred in at least one of the compartments of the airplane. From these experiences it has been decided to eliminate ditching positions in the gunner's and radar compartments. The following procedure and ditching positions have, therefore, been established.

a. Pilot.

Give the co-pilot warning: "PREPARE FOR DITCHING IN ___ MINUTES." Give several short rings on the alarm bell. Turn the IFF emergency switch to ON. Remove your parachute harness, flak suit, and winter flying boots, but keep your flak helmet on. Fasten your safety belt.

Advise any accompanying aircraft of your distress by radio, then turn to interphone.

Give the co-pilot the order: "OPEN EMERGENCY EXITS AND THROW OUT EQUIPMENT". If possible, give this order above 5000 feet.

Give the co-pilot the order: "STATIONS FOR DITCHING. IMPACT IN ____ SECONDS." If possible, give this order above 2000 feet. Order the flight engineer to "STOP INBOARD ENGINES". Feather the inboard propellers. Simultaneously, push both radio destruction buttons. Open windows, brace your feet on rudder pedals, knees flexed. About five seconds before impact, give the co-pilot the order: "BRACE FOR IMPACT".

Exit through the left window. If the plane is not afire, inflate your life vest when on the window ledge. Climb atop cabin, then to left wing.

b. Co-Pilot.

Relay the pilot's command over the interphone call positions: "PREPARE FOR DITCHING IN ____ MINUTES". Receive acknowledgments. Tell the pilot: "CREW NOTIFIED".

Remove your parachute harness, flak suit and winter flying boots, but keep your flak helmet on. Fasten your safety belt.

Stand by on interphone to relay the pilot's orders.

Relay orders: "OPEN EMERGENCY EXITS AND THROW OUT EQUIPMENT", and check on the crew's progress.

Relay order: "STATIONS FOR DITCHING. IMPACT IN ____ SECONDS". Open side window, brace feet on rudder bar with knees flexed, and when the pilot gives the order: "BRACE FOR IMPACT", send one long ring on the alarm bell.

Exit through right window. Inflate life vest on window ledge. Climb atop cabin, thence to right wing. Secure right life raft or pull outside raft release handle if necessary.

c. Bombardier.

Acknowledge in turn: "BOMBARDIER DITCHING".

Remove your parachute harness, winter flying boots, and flak suit, but keep flak helmet on.

Open bomb bay doors, jettison bombs, jettison destroyed bombsight and data, ascertain that other crew members have finished jettisoning all loose equipment and then close and check bomb bay doors. Shoot out ammunition from front turrets.

On command from the pilot assume a sitting position next to the flight engineer, with your back cushioned against the co-pilot's armor plate, hands and cushion behind your head, and knees flexed.

Pick up any emergency equipment in the front compartment and hand it to the flight engineer. Exit second through the front emergency hatch behind the flight engineer. Inflate your Mae West on the window ledge. Use the front top turret gun to climb atop cabin, thence to left wing.

Assist the pilot in preparing the raft and equipment and assembling the men to board the life raft.

d. Flight Engineer.

Remove your parachute harness, flak suit, and winter flying boots but keep your flak helmet on.

Open the front emergency hatch and acknowledge to the co-pilot: "FRONT HATCH OPEN". Jettison it together with any other loose equipment through front bomb bay.

Get the emergency signal kit and tie its line to your arm.

Stop the inboard engines on the pilot's command. Take your regular position facing aft and keep to your left with your head and shoulders braced against the co-pilot's armor plate, safety belt fastened and hands braced against the control stand.

Carrying the signal kit, exit immediately through the front emergency exit.

If the airplane is not afire, inflate your life vest while on the window ledge. Climb atop the cabin and proceed to the right wing.

Assist the co-pilot in securing the life-raft, setting up the equipment and assembling the men to board the raft.

e. Navigator.

Acknowledge in turn: "NAVIGATOR DITCHING".

Remove your parachute harness, winter flying boots and flak suit, but keep your flak helmet on.

Calculate the position, course, altitude, and ground speed for the radio operator to transmit.

Give the pilot surface wind strength and direction. Destroy classified documents.

Gather your maps and navigation equipment into a water proof bag or tuck inside your clothing.

Jettison all drift signal flares through the release tube. Assist in jettisoning all loose equipment, then close the pressure door to bomb bay.

(1) In the two gun forward turret model return to your original position in the navigator's seat and fasten your safety belt. Slide the seat fully forward and face forward with your legs braced. Place a pad over the edge of the table, rest your head on your arms on the table. Exit fourth through the engineer's emergency hatch.

(2) In the four gun forward turret model fold the table upward and move your seat stand as far aft as possible. Assume a sitting position on the floor with your back well padded and braced against the panels under the navigator's table. Place your hands and a cushion behind your head. Exit fourth through the engineer's emergency hatch, or make your exit through the astrodome opening.

Inflate your life vest and proceed to the right wing with your navigation equipment.

f. Radio Operator.

Acknowledge in turn: "RADIO OPERATOR DITCHING".

Remove your parachute harness, flak suit, and flying boots, but keep your flak helmet on.

Set IFF emergency switch ON. Put out the trailing antennae. Transmit the position, course, altitude and ground data as received from the navigator on MF/DF (medium frequency, direction finding). Relay fixes or bearings obtained to the navigator. Give MF/DF contact all data as soon as possible without waiting too long for an answer.

Destroy classified material and check the IFF setting. Continue to send emergency signals.

In the two gun forward turret model, you can assume either of the following positions:

(1) Assume a sitting position on the floor with your back against the rear of the engineer's control stand, back and head well-cushioned, and knees flexed, facing aft. If a pad is available, hold it in front of your face to protect it against any dislodged articles.

(2) Lie down cross-wise on the floor, with a cushion and your back against the wheel well step; bend at the hips

to extend your legs alongside of the turret well. Protect your head with a cushion.

In the four gun forward turret, you have a choice of the following positions:

(1) Assume a sitting position on the floor at side of the navigator with your back against the panels under the navigator's table. Your back and head should be well cushioned, and knees flexed.

(2) Assume a sitting position on the aft side of the dome of the forward lower turret, facing toward the rear, with your back against the forward upper turret, and knees flexed and legs braced against the front pressurized door.

Pull both the life raft release handles on the rear pressure bulkhead. New model aircraft with the quickly removable astrodome affords an easy exit through the astrodome opening. In the early model aircraft exit will be made through the engineer's escape hatch following the bombardier. After making your exit, inflate your Mae West and proceed to the left wing.

g. Top Gunner.

Acknowledge in turn: "TOP GUNNER DITCHING".

Remove your parachute harness, flak suit, and winter flying boots, but keep your flak helmet on.

Shoot out the ammunition from the rear upper turret. Check with other gunners to be sure all ammunition has been shot away.

Close the pressure door to the bomb bay and reinforce it if possible. Proceed to the rear unpressurized compartment and with the other gunners dismount and jettison through the rear entrance, the K-19 camera and auxiliary power unit.

Assume a sitting position against the rear pressurized bulkhead, with your back well cushioned, hands clasped tightly behind head, knees flexed, and facing aft.

Exit second through the rear escape hatch after assisting in handing the emergency equipment through the hatch. Take the emergency equipment to the left wing and with the right gunner inflate the third life raft and place emergency equipment in this raft.

h. Right Gunner.

Acknowledge in turn: "RIGHT GUNNER DITCHING".

Remove your parachute harness, flak suit and flying boots, but keep your flak helmet on.

Proceed to the rear unpressurized compartment and work on the dismounting of the K-19 camera and the auxiliary power unit. Jettison these units plus other unnecessary equipment through the rear entrance. Open the rear escape hatch and remove hatch if possible.

Assume a sitting position on the left side of the compartment, with your back against the rear bulkhead of the radar compartment. Face aft, with your knees flexed and a cushion and your hands behind your head.

Exit first through the rear escape hatch. Inflate your Mae West and stand by to receive the emergency equipment. Then proceed to the left wing, inflate the life raft and place the emergency equipment aboard.

i. Left Gunner.

Acknowledge in turn: "LEFT GUNNER DITCHING".

Remove your parachute harness, flak suit and flying boots, but keep your flak helmet on.

Proceed to the unpressurized compartment and assist in the dismounting of the K-19 camera and auxiliary power unit. Assist in jettisoning these units and other surplus equipment through the rear entrance. Insure that the rear entrance door is securely fastened.

Assume a sitting position on the right side of the rear unpressurized compartment next to the radar operator with your back cushioned and braced against the rear bulkhead of the radar compartment, knees flexed and hands clasped tightly behind your head.

Exit third through the rear escape hatch. Inflate your Mae West and stand by to assist other men to escape. Then proceed to the left wing and assist in preparing the emergency equipment for use.

j. Radar Operator.

Acknowledge in turn: "RADAR OPERATOR DITCHING".

Remove your parachute harness, flak suit, and flying boots, but keep your flak helmet on.

Collect and jettison any unnecessary and loose equipment in the compartment.

Relay the pilot's interphone instructions to the gunners. Keep the pilot informed of the action underway. Proceed to the rear unpressurized compartment and close the rear pressurized door.

Place the third life raft pack on the floor in the corner between the rear pressurized door and the rear entrance door. This will aid in preventing collapse of the entrance door and also with the radar operator sitting on the pack, permit four men to sit with their backs against the rear pressurized bulkhead.

After the last impact, assist in moving the emergency equipment through the escape hatch and exit fourth. Inflate your Mae West and proceed to the left wing.

k. Tail Gunner.

Acknowledge in turn: "TAIL GUNNER DITCHING".

Remove your parachute harness, flak suit and flying boots, but keep your flak helmet on.

Shoot out ammunition in guns. Jettison tail gunners escape hatch.

Remain in seat, facing aft, back and head cushioned against back of seat and compartment bulkhead, knees flexed.

Exit thru gunners escape hatch to left horizontal stabilizer, inflate Mae West and proceed to right wing.

4. Escape From the Plane.

Once the plane has come to rest on the surface, the action of the crew must be quick and efficient. At best, land planes will float but a short time. The length of time depends on many factors such as injury to the fuselage, buoyancy of plane, and condition of the sea.

In any event, the crew of a plane brought down at sea must act quickly. It is imperative you get out of the plane, inflate the raft and board it with the necessary equipment. As has been seen, a fairly large deceleration force may be experienced at the time of impact. It may be sufficient to partially stun members of the crew and to hurl loose equipment about the fuselage. However, if the distress drill has been correctly taught and faithfully practiced, members of the crew will be able to do the correct thing almost instinctively. The fact that a great deal of confusion may exist during the crucial few moments the plane floats makes it imperative that all crew members know their jobs and do them without confusion or doubt.

When a plane comes down into the water, there may be two impacts. A fairly slight one can be expected as the tail first makes contact and a more violent one as the plane itself settles. The crew should be very careful not to change positions or rise from ditching stations until the plane has come to a complete stop. As soon as the motion of the plane stops, the escape

procedure should be started. The crew member delegated to the job should operate the life raft compartment releases. The release should not be gripped before or during the descent as the impact may cause the release to operate. If this is done, the raft may be ejected from its compartment while the plane is still moving and thus break free and drift out of reach.

Other members of the crew, as soon as the plane comes to rest must rise from ditching stations, carefully collect such equipment as is detailed for each in drill, and leave by the hatch used in practice. In the B-29, the third life raft and equipment sacks should be moved through the rear escape hatch and to the left wing. There, the life raft will be inflated and the auxiliary equipment will be placed in the life rafts ejected from the fuselage compartments. Two men, the pilot and co-pilot, will assist the two life rafts from their compartments and see that they are properly inflated. Care must be taken that there are no tangling lines which might cause the raft to burst.

Since the escape hatches are not overly large it is recommended that crew members inflate their life vests immediately on emerging from a hatch. The crew should not be surprised to find that waves are breaking over the plane. If they are large, it is possible that men may be swept off. It is recommended that a life line be attached to the inside of the hatch.

During the first phases of the distress procedure, parachutes should be kept on or near-to-hand in case descent by parachute should become necessary. However, when the altitude falls below 1,000 feet, parachutes should be removed. They should not be entirely discarded, however, since they can be used to pad projections near ditching stations and prevent possible injury. During the escape from the plane, it would be well if two or three members of the crew took along their parachute packs. Parachutes can have many uses in the raft or on the water. The packs have a certain buoyancy and can be used for a short time to remain afloat. The parachute can be used to make sails, catch rain water, for shade and signaling during the stay aboard the raft.

The man designated to assist the raft from its compartment should also make sure it inflates properly and is launched right side up. If the raft inflates in an inverted position, efforts to right it should be made from the wing. If this fails or the plane is sinking rapidly, one man should jump into the water and right the raft. Crew members should not jump onto an inverted raft as this will expel air trapped beneath and make the righting more difficult.

Rafts are attached to the plane by a light rope. This rope is intentionally light so that it will break if the plane sinks while the raft is still attached. If the ditching has been made into the wind, the raft should float toward the tail and the boarding should not be difficult. If there is a cross wind after the plane comes to rest, the plane will tend to swing into the wind. If the raft is on the upwind side, there is danger that it will become wedged under the wing as the plane rolls and swings into the wind. If the raft is on the downwind side, there is danger that it will be caught beneath the fuselage or tail of the plane which may be threshing up and down. Care should be taken that jagged edges of the wing, tail or fuselage do not puncture the raft.

D. FIRE

The B-29 is equipped with a CO_2 system fed by two high pressure CO_2 bottles mounted in the nose wheel well. Lines from each bottle run to all four engine nacelles. The flight engineer can direct the CO_2 charge to the desired engine by turning the selector knob on his instrument panel, and pulling the CO_2 release handle (or both handles, if desired) for the bottle he wishes to use.

Besides the nacelle extinguisher system each airplane is equipped with three hand extinguishers, two CO_2 and one carbon tetrachloride, for extinguishing cabin fires. One CO_2 extinguisher is located on the inboard side of the flight engineer's control stand, the other is in the aft pressurized compartment aft of the auxiliary equipment panel. The carbon tetrachloride extinguisher is located beside the rear entrance door.

1. Precautions In Use of Fire Fighting Equipment.

   a. To use the carbon dioxide extinguisher, stand close to the fire, raise horn, and direct gas to the base of the fire. Hold on to the insulated tubing to avoid frostbite from grasping the metal horn on the top of the cylinder. The white discharge is "dry-ice".

   b. To stop the flow of gas, replace the horn in the clip on the side of the cylinder. Recharge the extinguisher after each use.

   c. Stand as far as possible from the fire when using the carbon tetrachloride extinguisher. The effective range is 20 to 30 feet. To operate, turn the handle and pump it. Keep the stream full and steady. To shut off, push the handle in and turn it until the sealing plunger is depressed.

   d. When sprayed on a fire, carbon tetrachloride produces phosgene a very poisonous gas, which can be harmful even in small amounts and may be fatal. Do not use it in a confined area and do not stand near the fire. Ventilate as soon as fire is extinguished.

2. Engine Fires.

   a. Nacelle or engine fire on the ground. If the fire is known to be a torching turbo, put it out by increasing the throttle setting momentarily. For other engine or nacelle fires on the ground, use the following steps:

      (1) Move the mixture control to idle cut-off on all four engines.
      (2) Close fuel shut-off valves for all engines.
      (3) Turn off the booster pump switches for all engines.
      (4) Close the throttles.
      (5) Open the cowl flaps.
      (6) Set nacelle fire extinguisher to the proper engines. Pull first one, and then, if necessary, the other fire extinguisher control handle. The flight engineer will check with the

scanners on the condition of the fire before pulling the second control handle. Note: The engine fire extinguisher is for fires in the accessory section and is not effective against fires in the engine itself. If the fire is still burning:

(7) Turn all ignition switches off.
(8) Turn battery switch off.
(9) Stop auxiliary power plant.
(10) Send crew members for additional ground fire fighting equipment.

3. Nacelle Fire In Flight.

a. A crew member spotting a fire uses the "call" position on the jackbox and says, "FIRE ON NO.__ ENGINE". If possible, crew members will identify fires as to type and location. From this point, at the pilot's discretion, the following procedure should be used.

(1) Pilot feathers propeller and says to flight engineer, "USE ENGINE FIRE PROCEDURE".
(2) Flight engineer moves the mixture control for the engine afire to the IDLE CUT-OFF position, and shuts off the fuel valve and boost pump as the pilot increases the air speed in an attempt to blow out the fire.
(3) Set cowl flaps to not more than 15 degrees and close the throttle.
(4) Set nacelle fire extinguisher to the proper engine, pull first one, and then if necessary, the other fire extinguisher control handle.
(5) The flight engineer closes the cabin air valves and the radio operator closes the forward pressure door. If smoke has entered the cabin, the co-pilot opens his window. In case of excessive smoke or fire in the cabin, follow the procedure under "Cabin Fires During Flight" (Paragraph 4 below).
(6) If the fire is out of control, open the bomb bay doors, and abandon the airplane.
(7) If an engine catches fire during take-off, the pilot will if unable to put out the fire, make an emergency landing following the crash landing procedure when necessary.

4. Cabin Fires During Flight.

In all cabin fires during flight, immediately pull the emergency pressure relief handle if the cabin is pressurized. If the fire is in the rear compartment, use the CO_2 extinguisher first and then, if necessary, use the portable carbon tetrachloride extinguisher. If the fire is in the forward compartment use the CO_2 extinguisher mounted beside the flight engineer's control stand.

If the cabin fire is caused by an electrical short circuit, the procedure is the same except that the flight engineer must turn all electrical power off with the battery and generator switches.

If the cabin becomes excessively smoky or gaseous after using the fire extinguishers, open the bomb bay doors for ventilation. If the fire is extremely bad, and there is danger of an explosion from fuel tanks, sound a series of short rings on the alarm bell so the crew can prepare to abandon the airplane.


WEATHER
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XIII. WEATHER

As our B-29 operations will cover a vast area, no attempt will be made to describe fully the weather conditions which will be encountered between the Rear and Forward Areas and on combat missions. Rather, an attempt will be made to describe only the salient features and hazards to operations. For further detailed information it is recommended that the pilot consult his Group Weather Officer.

A. WEATHER CONDITIONS - ROUTE FROM REAR TO FORWARD AREA

To describe adequately the weather conditions from the Rear to the Forward area, it is best to divide the route into three sections and discuss them separately by season. As the principal weather features are caused primarily by the geography of the region, the route divides into the following three parts: (1) India (2) The "Hump" (3) China.

1. India

The weather in India can conveniently be broken into four seasons: (1) December through February, which is the winter or northeast monsoon season; (2) March through May, which is the spring transitional season; (3) June through September, which is the southwest or summer monsoon season; and (4) October and November, which is the fall transitional period.

a. December through February. This is the season of good weather. The skies are generally clear, but are interspersed with brief spells of medium cloudiness. Thunderstorms are rare, but three or four days of thunderstorms and turbulence may be expected in Assam. Visibility is usually rather poor; it is usually three to five miles in haze and dust during the day and is restricted to one to two miles due to ground fog during the evening and early morning, expecially in the Assam Valley where it often drops to one-half mile in ground fog. Winds are usually north to northwest up to 3000 feet at 10 to 15 miles per hour, and northwest to west above 3000 feet. The velocity increases with height and reaches 25 to 35 miles per hour at 15,000 feet.

b. March through May. The cloudiness starts to increase during this season, averaging 2/10 to 5/10 in March and 4/10 to 7/10 in May. This is the season of northwesters in Bengal, which consist of a line of particularly violent thunderstorms. Three or four northwesters may be expected during this season. Surface velocities reach 60 to 80 miles per hour. During infrequent periods of low cloudiness, ceilings are likely to average 1000 to 2000 feet, otherwise they are unlimited. Visibility is usually six miles or better except during morning hours when it may be restricted by fog or mist. Winds are south to southwest at 10-15 miles per hour up to 3000 feet and shift to west to northwest and increase to 25-30 miles per hour from 3000 to 15,000 feet.

c. June through September. This is the cloudiest season of the year, averaging from 7/10 to 9/10 cloud cover. There are several cloud layers present and ceilings usually run from 3000 feet to 1000 feet and lower to 500 feet or less in frequent afternoon rain showers. During this, the monsoon season, the visibility is usually over six miles except when restricted to one or two miles in rain. Winds are south to southeast at 12 to 20 miles up to 13,000 feet.

d. October and November. The cloudiness decreases to 2/10 to 4/10 by the end of October. Clouds are usually of fair weather cumulus type with a few afternoon thunderstorms. Visibility is good during the day, but may be restricted to one to two miles in early morning fog. Winds are northeast to east at 10 to 12 miles per hour up to 6000 feet, are variable above, and become westerly at 15 to 20 miles per hour above 10,000 feet.

2. The "Hump"

Weather over the "Hump" can be conveniently broken up into four seasons. (1) Spring refers to the months February, March and April; (2) Summer includes May through September; (3) Fall refers to October and November; and (4) Winter consists of the months December and January. The periods are not of equal length, but are so defined for the similarity of the weather during the particular season. Any particular date does not mark a definite change in the characteristics of the period, as the same features may be observed near the border of an adjacent period.

a. Spring. During this season west to southwest winds, increasing cloudiness, and severe turbulence cause the worst flying weather of the year. There is considerable thunderstorm activity and the clouds build up to 25,000 to 30,000 feet. Average cloud tops are above 20,000 feet during the late afternoon, with the highest clouds to the north of the route and the lowest over Myitkyina and the Hukon Valley. Considerable icing can be expected in the clouds between 12,000 and 20,000 feet. It may be rime or clear or a mixture of both. Turbulence and icing are severe in the cumulus activity. Winds above 12,000 to 15,000 feet are extremely strong. They are from west to southwest averaging 40-60 miles per hour, and speeds of 100 have been frequently reported. March combines the strongest winds with highest cloud build-ups. Thunderclouds which first appear in February increase in intensity during March, and frequently reach to 30,000 feet. By the latter part of April the high winds have decreased to 20 to 30 miles per hour. However, they are still from the southwest. Turbulence and icing also decrease in intensity during the month of March.

b. Summer. During this season of the year the clouds follow fairly typical patterns. Early in the morning a low deck of stratocumulus or altocumulus will form which can be topped at 16,000 to 17,000 feet. These will be broken up rapidly by cumulus, which start to build up by 0800 Local Time, and which reach 20,000 to 30,000 feet during the afternoon. On particularly bad days these cumulus will

merge and cause instrument conditions over the "Hump". Turbulence will then be moderate to severe. The lowering cumulus flatten out at night and there is a marked tendency for the "Hump" to clear by midnight. The whole cycle repeats itself again starting about 0300 Local Time. The most predominant features are the afternoon thunderstorms, which form over the first ridge and the "Hump" proper. Turbulence, ice and precipitation are usually severe, but as these thunderstorms seldom form in a line, it is usually possible to avoid them. Occasionally, however, it has been reported they have been completely hidden by other cloud formations. Ordinarily, rime ice is the only type of wing icing encountered. The freezing level fluctuates from 16,000 to 20,000 feet, but the average is 18,000 feet.

c. Fall. During this season, the "Hump" weather is predominately good. Clouds have begun to clear in early October but the wind speeds have picked up to 30 to 40 miles per hour from the west by the end of November. Turbulence is light and there is some rime icing. The freezing level is between 13,000 and 15,000 feet.

d. Winter. This season is usually cloudless. The wind speeds are high and are usually well over 50 miles per hour from the west or southwest, while there have been several periods of one to three days at a time where the winds were from 80 to 100. A few cold fronts may cross the "Hump" during this period and when they do the combination of unstable air and upslope motion causes extremely bad conditions. Cumulus will sometimes build to over 30,000 feet. However, these conditions seldom last for more than 36 hours. The freezing level is between 14,000 and 16,000 feet and where clouds are encountered icing is rather severe. The most dangerous level is between plus two and minus ten degrees centigrade.

3. China

In China the weather divides itself into two main seasons: Winter and Summer. Winter includes the months November through April; Summer consists of the months May through October.

a. Winter. Of the two seasons, Winter is definitely the worse. As the forward bases lie in a pocket surrounded by mountains reaching to about 10,000 feet on all sides, air becomes trapped and stagnates there for long periods of time. The greatest hazard to flying is the poor visibility caused by haze. Visibility is rarely over six miles during the day and falls to as low as one - half to one mile during the periods of darkness. It is worse at sunrise and shortly after sunset. Ceilings will average between 2000 and 3000 feet and there are about 18 days per month when the sky is more than 5/10 covered. The clouds are stratiform and occur in layers up to and above 12,000 feet. As the freezing level fluctuates from a low of 4000 feet in January to high of 12,000 feet in April, the danger of

collecting rime ice on descent or ascent is always possible. Precipitation is light during this season, being mostly in the form of drizzle. There is an average of four rainy days per month. Surface winds are light northerly, while winds above 10,000 feet are moderate and are usually westerly.

b. Summer. As the visibility improves, Summer can be considered the better of the two seasons. There are about 25 cloudy days per month, but the clouds are cumulus type which give broken sky cover with ceilings above 3000 feet. The combination of the monsoon and upslope effect gives about 14 rainy days per month. Visibility is good, rarely falling below three miles except in precipitation. The freezing level fluctuates from 12,000 feet in October to 20,000 feet in August and icing will cause little trouble except in May and October.

B. WEATHER CONDITIONS OVER MANCHURIA, JAPAN, FORMOSA, SOUTHERN CHINA AND THE PHILIPPINE ISLANDS.

1. Manchuria

In the Winter the climate of Manchuria is dominated by polar continental air masses, and in the Summer by maritime subtropical air masses. Fall and Spring are periods of transition from one air mass to the other. Consequently, the Winter season with 11 to 16 days per month with clear skies and its cold, dry continental air is particularly suited for high level bombardment, with only three to five days per month with cloud cover more than 8/10; whereas, the Summer frequency is 10 to 13 days. Spring and Fall frequencies are variable, depending upon the degree of transition, but generally range between five to ten days per month.

a. Winter. Thunderstorms are rare. Severe icing occurs most frequently during the winter months in Southern Manchuria (i.e., south of 42° N.) but then only six to seven days per month due to lack of cloud cover. Northern Manchuria is so cold at high altitudes that icing is rare in winter. Fog rarely occurs in the winter but visibilities less than two and one - half miles are estimated to occur on five to ten days per month from September through March as a result of haze and dust. Ten to fifteen days over six miles is the rule. Winds aloft are generally westerly to northwesterly, sometimes going to north in polar outbreaks. Speeds from 25 to 35 knots are average.

b. Summer. Thunderstorms have their highest frequency from May through September, but then they only occur two to four days per month. Severe icing is rare in Southern Manchuria, but moist, cold air aloft in Northern Manchuria during the cloudiest season causes the risk of icing to be greatest in summer. Visibility is restricted to less than six miles about five to eight days per month because of haze, and fog occurs about

once a month. Visibility above six miles is, therefore, available on at least 18 days per month. Winds aloft are light southwesterly.

c. Fall and Spring. The periods of Fall and Spring have climatic conditions which fall between those of Winter and Summer and the frequencies will be more similar to the summer frequencies in the late Spring and early Fall, and near winter conditions in late Fall and early Spring. Otherwise the situation will depend upon the dominant air mass during the transition periods of Spring and Fall.

d. Winter Route. Enroute from the forward bases to a target in Manchuria the most hazardous weather will be encountered over the mountains that border the Red Basin on the northeast. This is probably due to the fact that the polar continental air that streams down the eastern side of the high and is normally centered around the Gulf of Pohai, is modified in the lower layers by the passage over the Yellow Sea. Thus, where it returns to the plains of north China, it is unstable and moist in the lower levels. Although extensive cloudiness exists in the plains, the forced rise of air in the mountain area produces frequent thunderstorms which penetrate layer clouds on the eastern side of the range. Although layer clouds contain rime and sometimes clear ice in the lower levels, they produce severe icing conditions in the towering cumulus and cumulonimbus. The tops of the turbulent clouds extend up to 20 to 25 thousand feet and the turbulence is severe. Beyond the mountains, in the plains, the cloud coverage in Winter is extensive, but usually stratiform, and the icing conditions are light to moderate rime. Thunderstorms may occur at any time of the day with the passage of a cold front preceding a fresh outbreak of polar air, but otherwise they are infrequent late afternoon occurrences. The climate in general is similar to that of our middle states bordering the Mississippi River.

e. Summer Route. The mountains in the Summer produce severe thunderstorms in the late afternoon and evening which tend to dissipate towards dawn, leaving a thin stratiform layer covering the mountains. The frequencies of thunderstorms over the mountains are greatest in the spring and summer months in conjunction with trailing ends of the polar front. The China plains in Summer have fairly mild conditions, but the thunderstorm frequencies are high in the late afternoon and evening. The freezing level over the route during the summer season is 17,000 feet, gradually sloping downward to 16,000 feet near the Gulf of Pohai.

2. Japan

Flying weather over Japan is controlled largely by monsoonal effects with subsequent orographic action, frontal weather, and typhoons. The backbone

of mountain ranges running northeast-southwest on the Japanese islands cause, in Winter, orographic uplift of the northerly monsoonal flow, giving northwestern areas maximum cloudiness, and southeastern targets minimum cloudiness. In Summer, similar uplift of the southerly monsoon causes maximum cloudiness over southeastern targets, and a minimum over the northwestern areas. Targets on Kyushu, such as Nagasaki and Sasebo, get a mean high average of cloud cover the year around because of exposure to both winter and summer monsoonal flow. It should be noted that the winter monsoon is stronger and more persistent than that of the summer, due to the steep pressure gradient existing between continental high pressure and North Pacific low pressure. In the Summer, the flow is around the rather loose gradient of the Pacific high pressure cell. Frontal effects may be considered as being superimposed on the monsoonal conditions, or interrupting the monsoonal flow at times. The polar front is located east of Japan during the winter months, with families of deep cyclones developing along this front and moving northeast into the persistent North Pacific low. In the transitional periods, Spring and Fall, the mean position of the polar front crosses Japan with increased frequency of cyclones, directly affecting Japan with precipitation and clouds at various levels. This condition often extends into mid-June and mid-July, lessening only as the polar front moves inland. Typhoons occur from July through October, and all of the southern Japanese waters and coasts are likely to be visited by three to four such storms during these months. Cloud decks and high winds extend to altitude, making bombardment at altitudes of 30,000 feet and higher impossible. Icing at about 24,000 feet is the highest the freezing level will reach in the summer months. Consequently, icing may be expected in the clouds above this level during all seasons. Forward visibility at flight level will be unlimited in the absence of frontal weather or typhoons. Otherwise, forward visibility will lower to the point of making formation flying difficult or prohibitive. Fog will not cause frequent visibility impediments to Japanese area. Nagasaki, for instance, has a high of two foggy days in June, while Hiroshima on the southwest coast of Honshu has a high of one day in November. Thunderstorm activity reaches a high average in summer. Highest frequency to be expected is seven or eight days per month during July and August with the overall average much less. However, cold flow of air across the warmer sea of Japan in the Wirter causes instability in the lower levels. This results in the usual type of cumulus and stratocumulus cloud as the air is lifted over the land.

3. Formosa, Southern China and the Philippine Islands.

The area under consideration is a fan-shaped region extending from Chengtu towards the southeast. For a radius of about 200 miles east and south of Chengtu stretches the Red Basin. It is an area of gently rolling hills, few of which are higher than 3000 feet above sea level. A region of low mountains ranging from 6000 to 7000 feet forms a roughly circular boundary to the basin. The area continues through a somewhat lower group to the southwest none of which reach 6000 feet, to the higher abuttments of the Himalayas which attain 10,000 feet due south from Chengtu. To the east and east-southeast, the area we are concerned with, the rim of the basin is lowest and the mountains forming it persist to the coast as an intermittent sprinkling of low hills ranging from 3000 to 6000 feet in elevation. Across the 100 mile strait from the port of Amoy lies the island of Formosa, the distinguishing topographical feature of which is a rugged mountain ridge oriented north-northeast by south-southwest

[redacted]

nd which reaches over 14,000 feet at its highest point. This ridge rises abruptly from the east side of the island but slopes off gently to a plains area on the western side. South of Formosa and across the South China Sea from Hong Kong are the Philippine Islands. Their topography is mountainous in character, with peaks reaching to between 9,000 and 10,000 feet, but due to the complexity of the archipelago it cannot be reduced to the simple one-ridge system of Formosa.

a. Formosa. The same monsoonal flow which controls China governs the weather of Formosa, but due to the simpler topography of the island the resulting weather pattern is likewise simpler. During the winter monsoon, October through March, the air flowing up the windward mountain slopes gives cloudy and rainy weather in the north and east parts of the island. As an average 20 days per month have more than 8/10 cloud cover from December through March, and only one day per month has less than 2/10. Stratus cloud types predominate with tops varying from 2,000 to 12,000 feet. During this period, the south and southwest portions of the island are having relatively dry down-slope winds with consequently less cloudiness and little precipitation. The average number of clear days average four to nine per month from October through February. Snow caps the higher mountains during the Winter and occasionally falls as low as 3500 feet. Otherwise, precipitation is rain or drizzle. During the summer monsoon, June through August, the situation is reversed, with up-slope winds producing clouds and rain in the south and southwest, and down-slope winds producing clear weather along the north and east coast. An average of two clear days per month occur in the southwest, with 15 days of rain. The cloudiness is mostly convective, and consequently is at a minimum around sunrise. Thunderstorm activity is frequent, and most of the precipitation occurs as heavy intermittent showers. The southwest monsoon is neither as strong nor as constant as the northeast one, and is frequently interrupted by frontal influence, with consequent modifications of the seasonal weather patterns. Typhoons affect Formosa with about the same frequency as China proper.

b. South China Mainland. Probably the most important single weather control in all of Southeast Asia is the monsoon circulation common to all parts of the area. The winter monsoon usually dominates the months from October through March with a flow of cold winds which reach South China from the northwest and east, having picked up considerable moisture from the South China Sea on the way. April and May are transition months during which this flow weakens, and from June through August the summer monsoon reigns as a rather weak flow from the southwest in Southwestern China, and from the southeast in Central and Southeastern China. The change back to the winter regime occurs rather abruptly with strong outbreaks of polar air during the month of September. Although the northeast monsoon is the stronger flow, at the surface it is the shallower being replaced by westerlies as a general rule at 10,000 feet or frequently lower. By contrast, the summer monsoon which is light and easily masked by local effects at the surface, flows deeper, with southerly currents extending at times to the 15,000 or 20,000 foot levels. Maximum

cloudiness and precipitation occur during the late Spring and Summer, with minimum in the Fall and early Winter. Also, cloudiness is greater along the coast than in the interior in all seasons, although this is influenced a great deal by various local effects. Extra-tropical cyclones are rare south of 25 degrees north latitude, but there is a quasi-stationary front between the polar air of North China and the tropical air of South China on which shallow waves appear. Any kind of lifting will produce clouds and precipitation in the moist, tropical air mass of the summer monsoon, and these wave disturbances and general overrunning over the front produce much of South China's spring cloudiness and rain. Winter cloudiness which varies widely depending upon local terrain, is usually due to up-slope action when the moist northeast or east current hits the China coast, or to outbreaks of polar continental air. The persistent all-season cloudiness of the coastal area is shown by data from Hong Kong:

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Av No. Clear* Days per month	2	2	2	1	1	0	0	1	2	8	6	5
Av No. Cloudy Days per month	15	20	21	21	20	18	15	14	10	9	8	14

*Clear indicates less than 2/10 cloudiness, cloudy more than 8/10.

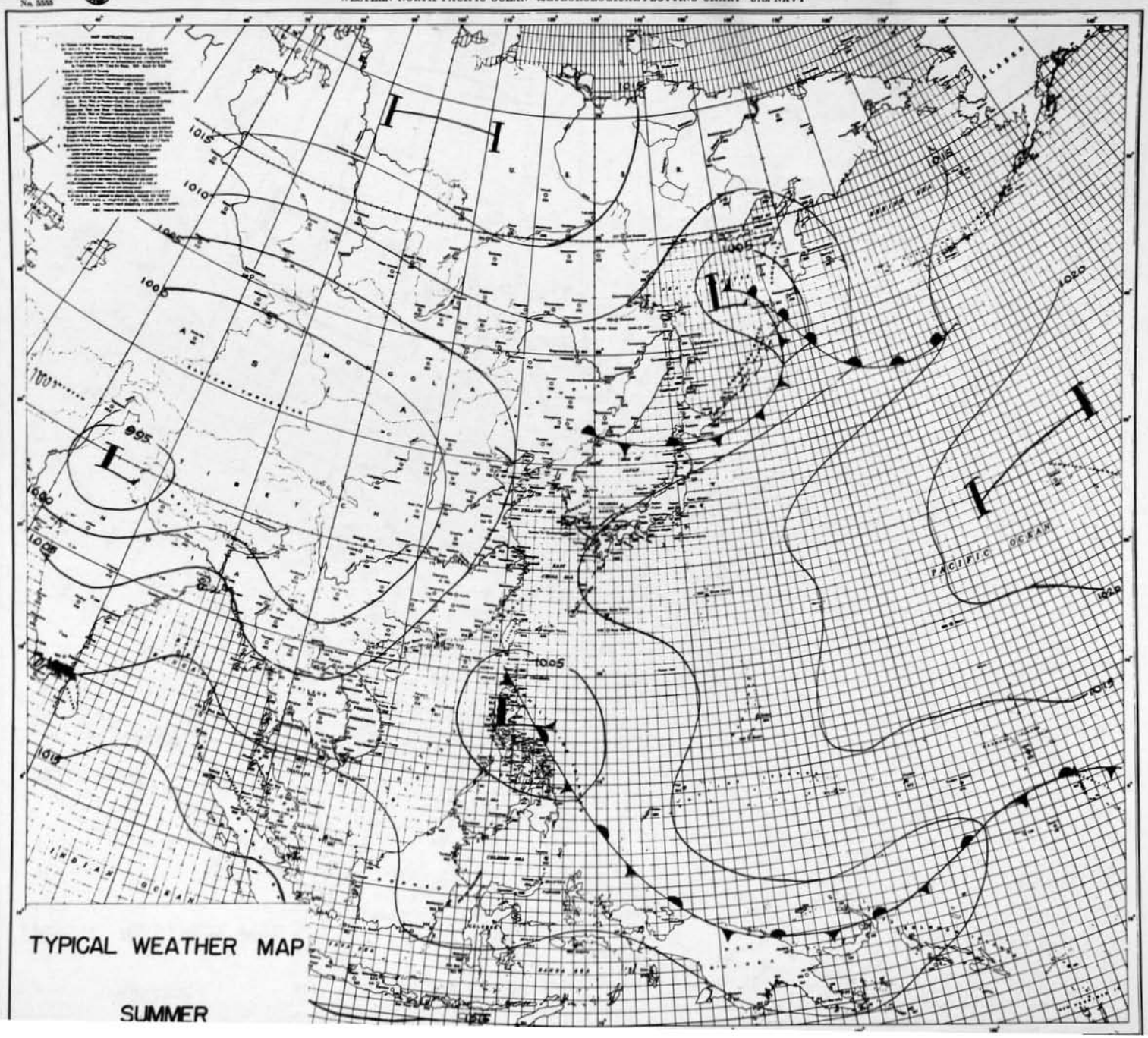
Convective clouds are the dominant type in Summer, and thunderstorms constitute an important hazard to flying. Such activity is most frequent inland and over mountainous areas. The normal season for thunderstorms is from March through October with a maximum frequency which, while it varies somewhat with locality, usually occurs in June or July. Activity is infrequent from November through February. The icing level usually ranges from 15,000 feet in Summer to 6,000 feet in Winter with minima of 10,000 feet in Summer and 4,000 feet in Winter occurring occasionally. The icing hazard is greatest in thunderstorms, and therefore, is greatest in Spring and Summer when such storms are frequent. Winter cloudiness is stratiform as a rule and usually not extensive or deep; so, except over mountainous regions or in zones of frontal activity, ice is not apt to be a hazard during that season. All routes in and out of the Red Basin pass over mountains of some sort, and since the Basin area is persistently cloudy in winter, ice is a serious problem there during the winter months. The most severe weather encountered in this area occurs in tropical cyclones or typhoons along the South China coast. The normal typhoon season is coincident with the period of the southwest monsoon, with frequency of occurrence reaching a maximum in August and September. The average frequency with which they hit the South China coast is once in June, twice in each of the months of July, August, and September, and once in

October. They are relatively infrequent in November, December, and May, and almost never reach the coast during January through April. As a rule these disturbances do not move inland any great distance, dissipating shortly after crossing the coastline.

c. Philippine Islands. Here again we find a period from May to September during which the main air stream across the islands is the southwest monsoon. This is replaced from October through January by the northeast monsoon. In addition there is a somewhat longer transition period from February through April during which the trade winds from the east and southeast dominate the pattern. Unaltered by other influences, or perhaps with a simpler topography, this arrangement would produce a distribution of cloudiness essentially the same as Formosa's. Manila, which is sheltered from nearly all except the southwest current exhibits this, having 18 clear days against six cloudy days per month from July through September. However, a great deal of the archipelago's serrated coastline is nearly always exposed to one current or another, with the result that the skies are rather cloudy during all months. The type of cloudiness varies, however. There is a mixture of stratiform and cumuliform types in Winter, with cumulus occurring more characteristically in the southern islands, while in Summer convective cumulus is the rule over the whole chain. Thunderstorms with heavy showers occur during the whole year, reaching maximum frequency and intensity in mid-summer. The icing level averages around 13,000 feet in these latitudes, and severe icing conditions are found in thunderstorms about that level. Again, like Formosa, the normal air flow patterns are interrupted by cyclonic systems of various kinds. True extra-tropical cyclones rarely occur so far south, but shallow frontal waves influence the area, and in addition, the islands lie across the normal typhoon belt. Both of these circumstances tend to increase the average cloudiness. Typhoons develop east of the Philippine archipelago and pursue two characteristic tracks; one almost due west across the islands, the other recurving to the north and northeast in a parabolic path tangent to the island chain or missing it altogether. This pattern shifts as a unit to the north in Summer and south in Winter, the normal westward branch of the pattern moving from Northern Mindanao during Winter and from just north of Luzon during the Summer.

No. 5555

WESTERN NORTH PACIFIC OCEAN–METEOROLOGICAL PLOTTING CHART–U.S. NAVY

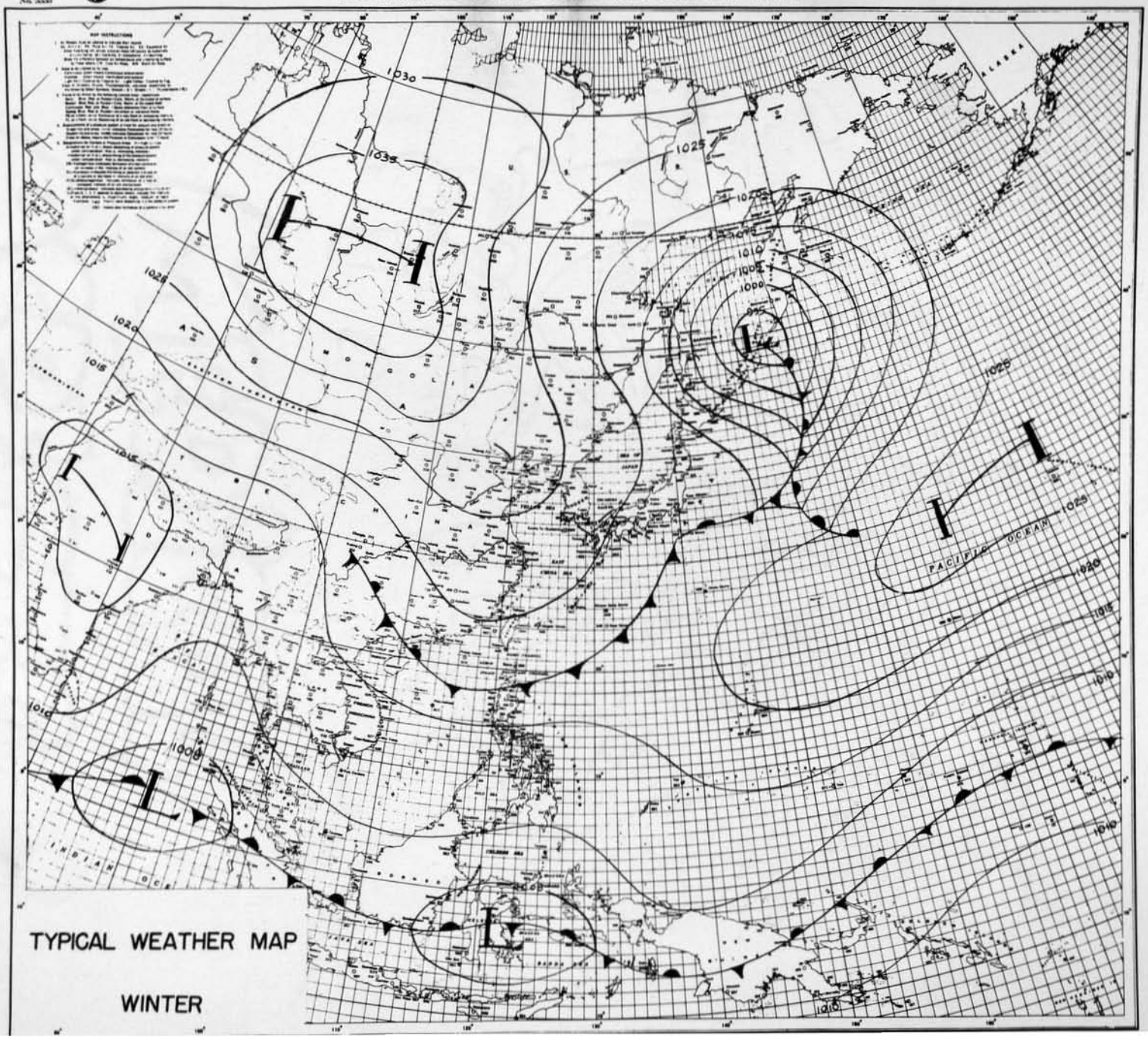


TYPICAL WEATHER MAP

SUMMER

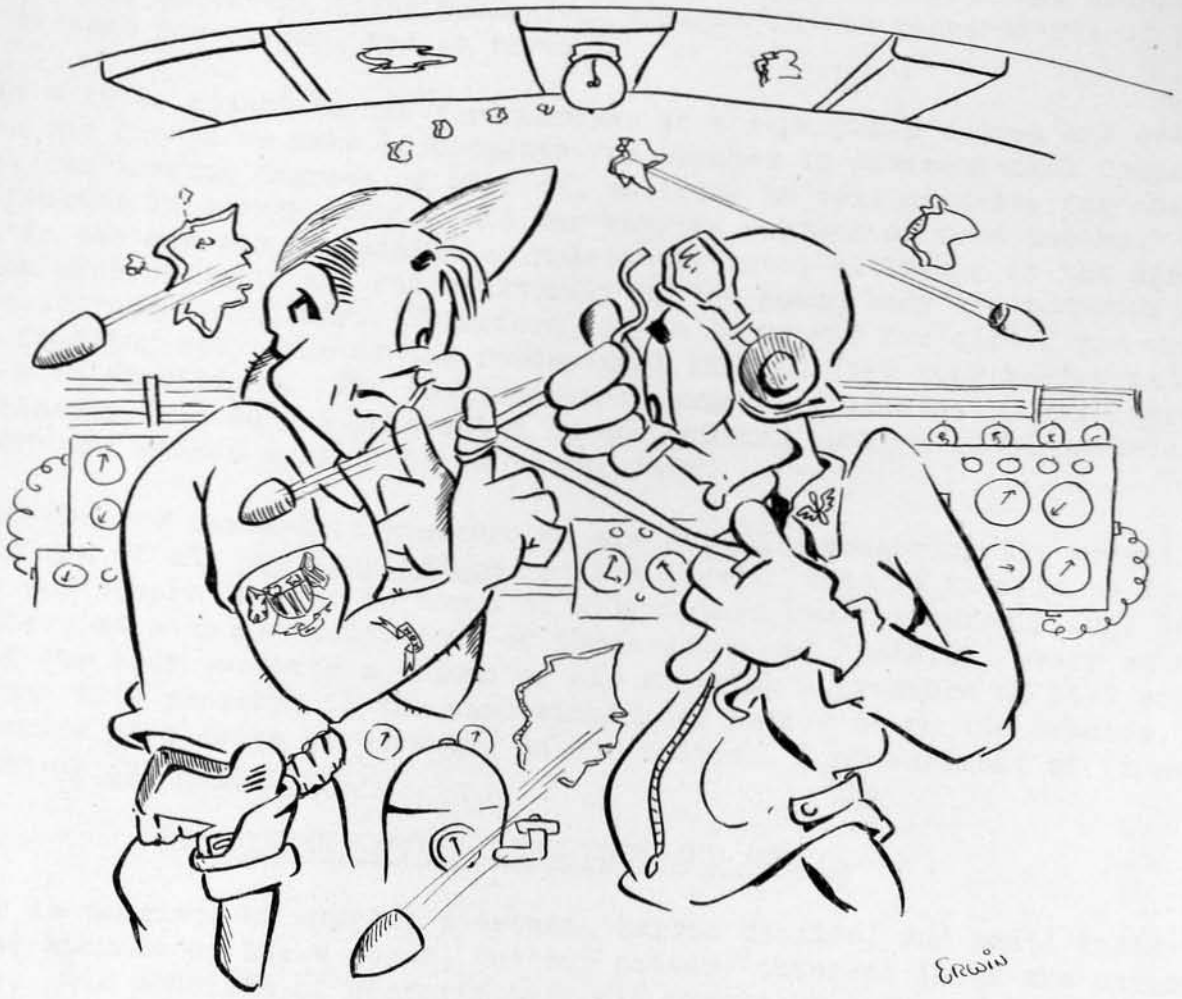
No. 5535

WESTERN NORTH PACIFIC OCEAN–METEOROLOGICAL PLOTTING CHART–U.S. NAVY



TYPICAL WEATHER MAP

WINTER



MEDICAL ASPECTS

XIV. MEDICAL ASPECTS OF COMBAT

By the term "Physiology of High Altitude Flying" is meant the changes in the functions of the human body when it goes from the earth into the air. Included in this are changes in your rate and depth of breathing, changes in your body heat-regulating mechanism, changes in the requirements of your body tissues for oxygen, and so forth.

Man is able to adjust to his surroundings to a remarkable degree and every day on the ground we make adjustments for changes in environmental temperatures, for varying degrees of physical activity as well as rest, for changing requirements in energy output, and for varying degrees of food intake. However, in the air and especially at relatively great altitudes in the air, the changes made suddenly and satisfactorily by the human body are numerous and of considerable magnitude. Therefore, it is important for all of you who fly to be familiar with some of the fundamental changes that your bodies undergo under such conditions. The environmental changes of greatest physiological significance that we are interested in are, marked changes in barometric pressure and marked variations in temperature.

When we measure barometric pressure we are actually measuring the weight of a column of air one inch square, at sea level. This we know to be 14.7 pounds per square inch or in terms of millimeters (mm) of mercury (Hg) 760. Therefore, at standard conditions of temperature and humidity, every square inch of our body supports a column of air exerting a pressure of 14.7 pounds, and since this pressure is the same within our bodies as on the outside, we are unaware of a sense of pressure on our bodies. A measurement of 760mm Hg is known as one atmosphere.

A. OXYGEN NEEDS OF THE BODY AND ANOXIA

All air is composed of oxygen, nitrogen, carbon dioxide, and small insignificant amounts of inert gases, but our primary interest is in the oxygen content. Air consists of approximately 21% oxygen by volume. This percentage of oxygen never varies with any altitude that we fly, but the important point is that the air itself becomes less dense or less heavy as we ascend. In other words, one quart of air at sea level will contain 21% oxygen and one quart of air at 30,000 feet will contain 21% oxygen, but the quart of air at 30,000 feet actually contains less oxygen by weight, because of the decreased density of the air.

In order to function normally, the human body must receive adequate amounts of oxygen for the body cells and tissues. This means that the quantity of oxygen in the airspaces of the lungs must be adequate in order to maintain a sufficient supply in the blood. It is the partial pressure or density of oxygen in the lungs that permits its diffusion through the lung walls into the blood. The partial pressure of oxygen is directly proportionate to the barometric pressure, and as the barometric pressure falls upon ascent so does the partial pressure of oxygen in the lungs. Consequently, the blood gets less and less oxygen as do the tissues. Thus there is a need for furnishing a supplementary supply of oxygen at altitudes.

RESTRICTED

1. Anoxia.

The term anoxia will be heard frequently and you will receive lectures on this subject from your Squadron Surgeon. Anoxia means without oxygen and can mean any degree of deficiency in oxygen, from the mildest to the most severe. Severe anoxia will result in death. It is necessary for all persons who fly to be able to recognize the early symptoms of anoxia, so that adequate steps may be taken immediately to prevent serious or fatal anoxia. The following are the signs and symptoms which may serve as an adequate warning signal and should not be disregarded.

a. Change in rate and depth of breathing with breathing becoming more rapid and deeper.

b. Frequent sighing and yawning.

c. Vague feeling or anxiety which disappears as anoxia becomes more marked.

d. Loss of judgment and insight into our own predicament. This may take effect before you experience any of the above symptoms or signs.

e. Feeling of elation and happiness or, in some people, feeling of extreme fatigue and drowsiness. Very similar to our reactions when we get inebriated (drunk).

f. Unconsciousness. It is important to remember that unconsciousness may come on suddenly and without warning and without any of the above listed signs and symptoms being experienced.

From the above list it is easy to see that loss of judgment and insight into our own predicament, as well as sudden unconsciousness are the effects of oxygen-want that give us no warning and may be the first or only effects before a serious state of anoxia is reached. Picture the pilot of a bomber suffering from a gradually increasing oxygen deficiency. At first he breathes more deeply and rapidly occasionally sighing and yawning. Soon he feels giddy and light headed with rapid changes to a feeling of joy and contentment with no cares or worries, in spite of the fact that his ship is completely out of formation and heading in the wrong direction. Finally he loses both consciousness and control of his airplane. This has happened - it isn't mere fiction. Don't let something like this happen to you or any of your crew.

How do we prevent oxygen deficiency? Simply by supplying ourselves with a supplementary source of oxygen at the proper time and using it as long as necessary. Detailed and specific instructions in the use of oxygen and oxygen equipment will be given you by the surgeon and personal equipment officers. You must pay attention to what these men tell you. It is for your benefit, not theirs.

In this Command we insist that all personnel use supplementary oxygen when the pressurized cabin pressure is equal to an altitude from 10,000 feet

up and this means that your mask is adjusted and you are ready to breathe in the oxygen when the cabin pressure arrives at 10,000 feet. On descent, you stay on oxygen until 10,000 feet cabin pressure altitude is reached.

We all realize that the wearing of an oxygen mask is at best somewhat uncomfortable and cumbersome, but we also realize that a conscious and useful crewman is far more valuable than an unconscious and anoxic person who requires the help of two or three other crew members to save his life. When the aircraft is flying at an altitude above 10,000 feet the oxygen mask must be kept handy for immediate use in case of cabin pressure failure. This is especially true over the target.

2. Degrees of Anoxia at Various Altitudes for the Average Individual.

Altitude	Useful consciouness will last	Unconsciousness will occur	Death will occur
15,000 ft.	hours	rarely	rarely
18,000 ft.	10 to 15 minutes	4 to 6 hours	rarely
25,000 ft.	2 minutes	5 to 8 minutes	1/2 to 4 hours
30,000 ft.	45 seconds	1 minute	20 minutes
35,000 ft.	25 seconds	1 minute	20 minutes
40,000 ft.	10 seconds	30 seconds	10 minutes

This gives you an idea how much time you have to get your oxygen mask on in the event of cabin pressure failure.

B. EFFECT OF PRESSURE CHANGES ON EARS, SINUSES AND INTESTINES

It has been previously stated that we are not aware of the effects of pressure on our body at sea-level because under ordinary circumstances the pressure is the same inside and outside our bodies. This equality of pressure must be maintained in ascending and especially in descending. One should be fully aware of the proper methods of maintaining equal pressure within and without the body.

1. Ears.

The anatomic construction of your ear consists chiefly of an external ear, a middle ear cavity, and an internal ear. The middle ear cavity is connected to the outside air, so to speak, by a tube which leads from the ear cavity to the back of your nose. This tube normally stays open, thus allowing air to come in or go out. Many people can open this tube at will by yawning, chewing gum, hollering, snapping the jaws, etc. If one has a cold, there is a great tendency for the opening of this tube in your nose to close due to swelling and congestion. The results of this tube being closed is that on going up, the air usually rushes out of your middle ear cavity with sufficient pressure to open the tube. On coming down, however, this tube remains closed, thus preventing air from entering the middle ear cavity. Thus you have less pressure within your middle ear cavity than the pressure on an ear drum itself. This results in a condition known as aero-otitis and can be extremely painful as well as a cause for grounding you for a considerable period.

If you have a head cold that is sufficiently severe to cause your nostrils to plug up, do not fly, see your Squadron Surgeon and he will determine your fitness for flying.

2. Sinuses.

Similarly, the sinuses are cavities within the head and the same thing may happen to them if you fly when their openings are swollen and partially or completely closed.

3. Intestines.

Since all gases expand at altitudes, it follows that gas within your intestines will similarly expand. Few people have trouble, since this gas is easily expelled by belching or by the rectum, but occasionally a large amount of gas in the intestine will give one symptoms. Avoid eating large meals and drinking carbonated beverages prior to missions and avoid the gas-forming foods. Your Squadron Surgeon will advise you on this subject.

4. Aeroembolism.

Aeroembolism or "bends" is the result of decreased atmospheric pressure accompanied by the formation of nitrogen bubbles in the blood and body tissues. Aeroembolism is not met at the altitudes we fly so it is not a problem to consider.

5. Changes in Temperature.

Temperatures drop about two degrees centigrade for every 1000 feet of altitude, starting from an assumed ground temperature of 15 degrees centigrade. Above 35,000 feet the temperature is quite constant around minus 55 degrees centigrade.

C. PRESSURIZED AIRPLANES

By pressurizing the airplane to a higher internal pressure than the pressure outside, a simulated lower altitude is created. In your airplane the degree of pressure is automatically regulated to maintain an 8000 foot cabin altitude up to 30,000 feet actual altitude. Oxygen is of course unnecessary at such an altitude. However, all the usual oxygen equipment must be in readiness, for if the pressure is lost in the pressurized portion of the airplane, as a result of an opening formed either spontaneously or as a result of enemy gunfire, all occupants will rapidly ascend from the simulated low altitude to the actual altitude and oxygen will be needed very soon.

Though many stories have been circulated about the danger of rapid decompression of pressurized airplanes there is now adequate proof that in the B-29, there is no danger what so ever. Consult your flight surgeon for further information.

D. FIRST AID IN COMBAT

Administering first aid to a wounded man while you are flying in combat at 28,000 feet with the temperature 40 degrees below zero and the air rough, is

a great deal different than dabbing some iodine on Joe's cut hand in the barracks. You must familiarize yourself with the fundamental principles of first aid in combat so that under stress and strain of battle you can function efficiently in this capacity if necessary. Your Squadron Surgeon will lecture you on this subject. Stay awake and learn something because it may mean saving your pal's life some day in the near future. The radio and radar operators are specially trained to administer first aid aloft. They are skilled in knowledge and use of the contents of the first aid and plasma kits aboard all B-29 combat aircraft.

1. Shock.

Learn to recognize shock early. The rapid pulse rate; extreme pallor; cold sweat; and deep, sighing breathing are the main signs to look for. Plain hemorrhage, and exposure are the main causes of shock. Remember the following four points and you will be doing everything possible for a man with shock.

a. See that the man has an adequate supply of oxygen at all times.

b. Stop the hemorrhage (see paragraph 3 below).

c. Keep the patient warm at all times.

d. Administer morphine (see paragraph 2 below).

2. Use and Misuse of Morphine.

Morphine is furnished to you in metal tubes, known as syrettes, each of which contains one-half grain of morphine solution. Morphine is a powerful narcotic and in the hands of the inexperienced can be a dangerous drug if not used according to instructions. Keep the following points in mind:

a. The dose for the average man is the contents of one tube, namely, one-half grain. In most cases this dose will not have to be repeated before the patient is seen by the Surgeon. It will take about 15 minutes before the morphine will begin to relieve pain.

b. Indications for the use of morphine are: (1) Severe pain and (2) Shock.

c. Never use morphine when:

(1) The patient is unconscious.
(2) The patient has a serious head wound.
(3) The patient has a wound which interferes greatly with his ability to breathe.
(4) The patient has only a minor wound which is not giving serious pain.

3. Hemorrhage and Splints.

Most cases of hemorrhage can be stopped by the adequate application of a pressure bandage. Apply the ordinary dressing, placing it firmly over the

wound so that it is exerting some pressure on the wound surface. This can be best done by re-enforcing the dressing with roller bandages.

A small percentage of wounds will not stop bleeding upon application of a pressure bandage and will require the use of a tourniquet to stop the hemorrhage. The proper use of the tourniquet will be demonstrated by your Surgeon. Make sure when you apply a tourniquet not to forget about it. Your patient may end up with a gangrene of the foot or hand if the entire blood supply has been stopped for a prolonged period of time. A tourniquet should be loosened and reset every 20 minutes.

Fractured arms and legs can be made a great deal more comfortable by splinting them. Wooden splints will be found in the auxiliary first aid kit, of each bomber. In the case of an injured leg it can be splinted to the good leg. In the case of arms, any suitable material can be used for a splint, such as a rolled blanket, rolled up flying jacket, etc. A simple method of splinting an arm is to simply use the shirt front as a support for the hand and wrist and bind the arm close to the body. Do not try to set the fracture. Move the injured part as little as possible and handle it very gently.

In cases where there is suspected fracture of the spine, disturb the patient as little as possible and let the Surgeon supervise removal of the man from the airplane. Detailed instruction will be given by your Squadron Surgeon.

4. Artificial Respiration.

Every man must know how to give artificial respiration. Your Squadron Surgeon will demonstrate the accepted methods of giving artificial respiration. On many occasions artificial respiration has saved a man's life. Occasionally a malfunction in the oxygen system may cause a man to lose consciousness. It is of the utmost importance that when any man loses consciousness because of lack of oxygen, an adequate supply of oxygen be furnished him at once. If, when an adequate supply of oxygen is furnished, the man does not breathe automatically, artificial respiration must be started immediately. A man will never get oxygen into his lungs even though the supply to his mask is sufficient, if he is not breathing the oxygen in. Artificial respiration given immediately will insure his getting oxygen into his lungs and then into his blood. Artificial respiration should be continued until such time as a man is breathing regularly and satisfactorily. He should not be left unattended until he is conscious and aware of his surroundings. YOUR KNOWLEDGE OF ARTIFICIAL RESPIRATION MAY SAVE YOUR PAL'S LIFE.

E. PHYSICAL FITNESS

You have been selected for flying duty because you satisfactorily fulfilled the requirements for physical as well as mental fitness. It is your responsibility to see that you maintain this fitness to fly at all times. Under conditions of combat this is not always easy. The primary job of your Squadron Surgeon is to help you maintain physical and mental health, and he will advise and help you whenever possible. Feel free to consult him about any problems you have, no matter how trivial they may seem to you.

1. Rest.

Try to get at least seven hours sleep every night. It is very important that you get sufficient sleep on nights preceding missions. Open the windows in your sleeping quarters to get plenty of fresh air.

2. Personal Cleanliness.

All stations have very adequate washing and shower facilities. Simply because you are in a theatre of operations doesn't mean you have to go without a shower for weeks at a time. Keep your body clean by taking showers or baths at least three times a week.

Do not sleep in the underwear you wear during the day. If you do not have pajamas, sleep in the nude or use a suit of clean underwear for sleeping purposes only. Adequate laundry service is provided. There is no excuse for not having clean clothing at all times. Underclothing and socks should be changed at least twice a week, preferable oftener. In emergencies you can wash out your own underclothing and socks.

3. Alcohol and Tobacco.

A word to the wise is sufficient. The excessive use of tobacco and alcohol will impair your physical condition as well as making you an easy victim to anoxia, frost bite and early fatique.

4. Athletics and Recreation.

All stations have supervised programs of athletics and recreation. Usually it is on a voluntary basis and you are encouraged to participate. It is extremely important that you have an hour or two of vigorous exercise two or three times a week. Some stations set aside one afternoon per week for organized athletics. Take advantage of these opportunities and get out for some healthful fun.

5. Passes and Leaves.

All combat crews are given adequate passes and leaves. You are encouraged to take your passes when they come due and to leave your station for the specified period. The change in environment and scenery is a good tonic.

6. Venereal Disease.

Gonorrhea and syphilis are serious problems. These two diseases account for many days lost and many men becoming unfit for further duty. You will receive frequent lectures on the prevention of gonorrhea and syphilis, and various methods of prevention will be demonstrated to you. These lectures are given for your benefit since you may be the unfortunate person to contract a venereal disease if you are not properly instructed in prevention. Pay attention and follow instruction. Remember that if you contract a venereal disease you will not only serve to prolong the war by your absence from duty but you will possibly impair your health for the rest of your life.
THE RISK DOES NOT JUSTIFY THE PLEASURE!

F. TEST YOUR KNOWLEDGE!

1. What are the symptoms of anoxia?
2. Do you check your oxygen regulator, flowmeter, and mask at frequent intervals?
3. How long can you retain consciousness without oxygen at 25,000 feet?
4. What effects do changes in pressure have on the ears and sinuses?
5. What can you do for yourself to prevent frostbite?
6. How serious can frostbite become?
7. Explain the proper first aid measures for shock, for bleeding, for broken bones, and for anoxia.
8. What are the proper times to administer morphine? When should morphine not be used?
9. Have you practiced artificial respiration within your aircraft?
10. Can you honestly say that you keep in good physical trim for a grueling tour of combat operations?