

# OPERATIONAL EMPLOYMENT OF LONE WOLF TACTICS

M-O-N-O-G-R-A-P-H

IN WHICH A DISCUSSION OF SIXTEEN  
LONE WOLF MISSIONS IS PRESENTED

*FIFTEENTH AIR FORCE*

## FOREWORD

IT IS THE CONTINUING COMMITMENT OF THE FIFTEENTH AIR FORCE TO DESTROY THE ENEMY WHENEVER AND WHEREVER HE CAN BE ATTACKED. HIS INDUSTRIES MUST BE DEMOLISHED, HIS COMMUNICATIONS DISRUPTED, HIS RESOURCES DEPLETED, HIS MODE OF LIVING MUST BE MADE SO UTTERLY HOPELESS THAT HIS NATION WILL COLLAPSE IN A TOTAL DEFEAT. FOR MORE THAN A YEAR THE AXIS HAS FELT THE OPPRESSIVE WEIGHT OF DAYLIGHT VISUAL ATTACKS BY FORMATIONS OF THE FIFTEENTH AIR FORCE. SINCE THE MIDDLE SUMMER MONTHS THE HUN HAS EXPERIENCED EVER-INCREASING DAYLIGHT NON-VISUAL AS WELL AS VISUAL BOMBINGS DELIVERED BY THIS AIR FORCE. NOW, BECAUSE OF RECENT TECHNICAL AND TACTICAL DEVELOPMENTS, AND THROUGH THE COURAGEOUS EFFORTS AND PERSEVERANCE OF OUR AIR AND GROUND CREWS, THE ENEMY IS BEING SUBJECTED TO ATTACKS BOTH BY NIGHT AND BY DAY, IN FAIR WEATHER AND FOUL. OUR PRESSURE UPON HIM IS CRUSHING. NO LONGER AT ANY TIME IS HE SECURE FROM THE MIGHT OF OUR OPERATIONS. TO THE MAXIMUM LIMIT OF ITS CAPABILITIES THE FIFTEENTH AIR FORCE CONTINUES TO FULFILL ITS COMMITMENT TOWARD ULTIMATE ALLIED VICTORY.

NATHAN F. TWINING  
MAJOR GENERAL, USA  
COMMANDING

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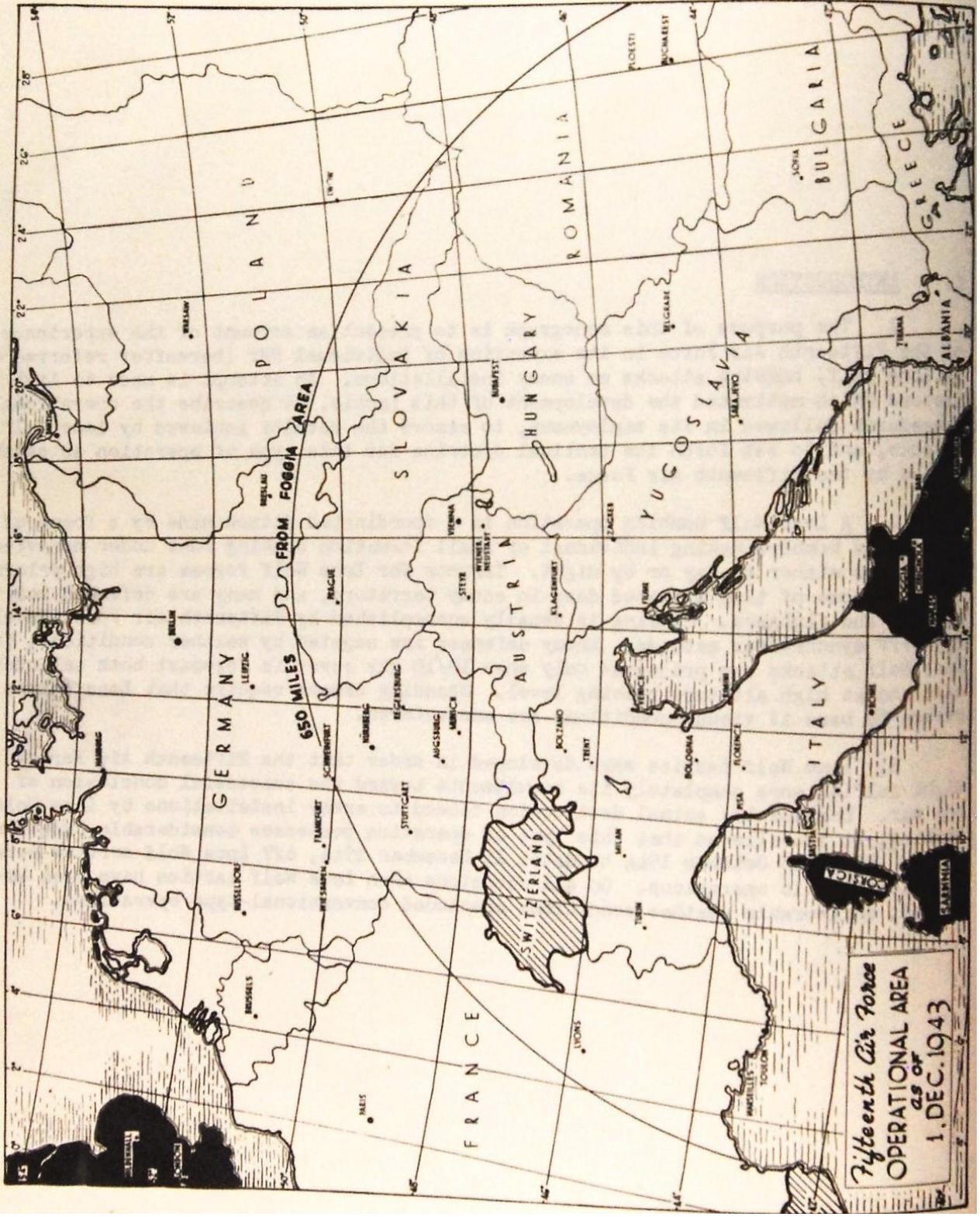
#### VII. CONCLUSIONS

## I. INTRODUCTION

1. The purpose of this monograph is to present an account of the experience of the Fifteenth Air Force in its execution of the individual PFF (hereafter preferred to as Lone Wolf) bombing attacks on enemy installations. An attempt is made to list the factors which motivated the development of this tactic, to describe the operational procedures followed in its employment, to record of results achieved by Lone Wolf attacks, and to set forth the tactical doctrine for this type of operation as established by the Fifteenth Air Force.

2. A Lone Wolf bombing operation is a coordinated attack made by a force of unescorted bombers making individual or small formation bombing runs under non-visual conditions either by day or by night. Targets for Lone Wolf forces are high priority targets some of them situated deep in enemy territory, and many are defended heavily by flak and fighters. Bombing is usually accomplished by Fifteenth Air Force-developed-PFF synchronous methods. Enemy defenses are negated by weather conditions, for Lone Wolf attacks are projected only when 10/10 sky cover is forecast both as undercast and at high altitude bombing level. Standing orders require that Lone Wolves return to base if visual conditions are encountered.

3. Lone Wolf tactics were developed in order that the Fifteenth Air Force might fulfill more completely its commitments toward a successful conclusion of the war. Besides the actual destruction caused to enemy installations by a Lone Wolf bombing, it is believed that this type of operation possesses considerable harassing value. Since 25 October 1944 to date, 12 December 1944, 627 Lone Wolf sorties were dispatched on 16 operations. On all occasions when Lone Wolf tactics have been employed, unfavorable weather conditions precluded conventional-type operations.



Fifteenth Air Force  
 OPERATIONAL AREA  
 as of  
 1. DEC. 1943

## II. DEVELOPMENT OF LONE WOLF TACTICS

### 1. Necessity for diversification of winter operations.

The necessity for extreme diversification in planning to minimize the effect of bad weather on strategic air operations during winter months has long been acknowledged. The acuteness of the situation became evident during the winter of 1943-1944 when heavy bomber operations of the Fifteenth Air Force were so often curtailed due to adverse weather conditions. During the summer months, when it became apparent that operations from the Italy during the winter of 1944-1945 would be more than ever important, much consideration was devoted to the possible solution to the problem of winter weather restrictions to operations. The retraction of his forces by the enemy toward his homeland reduced considerably the area available to this Air Force for waging air war, thus depriving us of that flexibility for employment of our forces to the east and west which was enjoyed formerly. On the west, South France and Central Italy were no longer target areas. The Po Valley was no longer a continuing strategic commitment. To the east, almost all Balkan targets had fallen into Allied hands. As is indicated on the enclosed map, three distinct weather areas for operations were no longer on the priorities list. This situation necessitated resort to every possible improvisation within our means to reduce to a minimum the effect of inclement weather on our operations.

### 2. Weather considerations.

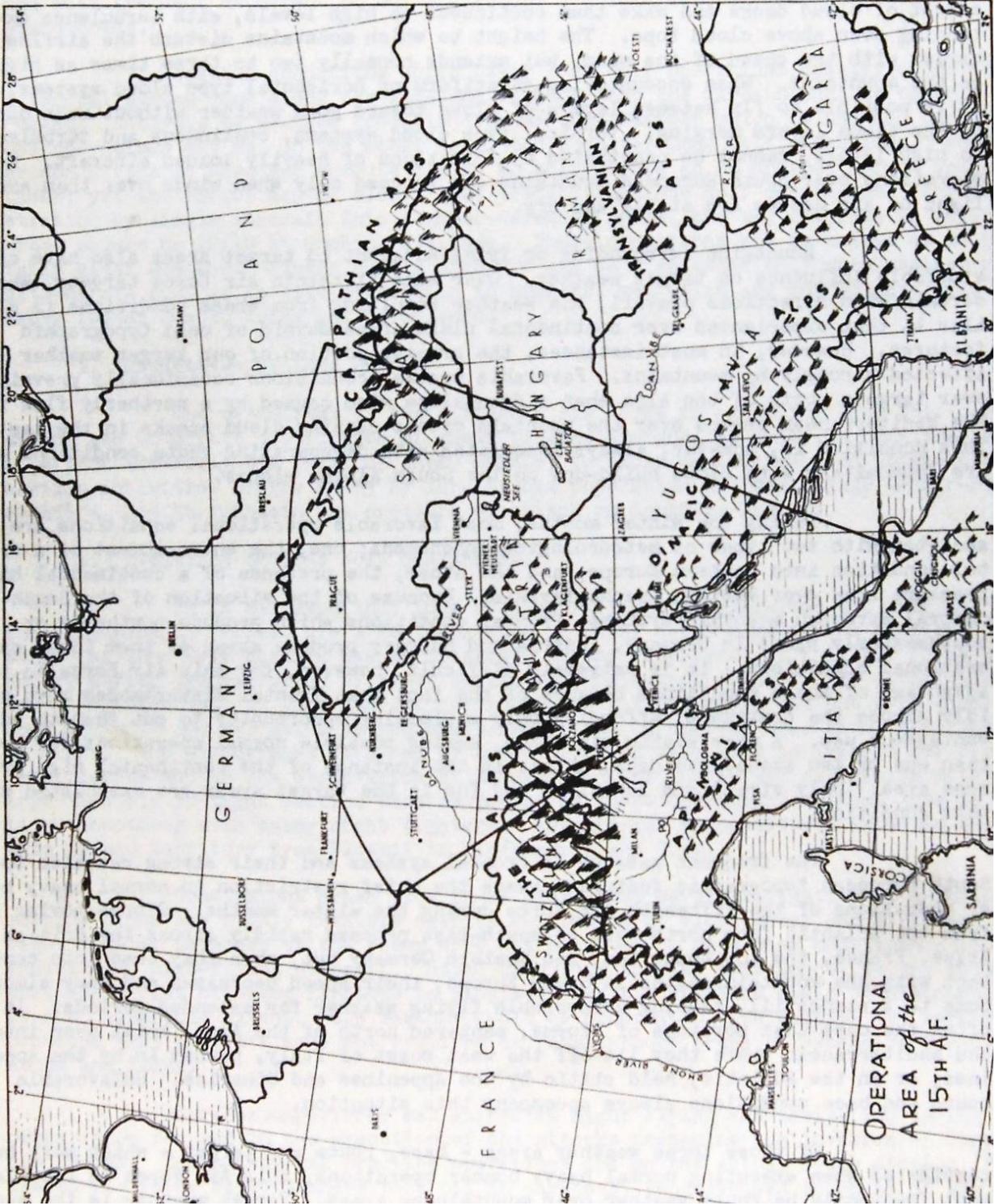
Base, route and target weather prevailing in Fifteenth Air Force operating areas during late fall, winter and early spring have definite local characteristics. Southeastern Italian bases have operational weather outbound seventy-five percent of the time but, unfortunately, some of the most unfavorable base weather occurs frequently at a time when target weather is good. When a frontal system passes over south German target areas from the northwest, the locality becomes operational, but the routes and the bases become poor. Often, by the time the bases improve, a second storm on the same frontal system is approaching the target area making it non-operational. Although final weather is at its peak during these months, the cloudiness associated with it is of short duration. Bases experience lowest ceilings greatest rainfall when a low pressure area is centered over the Southern Balkans or Adriatic, and a high pressure area is situated north of the Alps. This condition brings very strong northerly winds to southeastern Italy, producing very poor flying weather at bases and on lower

routes while flying conditions are good north of the Alps. This situation usually persists for a period of two to four days. Persistent low pressure areas over other parts of the Central Mediterranean also bring prolonged warm weather to bases, but with higher ceilings and smaller amounts of rain.

The most important factor contributing to unfavorable operating weather in winter as well as during summer is the influence on meteorological conditions introduced by the Appenines, Alps, and Dinaric Alps. But for them, route conditions would usually be good when target conditions are good. These mountains greatly affect the height and extent of cloud systems. Air currents, more or less horizontal over level land and oceans, acquire a mark vertical component in passing over mountains. This is the origin of the vertical type cloud system so prevalent in this section of Europe. Vertical wind velocity components over the mountains increase the extent of cloud decks and make them continuous to high levels, with turbulence extending even above cloud tops. The height to which mountains disturb the airflow varies with the speed of the wind, but extends normally two to three times as high as the mountains. When encountering stratiform or horizontal type cloud systems, it is possible to fly between layers of cloud toward good weather without much danger of the cloud layers merging. Vertical type cloud systems, continuous and turbulent to high levels, cannot be penetrated by formations of heavily loaded aircraft. Normal operations over South European mountains can succeed only when winds over them are light or air masses are stable and dry.

Mountains surrounding or lying adjacent to target areas also have considerable influence on target weather. Over some Fifteenth Air Force targets, when certain wind directions prevail, the weather resulting from these conditions is similar to that experienced over continental plain areas devoid of bold topographic features. However, in most instances, the greater portion of our target weather is affected strongly by mountains. Favorable weather conditions occasionally prevail over targets north of the Alps when a down-slope wind caused by a northerly flow from the Mediterranean sweeps over the mountain crests causing cloud breaks in the lee. This condition is, however, always associated with degenerating route conditions which are concomitant with cloud build-ups on the South alpine slopes.





During the winter months, most favorable operational conditions are associated with two types of meteorological phenomena; one, the encroachment of a frontal condition into Western Europe, and the other, the presence of a continental high pressure area over Western Czechoslovakia. Because of the situation of the south-central European mountain systems, frontal conditions which produced a southerly or southwesterly winds in Germany, Austria and Hungary produce ahead of them ideal operational conditions. It is extremely difficult, however, for this Air Force to take advantage of these conditions because of the fact that frontal disturbances move rapidly across the continent, affording only a fleeting opportunity to put them to advantageous use. A more static situation, making possible normal operations for more than one or two successive days, exists in the instance of the continental high pressure area. Only stratiform low cloud and fog in the target areas are associated with this condition.

The frequent passage of frontal systems and their strong reaction to the south European topographic features causes the chief restriction and to normal heavy bomber operations of the Fifteenth Air Force during the winter months. Storms moving in from the Atlantic from northwest to southeast proceed rapidly across the British Isles, France, the Low Countries, and Western Germany but, when they come into contact with the mountain chains in South Europe, their speed decreases and they almost come to a standstill, causing unfavorable flying weather for extended periods. It is often the case that portions of storms, centered north of the Alps, spill over into the Mediterranean where they live off the west coast of Italy, penned in by the Appenines, or in the Adriatic, held static by the Appenines and Dinarics. Unfavorable route and base conditions always accompany this situation.

Of those three weather areas - base, route and target - which must be considered when executing normal heavy bomber operations, this Air Force is troubled most frequently by route weather over mountainous areas. Target weather is the second most frequent deterrent to our operations and base weather causes relatively few stand-downs.

Weather conditions which favor Lone Wolf operations usually occur when a frontal system lies along the Alps and extends past the Carpathians, up through Poland. Analysis of weather conditions shows that weather which is too bad for normal operations may be, on the other hand, too good for Lone Wolf operations. Weather conditions at base and enroute may be so unfavorable as to prevent normal operations; yet the target

may be clear, thus prohibiting Lone Wolf operations. For penetration by single aircraft into fighter-defended areas, the sky coverage in these areas should be 10/10 at bombing altitude. These conditions are as unique as is totally clear weather. Single sortie aircraft can be dispatched only when weather conditions are such as to give protection to bombers, yet which are not so severe as to cause losses due to icing and turbulence.

### 3. Objectives of Lone Wolf.

The objectives of the Fifteenth Air Force in executing Lone Wolf operations are to effect destruction of enemy targets assigned as priority commitments, to affect adversely the level of enemy morale, to cause an interruption of the usual wartime activities of the enemy by forcing his population to take refuge in air-raid shelters, and to maintain the pressure of attack on Southern Germany.

### 4. Evolution of Lone Wolf Operations.

It is believed that Lone Wolf operations, as conceived and executed by the Fifteenth Air Force, are a new departure in USAAF heavy bombardment tactics. The embryo of Lone Wolf tactics was an outgrowth of the experience of this Air Force acquired during the execution of night sortie reconnaissance missions for pathfinder scope photography. In June and July of 1944, two B-17 aircraft and one B-24 aircraft were equipped and set aside as reconnaissance ships to operate over enemy territory at night. The photographs obtained by these aircraft were used to improve our radar intelligence and in the preparation of much-needed PFF target and navigation material. Approximately 20 night sorties were conducted on these operations without loss or positive encounter with enemy night fighters. Territories reconnoitered extended deep into German territory from Ploesti to Blechhammer and Brux.

Conclusions drawn from these operations were: Navigation by pathfinder methods alone was highly feasible despite conditions of cloud cover and darkness. Night fighter defenses of the enemy were not believed to have been committed against individual, high-flying aircraft. Based upon this initial experience, it was thought that the threat of enemy fighters to single-aircraft operations could be discounted to a considerable extent. Bad weather could be penetrated with comparative safety, provided that aircraft were not required to pass through areas of extensive turbulence and icing.



Further experience was gained in night flying and navigation during the preparation for and in the execution of the attacks preceding the invasion of Southern France. During several practice operations and on the actual D-Day mission, Fifteenth Air Force heavy bombers took off in darkness, rendezvoused in boxes of six aircraft each and navigated to the battle area by pathfinder methods. These operations further pointed toward the feasibility of single-sortie bombing operations by pathfinder methods. They pointed further the feasibility of single-sortie bombing operations by pathfinder aircraft.

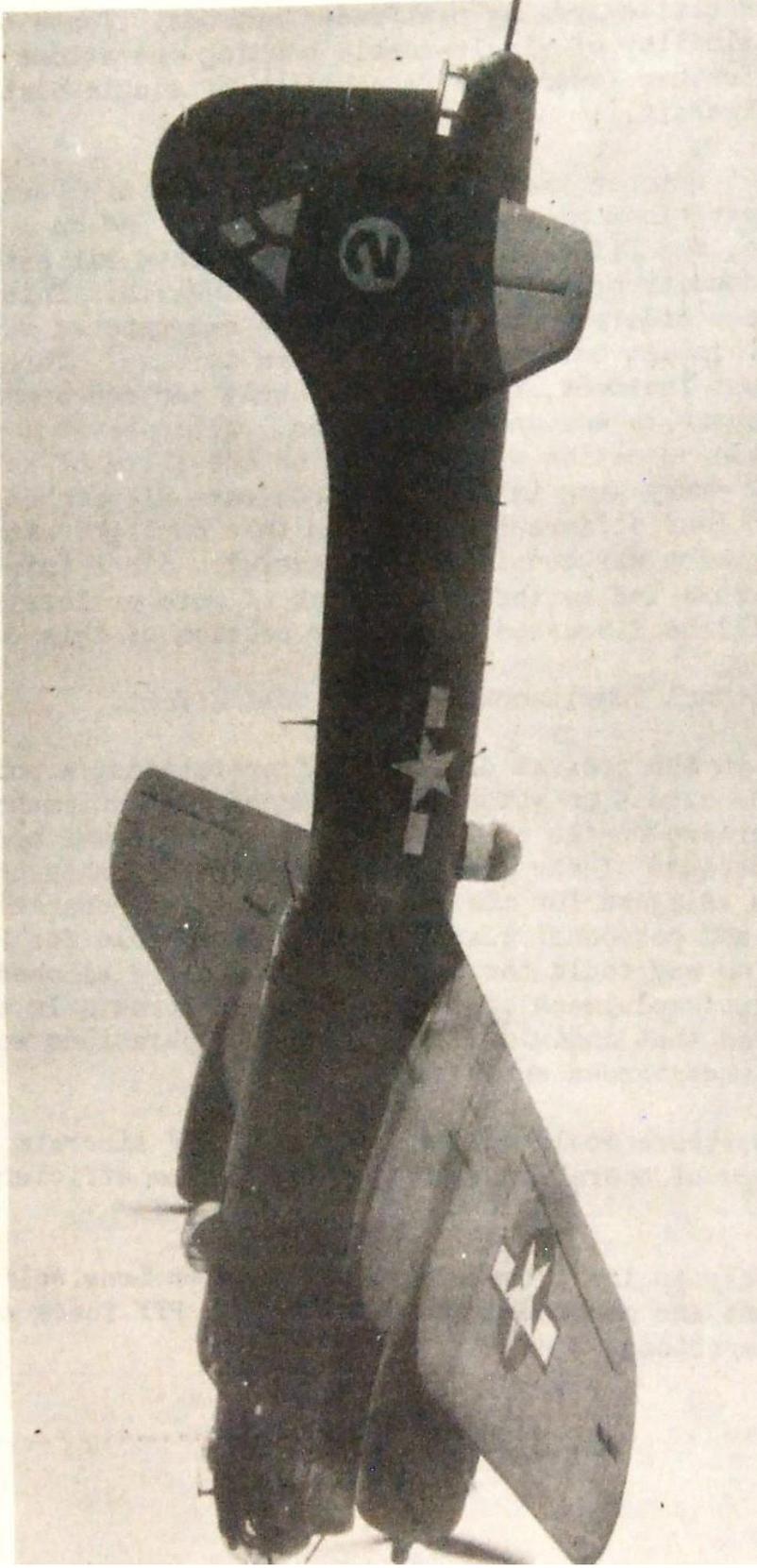
It wasn't until 25 October that it was felt that the Air Force was ready to commence Lone Wolf operations of an experimental nature and on a limited scale. On its maiden operation, the Fifteenth Air Force dispatched six pathfinder aircraft in complete overcast conditions to bomb Klagenfurt, Austria. This mission was executed in the daytime under orders that aircraft which encountered sky coverage less dense than the 10/10 forecast coverage would return to base. Three aircraft bombed the primary target without incident, two returned early and one bombed an alternate target. No losses or positive encounters occurred. After several small raids, both day and night, a large scale operation was effected on the third of November when, for the first time, forces from every Wing in the Air Force were dispatched. A total of 84 aircraft took off to bomb four different targets on this daylight attack. Again there were no losses and the mission was considered successful. Since this day, there have been numerous raids which have led to the development of more or less standard operating procedures. These will be discussed in a later section of this publication.

##### 5. Effect of Main Operational Commitments on Lone Wolf Effort.

Before embarking on the program of Lone Wolf operations, a policy was established which dealt with the extent to which the personnel and equipment requirements of the project should encroach on the efficiency of standing commitments for normal Air Force operations. Because of the great size and high priority of the task to which the Air Force had been assigned for the winter months, and because of the scarcity of critical equipment and personnel classifications available for PFF operations, it was decided that in no way could the Lone Wolf program be allowed to interfere with the normal efficient employment of our main bomber force. In the light of this decision it was projected that individual PFF aircraft

operations would be limited to a specific set of circumstances which were:

- a. Lone Wolf operations would not be laid on if PFF aircraft serviceability was so low that this type of operation might jeopardize the efficiency of normal operations.
- b. It was necessary to limit the effort expended on Lone Wolf so that the replacement flow of equipment and personnel could maintain a PFF force adequate in size for normal Air Force operations.



This Lone Wolf in dull dark battle dress was photographed in bright sunlight. Note the absence of strong reflection from the broad wing and tail surfaces. The dull-finish, dark gray camouflage job on Lone Wolves has been found to be very effective under conditions of restricted visibility both in daylight and darkness.

### III. FORCES AVAILABLE

#### 1. Availability of Personnel and Equipment

A statistical breakdown of the aircraft and crews available for Lone Wolf operations is set forth in Table A. As has been discussed previously, the primary considerations as to the size of the force which could be employed on these operations was the effect they would have on the PFF effort available for our main operations. For instance, although as many as 75 aircraft were available for Lone Wolf attacks on 3 December, the greatest number that was thought wise to dispatch was approximately 53.

The shortage of Mickey operators provided a concurrent, though not a cumulative restriction on the maximum pathfinder force available. This shortage, resulting from a diversion of pathfinder operator allotments from this Air Force to other theaters, became increasingly critical over the period reported. At no time was the actual number of operators available smaller than the number of operational aircraft on hand, but the strain on the operators in the Air Force was excessive. In isolated extreme cases a pathfinder operator flew a daylight mission and was scheduled to fly a night mission in the same twenty-four hour period. Instrument-trained crews were never a limiting factor to Lone Wolf operations. All pilots in the Air Force held instrument ratings, which were revalidated by the completion of the intensive training program. Three weeks of such training was carried out prior to the first Lone Wolf mission.

The number of pathfinder aircraft available for night operations has always been less than that which could be dispatched for attacks during daylight. It has been felt that only aircraft which have been modified and equipped with flame dampeners should be dispatched on night operations, whereas the day missions it has been possible to dispatch both modified and unmodified aircraft. Also, night operations have had a more adverse effect on pathfinder serviceability for normal operations because attacks made during darkness are twelve hours out of phase with the normal Air Force effort.

#### 2. Modifications Needed.

In the period during which the initial Lone Wolf operations were executed the chief factor which limited the scale of effort dispatched was the shortage of modified

aircraft. Because it was felt they were more capable of participating in the early stages of the project, the 5<sup>th</sup> and 47<sup>th</sup> Wings were given first priority for modifications to pathfinder aircraft. The rapidity with which this modification was effected is indicated by the date recorded in Table A.

Listed below is a description of the modifications which were deemed necessary for the conversion of standard PFF aircraft to Lone Wolves.

a. Camouflage - Dull dark gray paint job over the entire aircraft.

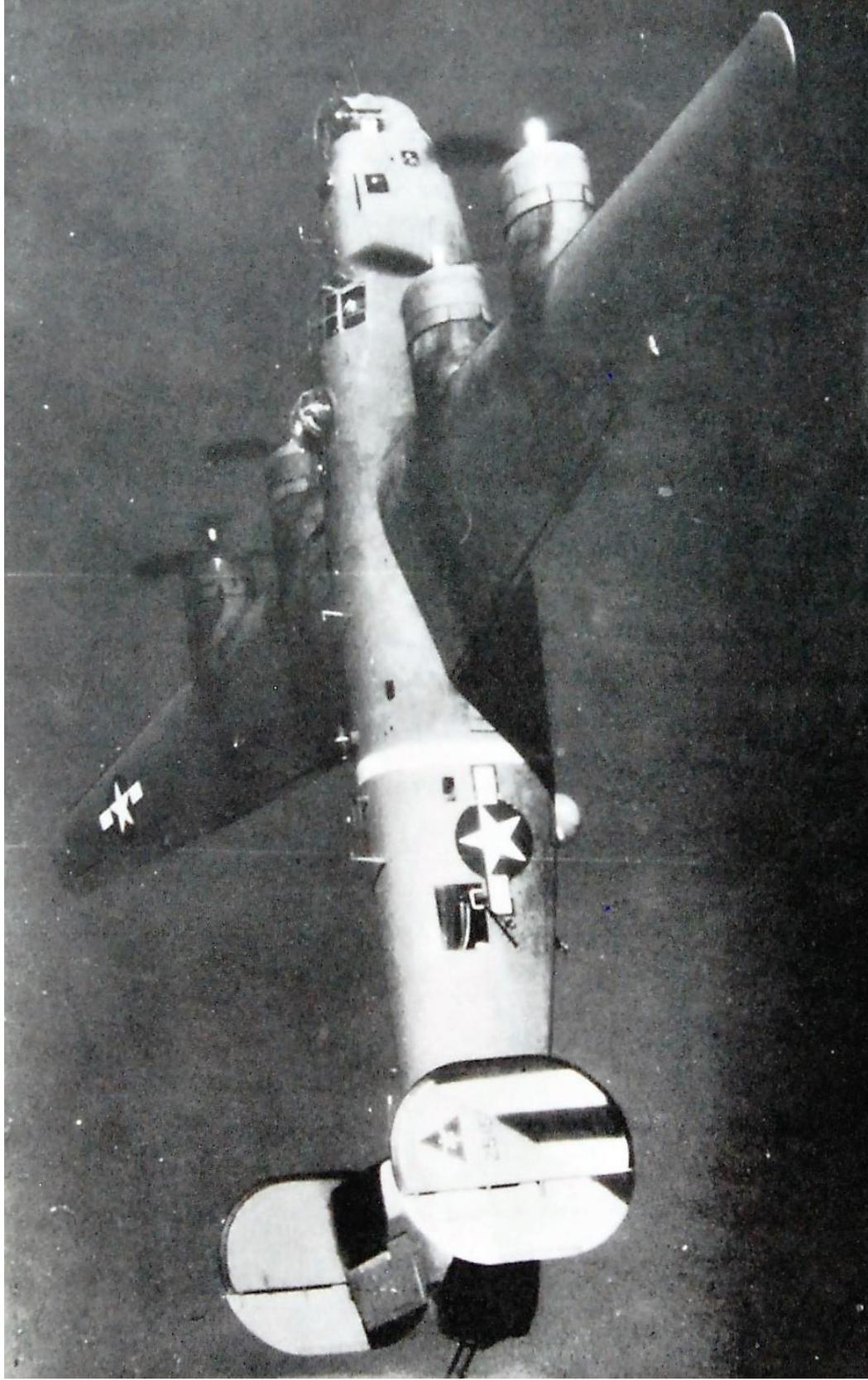
b. Heated de-icer and pressurization of H2X set - Necessary parts not available. Substitute plans provided for reinstallation of de-icers and pressurization of H2X by tapping in on de-icer pressure lines.

c. Flame Dampening - B-17 and B-24 flame dampener kits were made available and installed.

TABLE A  
STATUS PATHFINDER AIRCRAFT

WEEK ENDING	B-17 A/C 5TH WING			B-24 A/C 47TH WING			B-24 A/C 49th WING			B-24 CREWS					
	AV. ASGD	AV. SERV	NIGHT OPER	AV. HAND	AV. OPER	AV. ASGD	AV. SERV	NIGHT OPER	AV. HAND	AV. OPER	AV. ASGD	AV. SERV	NIGHT OPER	AV. HAND	AV. OPER
28 Oct	68	43	15	68	64	23	15	12	36	28	16	12	7	23	22
4 Nov	74	46	34	74	68	22	15	16	37	29	20	10	7	25	22
11 Nov	80	51	38	74	63	27	15	20	36	29	23	15	10	25	22
18 Nov	75	55	35	71	61	31	21	20	35	26	24	15	12	23	21
25 Nov	75	54	36	66	61	33	26	23	34	25	26	16	16	22	18
2 Dec	72	57	38	63	58	33	27	26	33	29	28	19	19	22	18
9 Dec	67	50	-	59	54	34	29	-	34	30	27	16	-	22	21
16 Dec	65	41	-	54	51	33	26	-	32	27	25	13	-	20	20

WEEK ENDING	B-24 A/C 55TH WING			B-24 A/C 304TH WING			B-24 CREWS			
	AV. ASGD	AV. SERV	NIGHT OPER	AV. HAND	AV. OPER	AV. ASGD	AV. SERV	NIGHT OPER	AV. HAND	AV. OPER
28 Oct	22	14	1	29	23	22	15	6	26	24
4 Nov	30	21	5	30	23	29	22	11	28	24
11 Nov	33	28	6	30	24	35	27	15	29	25
18 Nov	33	23	11	27	24	36	26	23	28	25
25 Nov	30	21	18	26	21	40	29	26	26	23
2 Dec	30	24	22	27	23	39	32	26	25	23
9 Dec	32	23	-	27	24	38	34	-	22	21
16 Dec	31	25	-	27	24	41	29	-	24	20



Lone Wolf Liberator wearing coat of dull gray camouflage paint. Photo was taken in direct, bright sunlight.

#### 4. Training Needed.

Concurrent with the final decision to execute a plan of single-aircraft operations, there was put into effect a training program which was calculated to increase the efficiency and provide for the safety of Lone Wolf crews. This training was laid on as a high priority program. Special emphasis was placed on the preparation of the crews for those exigencies which arise under conditions of darkness and unfavorable weather. Pilot training in instrument flying and night take-offs and landings was considered most important. To increase the safety factor involved in night training and to provide facilities for future operations, orientation lights were placed on extensions of the normal runway lighting systems. This innovation was the direct result of experience gained on D-Day of the South France invasion when this Air Force was required to dispatch a pre-dawn effort. On this occasion, casualties resulted from take-off crashes which were caused by the inability of pilots to keep themselves oriented with the ground until safe flying speed was attained. No problems of night and bad weather flying affected other crew members in any manner different from that encountered on normal operations. All crews had been trained already for blind bombing and navigation on normal operations. In preparation for Lone Wolf, intensified normal training for all crew members except pilots (specially instrument trained) was thought to be adequate.



Fifteenth Air Force Micky School in session.

#### IV. PHASING THE OPERATION

##### 1. Operating Procedures.

When the first Lone Wolf missions were flown, only one Wing participated. Allotment of take-off times, rendezvous areas, lines of departure and target times was not difficult. Later, when aircraft from all Wings participated, special care in planning was necessary to avoid possible congestion in local base areas, enroute and especially at the target. Take-off times were scheduled to prevent congestion in rendezvous areas. Several lines of departure were established near bases or at least in the southern sector of the route. A block of operating time was allotted to each Wing, which then divided its time block among its various Groups. Aircraft were scheduled to pass over their assigned line of departure at specified times and altitudes. To insure further against possible confusion and collision enroute, not more than two Wings were committed against any one target. Corridors of flight were established so that attacking forces might be separated laterally. Sometimes a line was established so that the bomber stream proceeded to the target on one side of the line and returned on the other side. Later, when the entire stacking force was assigned to one target, measures to insure closer timing were effected.

Lone Wolf S.O.P. currently in use provides that timing will be accomplished by the close observance of wing blocks of target time, all aircraft proceeding to the target area at standardized cruising speeds. Sufficient interval between time blocks is allowed to insure that aircraft from different Wings will not be in the rendezvous area at the same time. Definite routes are assigned to and from the target areas. Special emphasis is placed on the importance of the Groups and Wings adhering to the assigned target times. Allotment of time at the target is based on the arbitrary measure of the length of time required by a force of twelve aircraft to effect individual attacks. This time block is set at six minutes, thirty seconds per airplane. An interval of not less than five minutes during which no attack is scheduled is allowed before the next time block for bombing is assigned.

Target altitudes are based usually on the vertical distance required for the spacing of six aircraft. This determination is dependent largely on current target weather. The first six aircraft of a twelve-aircraft attack unit (arbitrary designation) are staggered down at 500 to 750-foot intervals below the leader. The seventh aircraft flies at

the same altitude as the lead and the remaining five are staggered down at the aforementioned intervals. For example - if the first aircraft was assigned a bombing altitude of 26,000 feet, the remaining planes would fly respectively at 25,500; 25,000; 24,500; 24,000; 23,500; (seventh plane) 26,000; 25,500; 25,000; 24,500; 24,000; 23,500. Other methods of fixing bombing altitudes have been and are being employed, all following roughly the same general pattern as that described above.

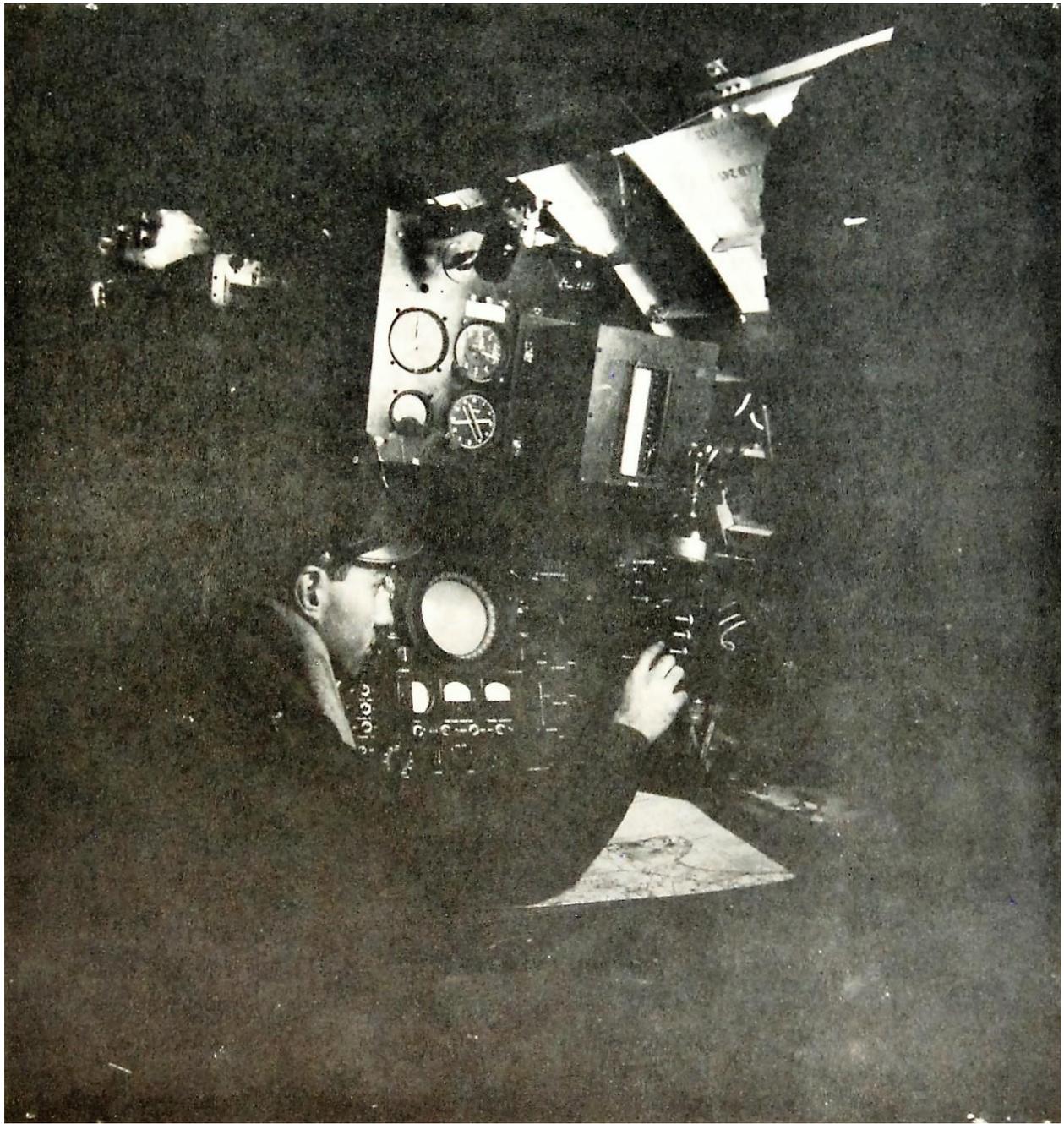
Weather reconnaissance aircraft are employed normally to reconnoiter the route prior to bomber take-off time for the purpose of transmitting current weather observations to Air Force Headquarters. Based on these reports, the final decision is made as to the advisability of executing the mission, diverting the bomber force, or cancelling the entire project. Every safety precaution is observed to insure the success of the operation.

In order that aircrews may take advantage of daylight visibility during the initial climb phase of an operation, it is customary, whenever practicable, to dispatch the force during daylight hours for attacks either during the daytime or shortly after dark. It is believed that aircrews can make favorable use of all possible visibility in daylight to avoid thunder storms and other conditions which cause icing. Under conditions where base weather will not be entirely favorable, it is usually projected to dispatch the force at such a time that its return to base will be during daylight hours, thus facilitating instrument let-down in conditions unfavorable to visibility.

The latest innovation of Lone Wolf is the flying of two to four-ship formations under conditions of restricted visibility. This procedure was tried, employing formations of two aircraft each on a day when visibility within high cirrostratus clouds was several hundred feet. The operation was successful and consideration is being given to the possible employment of formations composed of three or four non-PFF aircraft flying on one Lone Wolf leader. This tactic would allow for the multiplication of the effective bomb load of a Lone Wolf force, increasing greatly the efficiency of this type of operation.



In Lone Wolf's nose a bombardier gives his sight a pre-flight prior to take-off.



"Mickey Man" in blacked out B-17 checks his set.

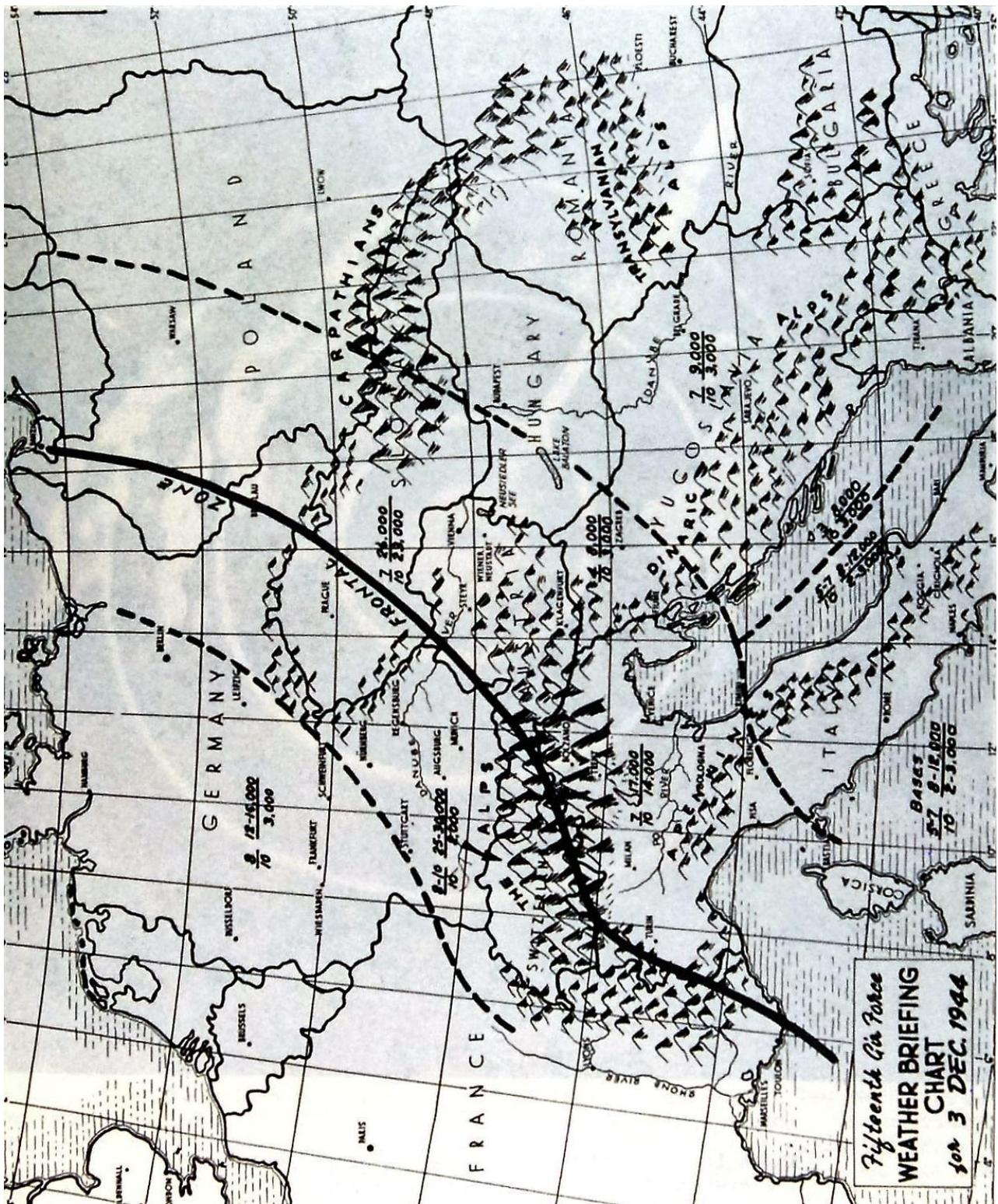
## 2. Typical Weather Situation - An example.

On 3 December 1944, 53 Lone Wolves were dispatched to bomb the Industrial Area at Linz and the Innsbruck Marshalling Yards. The weather situation which prevailed is typical of that condition which favors single-aircraft operations. See illustration on next page.

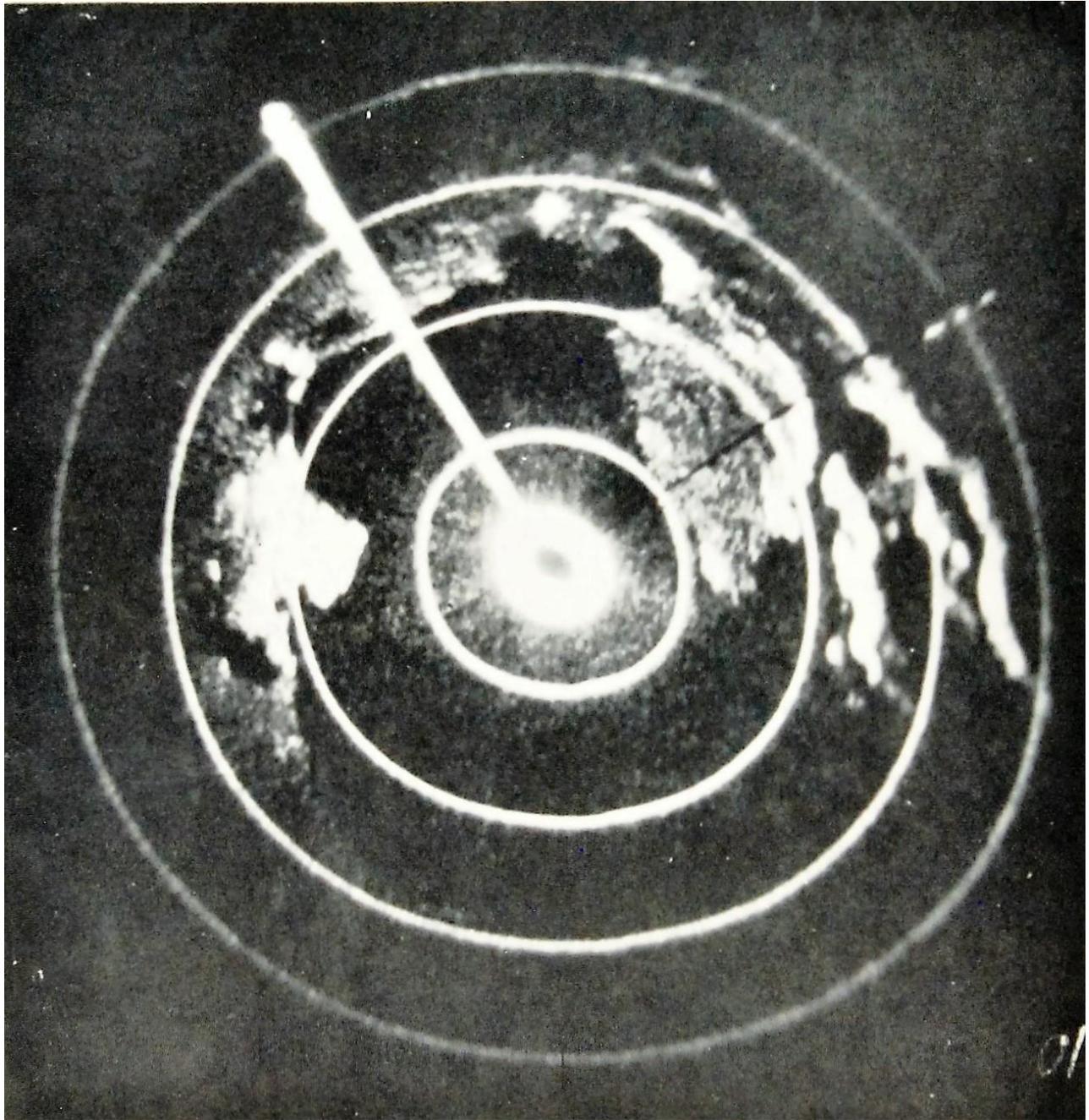
The weather situation on this date favored Lone Wolf operations for the following reasons:

- a. Weather at the target and over that portion of the route which lay in enemy territory afforded 7/10 cloud cover at bombing altitude, negating the threat of fighter opposition.
- b. The condition prevailing over enemy fighter bases, 4/10 sky cover at low levels and 7/10 cloud at medium altitude, clouds containing ice and precipitation, introduced a hazard to the flying of enemy interceptors.
- c. Base weather was favorable for the flying of heavily loaded bombardment aircraft.

Under the conditions prevailing it was possible to dispatch the force in good weather. On their departure from the base areas the bombers were able to climb above the icing level before middle and high cloud layers were encountered in the upper Adriatic, could effect a bombing run under conditions when there was but small prospect of fighter opposition, could withdraw from enemy territory in the overcast, breaking into the clear for landings at bases.



*Fifteenth Air Force*  
**WEATHER BRIEFING**  
**CHART**  
**for 3 DEC. 1944**



Above is an enlargement of a Mickey-Scope photograph. The presentation of the head of the Adriatic is recorded in sharp detail by the 100-mile scan of H2X.

### 3. Chronology of Operations.

#### 25 October - KLAGENFURT AIRCRAFT FACTORY (DAY)

The first experimental bombing attack by Lone Wolf aircraft was staged in daylight on 25 October. Six aircraft were dispatched at ten-minute intervals to fly in cloud layers to the target which was Klagenfurt, in Austria. The attack was to be delivered from normal bombing altitudes, target time 1200A, and bomb release was to be made by PFF synchronous methods.

The aircraft returned early and one aircraft, owing to insufficient cloud cover over target, bombed a target of opportunity. All six aircraft negotiated the route to and from target on instruments, penetrating a front enroute. Over the target, however, the clouds were ten-tenths low, no middle, three-tenths high. Three aircraft proceeded to bomb target on PFF, despite the absence of sufficient clouds to provide defensive cover against possible fighter opposition. All aircraft returned safely to base.

This mission indicated that fair weather conditions in the target area could detract from the success of this type operation.

#### 26 October - INNSBRUCK MARSHALLING YARDS (DAY)

Twelve aircraft were dispatched according to plan at one-minute intervals against the marshalling yards at Innsbruck. After flying instruments from base to crest of Alps, the bombers broke out into clear weather near the target. Five aircraft returned early and seven bombed the target visually.

On this mission the aircraft were spaced vertically at 1000-foot intervals within attack units of four aircraft each. The lead aircraft of each succeeding attack unit flew at the same altitude as the lead plane of the first attack unit. Altitudes were: 25,000; 26,000; 27,000; 28,000; 25,000; 26,000; etc.

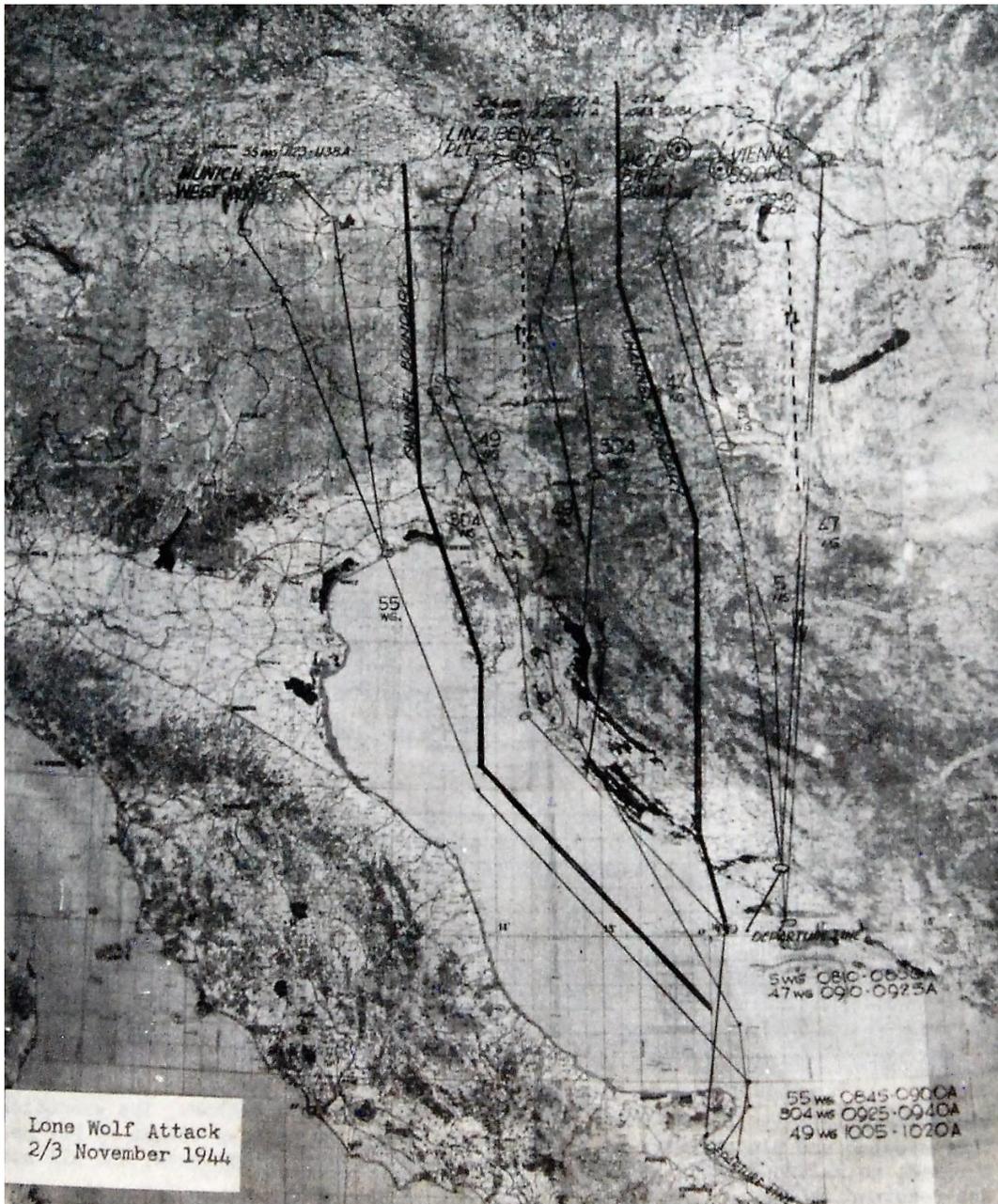
M/IAH flak was encountered at the target. Seven unidentified enemy aircraft were seen; six in the Udine area and one in the target area. The fact that these aircraft did not attack gave encouragement for the future exploitation of this tactic.

Tentative conclusions were that this type of operation is feasible for a specific set of weather conditions and provides a

means for effectively harassing the enemy on occasions when a large-scale bombing effort is not possible.

28 October - KLAGENFURT AIRCRAFT FACTORY (DAY)

Ten B-17's were dispatched from the 5th Bomb Wing. Ten B-17's attacked the primary target. All aircraft bombed by synchronous PFF method. The execution of this mission was almost ideal -- all aircraft bombed the primary target by PFF as briefed, no malfunctions occurred, no enemy aircraft were encountered, and all bombers returned safely.



28 October - MUNICH WEST MARSHALLING YARDS (NIGHT)

Twelve B-17's were dispatched from the 5th Bomb Wing. Eight B-17's bombed the primary target, all by synchronous PFF methods. Due to mechanical and PFF malfunction two B-17's bombed a target of opportunity. For the same reasons three sorties were abortive. S/IIH to IAH flak was experienced at the primary target. One unidentified aircraft was seen in the target area but no encounters were reported. The first night operation was considered highly successful. Aircraft participating in the attack were dispatched just prior to darkness. All aircraft returned to base safely, although some sustained battle damage from flak.

After having completed three day-missions and one night-mission it was concluded that harassing effect of this tactic was significant and satisfactory. Night operations seemed to offer more protection to our bombers, making it possible for the force to operate under less clouded weather conditions than could be penetrated in daylight.

30 October - KLAGENFURT MARSHALLING YARD (NIGHT)

Six B-24's were dispatched from the 47th Wing. Three bombed the primary and three were abortive. Four JU-88's were seen in the target area but were evaded successfully.

This operation was executed following a daylight operation against the same target. This was a further step toward a solution of the round-the-clock bombing problem.

2/3 October - VIENNA SOUTH ORDNANCE PLANT  
MOSEBIERBAUM OIL REFINERY  
KLAGENFURT AIRCRAFT FACTORY  
MUNICH WEST MARSHALLING YARD

During the hours of darkness on 2 November, 15 B-17's were dispatched to bomb the Moosebierbaum Oil Refinery. Five aircraft bombed the primary and two bombed alternates.

On the following day, the largest force to date, totaling seventy-four aircraft, was dispatched. Each of the five Wings was assigned an individual target. A maximum time interval of one minute between bombers was established. Target times for the Wings were so arranged that each Wing had complete freedom for the use of base areas for a period of forty minutes, thus precluding congestion in base areas where instrument flying conditions prevailed.

13 November - BLECHHAMMER SOUTH OIL REFINERY (NIGHT)

This was the first operation during which aircraft penetrated enemy territory to their maximum range. Thirty-one aircraft were dispatched against Blechhammer South Oil Refinery, one of the highest priority strategic oil targets of Europe. Of the force participating in the attack 15 bombed the factory, 4 bombed alternates, and 12 aborted. This was a night mission and target times were spaced from 2007 to 0322 hours. Extended timing plus the use of long-delay fuses made effective prolonged harassing of the enemy.

Surprise was achieved by the bombers which initiated the attack. The refinery was in full operation with lights ablaze and smoke pouring from the stacks of the boiler houses. Orange flames and explosions were observed in the target area. The first bomb strings walked through the refinery.

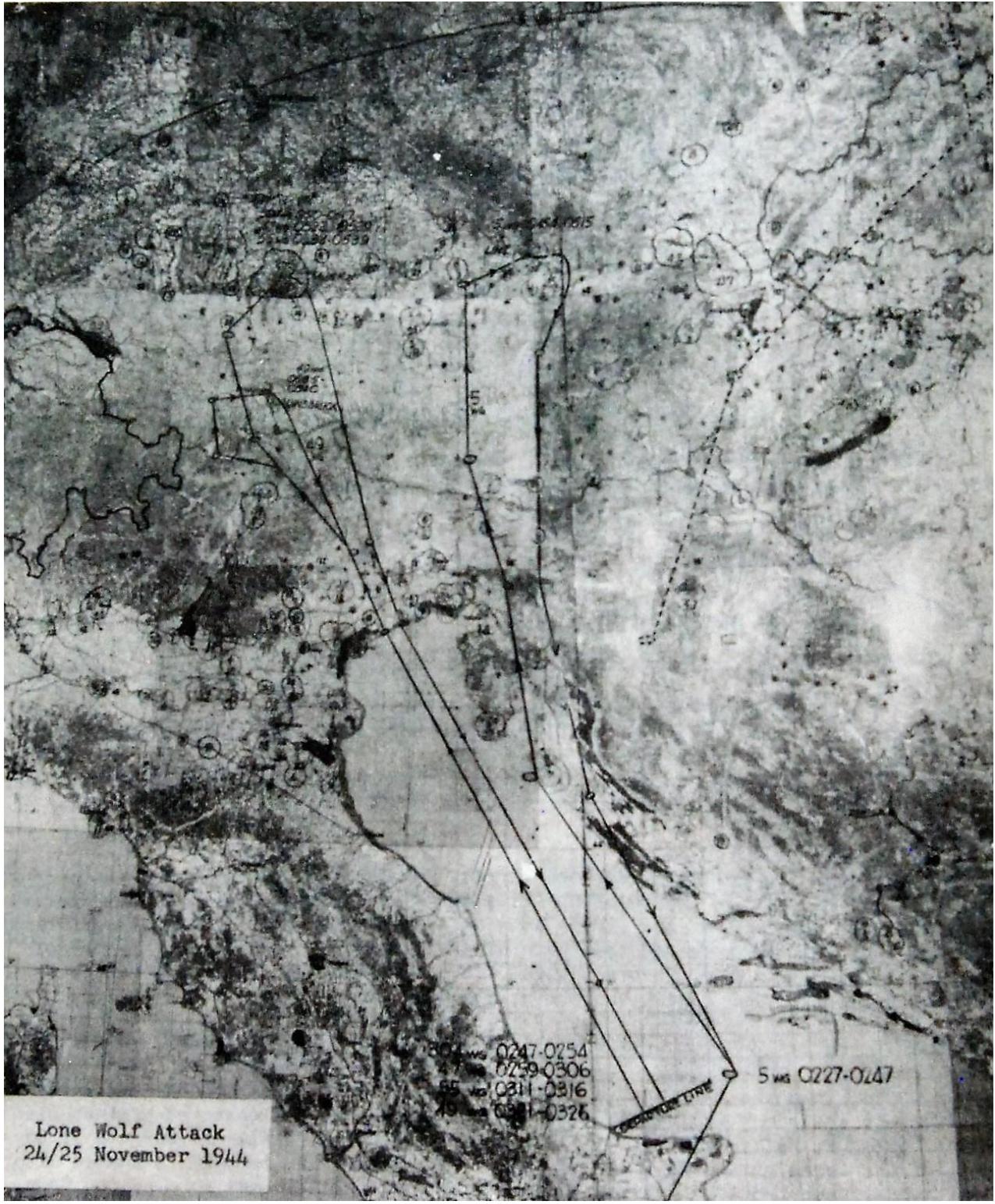
On this mission two aircraft were lost (1 crash-landed, 1 ditched - crews safe) and two are missing. These losses, the first to occur on Lone Wolf operations, were thought to have been caused partly by adverse weather.

15 November - LINZ BENZOL OIL REFINERY  
INNSBRUCK MAIN MARSHALLING YARD (DAY)

On this operation the first attempt was made to achieve coordination among all forces of several Wings assigned to the same target area. No difficulty was experienced. Of 99 aircraft dispatched; 66 bombed primary targets, 10 bombed alternates, and 23 aborted. Five aircraft are missing from this operation.

24/25 November - LINZ BENZOL REFINERY  
MUNICH WEST MARSHALLING YARD (NIGHT)

This attack was planned to achieve coordination between time of attack and heavy cloudiness immediately in advance of a fast-moving frontal disturbance. Timing permitted returning bombers to land after first light under conditions of deteriorating base weather. Of 63 bombers dispatched; 28 bombed primary targets, 18 bombed other targets, and 17 aborted. One aircraft was lost and two are missing.



Lone Wolf Attack  
24/25 November 1944

807 WGS 0247-0254  
0259-0306  
85 WGS 0311-0316  
70 WGS 0321-0326

5 WGS 0227-0247

OPERATIONAL TIME

12 December - BLECHHAMMER SOUTH SYNTHETIC OIL PLANT (DAY)

On this date 91 pathfinder aircraft were dispatched in an Air Force stream consisting of individual formation elements of two aircraft each and spaced at one-minute intervals. 79 sorties were effective. Completion of this mission brought the total number of effective sorties of this type to 460. Aircrews were instructed to fly in high cirrus clouds for protective cover against enemy fighters. This operation was projected to test the practicality of employing small formations operating under conditions of restricted visibility. Pilots reported no difficulty in maintaining formation positions and experienced no exceptional fatigue or vertigo. This type of operation enables one or two non-mickey aircraft to fly in formation with a lead and deputy-lead pathfinder aircraft. Advantages to this tactic are: doubled tonnage of bombs dropped on the target with no appreciable loss in accuracy, mutual protection afforded by bombing aircraft in small formation, psychological aid to crews as a result of mutual support, and reduction of early returns due to mickey equipment failure by employment of deputy-lead pathfinder. It is projected that in the future three or four-ship elements of this type may be employed so that a greater striking force may effect heavier attacks under cover of bad weather. Such eventual employment will change this type of operation from a tactic of chiefly harassing value one capable of delivering heavy blows against vital enemy installations.

TABLE B

DATE	WING	TARGET	A/C DIS-PAATCHED	BOMBED PRIMARY TARGET	BOMBED ALTERNATE OR TARGETS OF OPPORTUNITY	REASONS FOR BOMB. ALT & OPP TARGETS	ABORTIVE AIRCRAFT (2)	REASONS AIRCRAFT ABORTIVE	LOST AND MIA	RESULTS (3)	E/A SEEN	E/A ENCOUNTERED	TARGET TIME
CLEAR (1)      MECHANICAL      OTHER      CLEAR (1)      PFM      MECHANICAL      OTHER      ABORTIVE AIRCRAFT (2)      REASONS AIRCRAFT ABORTIVE      LOST AND MIA      RESULTS (3)      E/A SEEN      E/A ENCOUNTERED      TARGET TIME													
25 Oct	5th	Klagenfurt A/C Factory	6	3	1	0 1 0 0	2	2 0 0 0	0	NRO	0	0	1054-1118
26 Oct	5th	Innsbruck M/Y	12	7	0	0 0 0 0	5	5 0 0 0	0	GOOD	7	0	1130-1207
28 Oct	5th	Klagenfurt A/C Factory	10	10	0	0 0 0 0	0	0 0 0 0	0	NRO	0	0	1431-1524
28 Oct	5th	Munich West M/Y	12	7	2	0 1 1 0	3	0 2 1 0	0	NRO	1	0	2014-2035
30 Oct	47th	Klagenfurt M/Y	6	3	0	0 0 0 0	3	0 2 1 0	0	NRO	4	0	1950-2014
2 Nov	5th	Moosbierbaum O/R	15	5	2	2 0 0 0	8	2 4 2 0	0	NRO	0	0	2030-2044
3 Nov	5th	Vienna S. Ord Depot	28	15	2	0 1 0 1	11	2 4 5 0	0	NRO	0	0	0935-1039
	47th	Moosbierbaum O/R	11	2	4	2 2 0 0	5	0 3 2 0	0	NRO	0	0	1047-1105
	49th	Klagenfurt A/C Factory	11	8	0	0 0 0 0	3	0 2 1 0	0	NRO	0	0	1321-1342
	55th	Munich West M/Y	12	8	1	1 0 0 0	3	0 3 0 0	0	NRO	1	0	1106-1135
	304th	Klagenfurt A/C Factory	12	8	0	0 0 0 0	4	0 1 2 1	0	NRO	2	0	1257-1330
7 Nov	5th	Vienna Florisdorf O/R	17	10	6	2 1 2 1	1	0 0 1 0	0	NRO	0	0	1332-1427
12/13 Nov	5th	Blechhammer South O/R	22	13	1	0 1 0 0	8	0 3 4 1	2L 2M	FIRES	0	0	0230-0303
	47th	Blechhammer South O/R	9	2	3	3 0 0 0	4	2 2 0 0	0	FIRES	0	0	2006-2018
15 Nov	5th	Linz Benzol O/R	36	28	3	0 1 2 0	5	0 0 4 1	2M	NRO	0	0	1036-1128
	47th	Innsbruck Main M/Y	16	10	2	1 0 0 1	4	0 1 0 3	0	NRO	0	0	1009-1037
	49th	Innsbruck Main M/Y	11	7	1	0 0 1 0	3	0 1 1 1	1M	NRO	0	0	0928-0935
	55th	Linz Benzol O/R	18	9	2	0 2 0 0	7	0 2 2 3	2M	NRO	0	0	1120-1140
	304th	Linz Benzol O/R	18	12	2	0 0 2 0	4	0 1 2 1	0	NRO	0	0	1133-1218

24/25	5th	Linz Benzol O/R	35	18	8	4	0	4	0	9	2	2	2	3	1L 2M	NRO	13	1	0330-0430
Nov	49th	Munich West M/Y	7	3	3	2	0	1	0	1	1	0	0	0	0	NRO	0	0	0424-0434
	55th	Munich West M/Y	7	3	2	1	1	0	0	2	0	0	2	0	0	NRO	0	0	0436-0508
	304th	Munich West M/Y	14	4	5	4	0	1	0	5	0	3	2	0	0	NRO	4	1	0356-0415
29/30	5th	Linz Benzol Plant	29	18	3	0	1	2	0	8	0	5	3	0	0	NRO	4	3	0430-0513
Nov	47th	Munich West M/Y	10	4	5	5	0	0	0	1	1	0	0	0	0	NRO	2	1	0501-0510
3 Dec	5th	Linz Industrial Area	12	3	3	3	0	0	0	6	3	2	0	1	1M	NRO	2	1	1058-1140
	47th	Linz Industrial Area	12	3	3	3	0	0	0	6	5	1	0	0	0	NRO	2	0	1042-1110
	49th	Innsbruck M/Y	7	5	0	0	0	0	0	2	0	1	0	0	0	NRO	0	0	1024-1049
	55th	Linz Industrial Area	10	8	8	6	0	2	0	2	0	0	2	0	0	NRO	0	0	1020-1152
	304th	Linz Industrial Area	12	2	6	6	0	0	0	4	3	0	1	0	0	NRO	1	0	1020-1048
6/7 Dec	5th	Salzburg West M/Y	18	4	6	5	0	1	0	8	0	1	5	2	2M	FIRES	1	0	0500-0510
	47th	Innsbruck M/Y	12	1	4	3	1	0	0	7	5	0	2	0	0	HITS	3	1	0510-0530
	49th	Innsbruck M/Y	6	3	1	0	0	1	1	2	1	0	1	0	0	NRO	3	0	0530-0608
	55th	Salzburg West M/Y	6	1	4	3	0	0	1	1	0	1	0	0	0	NRO	1	1	0524-0534
	304th	Salzburg West M/Y	8	2	3	2	0	0	1	3	1	0	0	2	0	FIRES	2	2	0504-0534
7/8 Dec	5th	Moosbierbaum O/R	17	5	7	5	0	0	2	5	0	2	3	0	0	FIRES	6	5	0429-0555
	47th	Moosbierbaum O/R	12	0	7	1	2	0	0	5	1	0	3	1	0	HITS	1	1	0449-0538
	49th	Moosbierbaum O/R	6	0	1	1	0	0	0	5	3	0	1	1	0	HITS	13	6	0452-0535
	55th	Moosbierbaum O/R	8	0	5	5	0	0	0	3	0	2	1	0	0	HITS	1	1	0502-0523
	304th	Moosbierbaum O/R	8	0	3	3	0	0	0	5	0	1	1	3	0	HITS	0	0	0503-0551
12 Dec	5th	Blechhammer S. O/R	33	23	7	0	5	1	1	3	0	0	2	1	1M	NRO	19	2	1022-1102
	47th	Blechhammer S. O/R	21	11	6	6	0	0	0	4	1	2	1	0	0	NRO	6	0	1036-1110
	49th	Blechhammer S. O/R	7	3	2	0	1	1	0	2	0	0	2	0	0	NRO	1	1	1039-1115
	55th	Blechhammer S. O/R	12	5	6	5	0	1	0	1	1	0	0	0	0	NRO	1	0	1104-1202
	304th	Blechhammer S. O/R	16	9	6	1	1	3	1	1	0	0	0	1	1L	NRO	17	2	1044-1103
			627	297	146	89	22	25	10*	184	42	53	63	26**	4L 13M***		118	29	

(1) CLEAR - Inadequate cloud cover to afford bombers protection.

(2) ABORTIVE - Includes all non-effective sorties. Unless an aircraft was known to have bombed a target, it is listed as abortive.

(3) NRO - No results observed.

\* Other: 1 - turbulence; 2 - personnel; 2 - enemy aircraft; 5 - icing.

\*\* Other: 4 - turbulence; 5 - icing; 5 - enemy aircraft; 12 - lost or missing.

\*\*\* 5 of 17 aircraft listed as lost or missing bombed primary target.

□

## V. STATISTICAL SUMMARY OF OPERATIONS

### 1. Breakdown of Effort Expended

All data reported in this summary was compiled from current operations reports submitted by Groups and Wings.

Of 627 aircraft dispatched on 16 missions; 297 (47.4%) bombed their assigned target, 146 (23.2%) bombed alternate targets, and 184 (29.4%) aborted. Of the total aircraft dispatched, 4 were lost and 13 are listed as missing. This corresponds to an attrition rate of 2.7% and compares unfavorably with the less than 2% attrition experienced on normal operations of the Air Force during the same period. Effective sorties for the effort expended total 443, 70.6% of the force dispatched. Of that portion of the force (330 aircraft) which was prevented from attacking the briefed target; 131 (39.9%) were deterred by inadequate cloud cover, 88 (26.6%) by mechanical malfunctions, 75 (22.7%) by PFF failures, 12 (3.6%) by loss of the aircraft, 10 (3.0%) by icing conditions, 7 (2.1%) by enemy aircraft, 5 (1.5%) by excessive turbulence, and 2 (0.6%) by personnel failures. The percentage of the total Lone Wolf effort which was non-effective (abortive) was 29.4%. This figure compares favorably with that achieved by the Air Force during this same period when the percentage of non-effective sorties of the total bombers dispatched on normal operations amounted to 31%.

See Table B for a further breakdown of operational statistics.

### 2. Results achieved.

The extent of destruction created by Lone Wolf attacks during the period under consideration is not known. The conditions under which the operations were executed preclude bomb strike photographic or visual assessment. On two occasions, when bombing was accomplished under visual conditions, crews report the targets hit. On the day missions against Innsbruck on 26 October, crews bombed visually and claimed direct hits on the marshalling yard. On 13 November crews attacking Blechhammer South Synthetic Oil Refinery at night found the target clear and, in the case of the first ship over the target, even lighted. The lights were extinguished when bombs from the first airplane exploded in the target area. Crews making attacks subsequent to the initial release report fires in the target area.

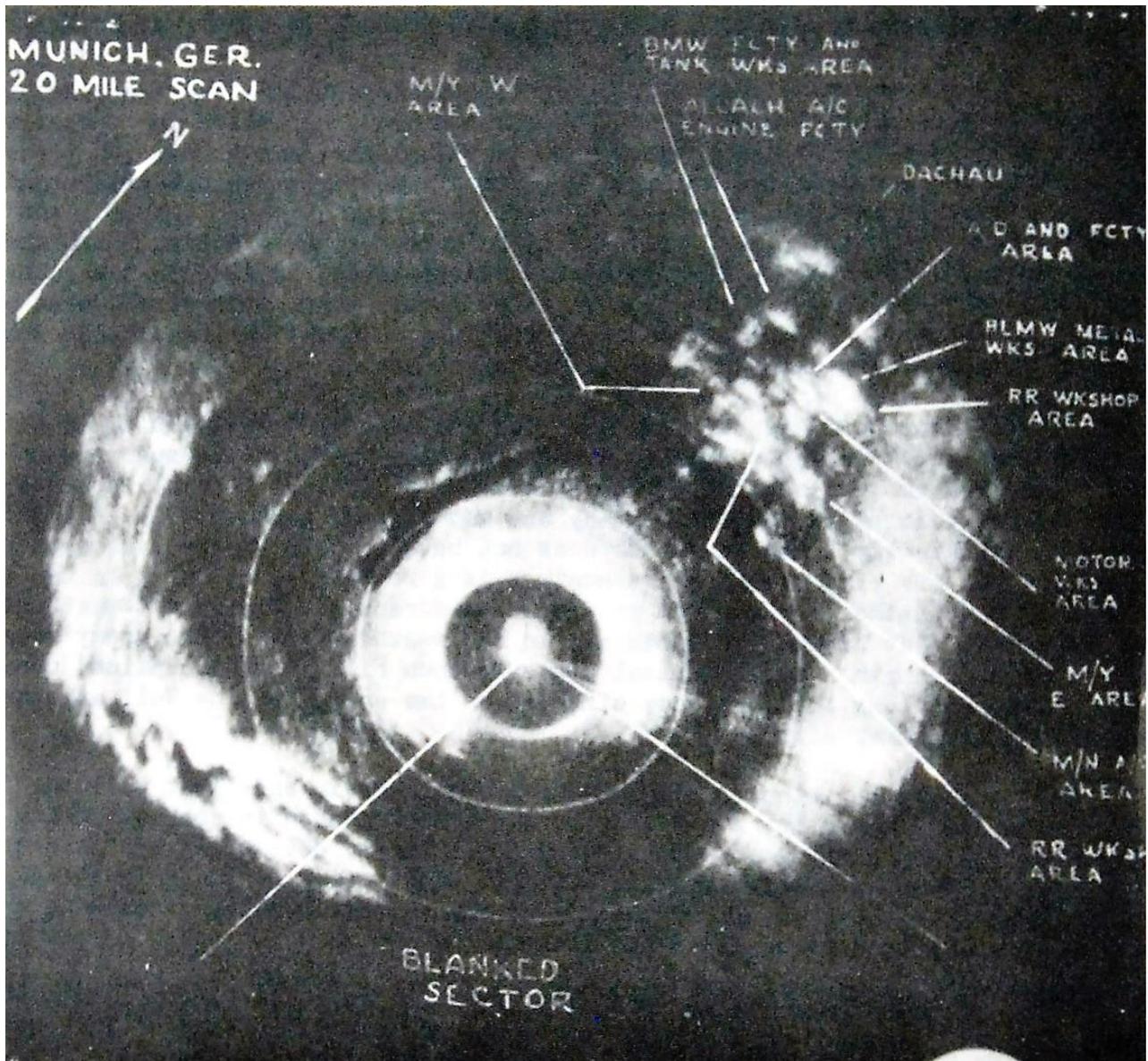
Lone Wolf attacks were designed and executed partially for their harassing value. The enemy has come to expect immunity from bombing operations at night, and when the weather is such as to prevent formation attacks. Workers freed from the fear of air bombardment by bad weather and darkness can go about their work more efficiently. Rolling stock does not have to be dispersed, fire watchers can relax, and air raid shelters are empty. As a result, he is using to the utmost periods of bad weather for maximum production and repair. It is felt that even light attacks carried out around-the-clock and in bad weather destroy the enemy's sense of security and maintain a psychological pressure on him. The disruption, confusion, loss in time and loss in efficiency effected on the enemy by Lone Wolf attacks has a significant strategic effect.

Participation in single-ship PFF attacks is excellent training for new mickey operators. Normally, a new operator is indoctrinated in combat bombing by flying a deputy lead position in normal formation attacks, developing proficiency in navigation procedures and familiarity with his mickey set. Single-ship attacks accomplish all this and also afford the new crewman active bombing experience which produces increasing confidence in his equipment.

Listed below is an account of bomb damage inflicted by Lone Wolf attacks. This information is fragmentary because of a total absence of bomb strike photography and only a partial coverage of reconnaissance photography.

OIL REFINERIES:     MOOSEBIERBAUM, BLECHHAMMER

There is no way of determining tangible results because, in the instance of each Lone Wolf attack, one or more formation attacks took place between the date of the "Lone Wolf" bombing and the reconnaissance photography. It is probable that such attacks interrupted refinery operations for a period of from three to six hours. This conclusion is based on information obtained at Ploesti where refinery personnel, when three or more aircraft attacked, fled to fields some distance away. Sufficient heat, steam and pressure were maintained in the refinery were maintained in the refinery to prevent the pipes from being fouled.



Above is a sample of one of the types of target material produced by the Fifteenth Air Force for use by Mickey Operators in effecting non-visual bombing runs. Note the extensive interpretation made of this Mickey-Scope presentation of Munich.

#### INNSBRUCK MARSHALLING YARD

Coordinated interpretation of the bomb strike photography of the visual attack of 26 October and reconnaissance photographs of 4 November show that the northwest roundhouse received two or more direct hits, the turntable was damaged, two large sheds were partially destroyed by direct hits, two other sheds were gutted by fire, two shops were damaged by hits, at least six hits were scored on tracks in the

yard and sidings and three or more residential buildings near the yards were hit.

Reconnaissance photographs of 7 December, following the 3 and 7 December attacks, show damage to a freight warehouse at the north end of the yard, two or three derailed freight cars, a cut siding at the east side of the yard, several derailed freight cars in this area, and some new craters in the residential area.

#### MUNICH WEST MARSHALLING YARD

No damage is disclosed by reconnaissance photographs. In all cases repair, sorting, and marshalling activities were probably suspended during the alert; locomotives and rolling stock may have been moved out of the yard to country sidings, as was the case in Roumania.

#### ARMAMENT: VIENNA SOUTH ORDNANCE DEPOT

Reconnaissance photographs do not disclose any apparent damage to the Vienna South Ordnance Depot. Probable results were the suspension of work during the alert.

#### INDUSTRY AND AIR

Photo interpretation reports do not show any tangible results to the Linz Industrial Area or the Klagenfurt Aircraft Factory.

Reconnaissance photography of 17 November shows six tracks cut in the central part of the Linz Marshalling Yard, severe damage to a roundhouse at the north end of the yard and roof damage to a railroad workshop in the station yard. The "Lone Wolf" attack of 15 November intervened between a formation PFF attack of 11 November and the reconnaissance, so that no statement of the damage resulting solely from the "Lone Wolf" mission is possible.

Probable results were cessation of works in the plants during alerts.

## VI. TACTICAL ANALYSIS

### 1. Degree of Success Achieved by Lone Wolf.

As has been noted in Section V, the damage inflicted on enemy installations by single-aircraft attacks is not readily assessable. In those few instances (Blechhammer, Innsbruck) when bombing runs were made visually, it is known that bombs landed in the target area, inflicting damage on the installations there. It is believed, in the light of experience gained in the employment of normal PFF forces, that there is a good probability that some of the bombs dropped on each Lone Wolf mission struck in the vicinity of the assigned target.

Crew reports from all single-aircraft operations indicate that enemy defenses were well alerted. In all, 118 enemy aircraft were sighted and slight to intense flak was reported over the majority of targets. The extent of this enemy opposition indicates that our operations effected a full-scale alerting of the enemy's defenses and probably drove much of the populace into shelters. This statement is made on the assumption that some bombs struck in and about centers of population, for it is doubted if only a warning is any longer sufficient cause to motivate the much-bombed citizenry of South Germany to seek shelter.

By embarking on a program of double-aircraft operations this Air Force has been enabled to execute 16 missions with a total of 627 sorties under conditions which precluded normal operations. To this extent, success has been achieved in maintaining the pressure of bombardment on the people of Southern Germany. It is not known to what extent Lone Wolf attacks have effected a deleterious influence on enemy morale, but it is believed that these attacks, occurring during the night and day in seemingly impossible flying weather, would accomplish nothing which would improve his spirits.

### 2. Efficiency of Employment.

As a method for the employment of heavy bomber force in this theater it is believed that Lone Wolf has sound possibilities. Because of the limitations imposed on this type of operation by weather, it would be unwise to commit any sizeable force to single-aircraft operations alone but, if a large Lone Wolf force was in existence in this theater, it could be employed as a normal bomber force part of the time and a Lone Wolf force part of the time, depending on which type of

operation was the most practicable under current weather conditions.

The effectiveness of the sorties dispatched on Lone Wolf operations during the period under consideration compared favorably with the effectiveness of the normal Air Force effort. (see attached summary) It is believed that when more experience is gained in the execution of this type of operation the rate of sortie effectiveness for Lone Wolf should surpass substantially that achieved on normal operations.

Because of the small force dispatched on single-aircraft operations against any one target, impressive lists of damage assessments are not forthcoming from Lone Wolf operations. On Linz, the target most heavily hit by Lone Wolves, only 85 loads of bombs were dropped. In the course of normal operations, PFF and visual, the total effort of one or two, and sometimes three, Wings is expended on this target. Were as substantial a force of Lone Wolves assigned this target it is believed the results achieved by them would equal or even exceed those achieved by normal non-visual attacks.

The attrition rate experienced on single-aircraft operations compares unfavorably with that experienced on normal Air Force operations. Although numerous sightings and a few engagements with enemy aircraft were made by Lone Wolves and some battle damage by flak was sustained, it is the expert opinion of commanders in the Wings and Groups that the bulk of our losses have been caused by bad weather. The overload on the pressure systems of aircraft, caused by the simultaneous use of gyro instruments, de-icers, and H2X pressurization is known to have caused malfunctions of pressure pumps which resulted in the loss of flight instruments. It is known also that the common de-icer systems installed on B-17 and B-24 type aircraft are not entirely satisfactory for all-weather flying. The installation of better equipment in Lone Wolf aircraft and the further training of pilots in bad weather flying would reduce the losses experienced in single-aircraft operations.

It is reasonable to assume that the bombing accuracy of Lone Wolf forces exceeds that of formations dispatched on normal non-visual operations. Fifteenth Air Force experience indicates that the bombing accuracy achieved by a bomber force varies directly with the number of bomb sighting operations effected. Thus far, the greatest number of aircraft dropping bombs on one Lone Wolf sighting is two, whereas the average number of aircraft loads of bombs released on one normal PFF sighting approximates twelve to eighteen.

### 3. Weather Limitations.

Just as weather limits the employment of a bomber force on normal operations, weather also sometimes precludes the use of Lone Wolf tactics. A set of meteorological conditions, equally as unique as for the ideal employment of normal heavy bomber tactics, determines the feasibility of dispatching a single-aircraft force. As noted in Section V of this discussion, sortie abortions caused by weather conditions unfavorable to this type of operation are quite common. The ill-advised commitment of a Lone Wolf force to an operation during which weather conditions proved unfavorable to this tactic would result in excessive losses either to enemy opposition or to weather. Although the development of Lone Wolf is a step in the right direction, it is not the answer to the problem of all-weather, round-the-clock bombing,

### 4. Defensive Characteristics.

Although the size and disposition of the enemy's fighter forces has always been given serious consideration in the planning of Lone Wolf operations, its effectiveness against us on these operations has always been discounted. Of those enemy aircraft sighted by our aircrews on these operations, very few were able to initiate an attack. There is no evidence which proves that we have sustained any loss to enemy aircraft on Lone Wolf operations. It is believed that the reason for the ineffectiveness of the enemy fighter force against us is that, although the enemy can, by using his excellent G.C.I. and A.I., bring his interceptors within close proximity to our Lone Wolves, he cannot effect a kill because of insufficient visibility for proper sighting. The enemy in South Germany is not thought to be capable of firing blind from his interceptors. Until the enemy puts into operation against us equipment which assures positive kills under instrument conditions, Lone Wolf possesses excellent capabilities for defense against fighters.

Some battle damage to flak has been experienced over heavily defended targets by Lone Wolf aircraft. It is probable that some of our losses have been caused directly, or at least contributed to, by enemy ground fire. As yet it has not appeared advisable on single-aircraft operations to saturate the flak defenses of the enemy to the extent they are saturated during normal daylight attacks. It would be ideal if a large force of Lone Wolves could effect an attack on a single target within an interval of a few minutes, super-saturating the gunlaying capabilities of the enemy. However, because of the difficulties which have been experienced in the correct

observance of target times, it has not been deemed wise to concentrate further Lone Wolf attacks because of the danger of mid-air collisions with other aircraft and with falling bombs. It is recognized that the RAF concentrates its single-aircraft night attacks into a very short period of time, but it is pointed out that these attacks take place under visual conditions, at least at the altitudes of flight.

The Lone Wolf tactic does have two advantages in flak defense which are not inherent in normal operations. The great differences (500-750 feet) in bombing altitudes employed by each individual Lone Wolf makes it impossible for enemy gunners to cut fuses which will be effective against more than one aircraft in a single formation. Single-aircraft operations allow for an increase in bombing altitude not possible on normal operations when formations must be flown. This allows Lone Wolves to bomb from a height where enemy flak is less effective.

Because one of the objectives of the Lone Wolf program is its harassing effect on the enemy, numerous instances have occurred when defensive tactics in the employment of the force have not been applicable. Two, and sometimes three, areas of fighter defense have been penetrated by portions of the force participating in a single operation. To harass simultaneously several suitable targets it has been found necessary to disregard the threat of rousing a formidable fighter force from more than one defended area. In view of the ineffectiveness of the fighter opposition put forth by the enemy, it is believed that this practice has been proved sound.

## VII. CONCLUSIONS

1. Lone Wolf tactics afford a sound method for employment of heavy bombers in the Mediterranean Theater.

2. Until a greater PFF force is available, the chief effect on the enemy from this type of operation will be harassment.

3. This tactic has enabled the Fifteenth Air Force to sustain better its pressure of attack on South Germany.

4. If a sufficiently large pathfinder force were available, it would be employed effectively in effecting a program of great destruction on the enemy.

5. Better de-icer equipment and better trained crews would reduce attrition.

6. It is necessary that some practice be established, the adoption of which will assure the positive control of traffic in target areas.

7. Lone Wolf is not a "cure all" for bad weather which stands down normal operations. Ideal "Lone Wolf" conditions are as unique as CAVU weather over Brux.

8. Lone Wolf bombing should be more accurate than normal PFF formation bombing. If pathfinder equipment produced excellent target definition, single-aircraft "pickle barrel" bombing would become a reality.