

I. Introduction

The lessons learned in one war against an adversary using strategy and tactics appropriate to the time and place cannot often be applied with success to another war fought under different conditions. Improved weapons alone can negate the lessons of an earlier war. But further, each war is unique in its total setting -- the politics and the economic realities of a North Vietnam are not those of a North Korea any more than the tropical setting of the former is equal to the harsh climate of the latter. Nevertheless, the experiences and hard won lessons of Korea should not be ignored, and indeed may be valuable when critically viewed and applied in North Vietnam.

This report reviews the environment of the two wars and the attempts by the United States Air Force and Marine and Naval aviation forces to interdict the transportation system of North Korea. An appreciation of this aspect of US operations in North Korea would seem to be an especially relevant backdrop to understanding some of the factors contributing to success or failure in the current US air operations in North Vietnam.

II. Environment: Similarities and Differences

~~A. Introduction~~

Numerous similarities exist between the present war in Vietnam and the Korean War. Each conflict involves a divided country. Communist China looms over the northern border of both North Korea and North Vietnam as a major

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supplier of war materiel, and as a participant or potential participant. Many contrasts exist also. For example, the topographic and climatic setting of the military actions being fought in South Vietnam are unlike those fought in Korea. Instead of the guerrilla and infiltration tactics characteristic of today's war in South Vietnam, the Korean War eventually involved large-scale land armies. The first attacks of the North Koreans in June 1950 were spearheaded by Soviet T-34 tanks. In August 1951 upwards of 60 Chinese and North Korean divisions, approximately 600,000 troops, were located in the immediate battle zone across the Korean peninsula. Even when not engaged in active combat each of these divisions required daily an estimated 40 tons of supplies.

Other contrasts can help put the two conflicts in perspective. North Korea occupies an area of about 47,000 square miles and in 1953 had a population of 9 million; North Vietnam has an area of 62,000 square miles and a population of 16 million. In the northcentral and northeastern areas of North Korea supplies had to travel down sharply dissected valleys between rugged mountains. Tunnels, bridges, and bottlenecks were frequently found along major supply routes. For example, the 400 mile rail line from P'yonggang to Ch'ongjin has 376 bridges and 97 tunnels. In Korea, the winters are extremely cold, much like those in Kansas. Frozen ground caused delayed-fused bombs to skip off targets before exploding. In tropical South Vietnam, such an occurrence is unlikely.

The Korean War, which started in June 1950 with North Korean divisions attacking across the 38th Parallel, lasted until the signing of an armistice in July 1953. The war had been characterized by bitter reverses, strong defenses, amphibious landings, rapid advances, and long periods of stalemate. Initially, South Korean and US forces retreated to the Pusan Perimeter, then struck back through the amphibious landings at Inchon and the advance into North Korea and to the Yalu River. October 1950 witnessed the beginning of the "new war" as Chinese armies entered the conflict and the newly-augmented United Nations forces found it necessary to retreat to defensive positions near the 38th Parallel. When discussions of a possible truce began in July 1951 after one year of fighting, the front extended from the Imjin River to Ch'orwon, then across the Korean peninsula to the Sea of Japan above Kosong.

III. Interdiction in North Korea

A. Introduction

In the summer of 1951 the need for a major interdiction effort against the transportation system of North Korea became apparent. As talks about a truce began and the fighting lulled, the US Eighth Army calculated that enemy forces in Korea were stockpiling daily 800 tons of supplies behind their lines. It was feared that the enemy would ". . . reach a degree of preparedness previously unparalleled in the Korean War." To interfere with this buildup, the Far East Air Force (FEAF) planned OPERATION STRANGLE, a comprehensive interdiction campaign against North Korea's railroads and highways.

Post-mortems on OPERATION STRANGLE have claimed that the codename was an unfortunate choice because it implied more than had been intended. Nevertheless, that name matches initial Air Force optimism about the probable effectiveness of the interdiction program. For example, one official statement at the beginning of OPERATION STRANGLE claimed:

"The Fifth Air Force and attached units in conjunction with US Naval Air units and FEAF Bomber Command have the capability of destroying the enemy's rail system in North Korea, and of hindering his highway transportation system to such an extent that he will not be capable of opposing the US Eighth Army effectively."

Starting in August 1951 and extending over the next 11 months, 81,600 interdiction and armed reconnaissance sorties were flown; more than 104,000 tons of bombs were dropped. By contrast, in a similar time period February -

December 1965 in North Vietnam, ^{057 *} 24,169 ~~sorties~~ ^{and fixed} were flown against ~~JOB~~ ^{and} ~~and~~ ^{and 34,260 tons of ordnance were expended. **} armed reconnaissance ^{targets}. A summary comparison of air operations in the

Korean War compared to current operations in North Vietnam (ROLLING THUNDER) is presented in Table 1 below.

OPERATION STRANGLE was not, however, the first US attempt at interdiction in Korea. In the first year of the Korean War the Air Force had flown 70,000 interdiction and armed reconnaissance sorties out of a total of 140,000

* ~~Armed Recon and fixed target sorties~~ Combined strike and flak suppression sorties. -4-

*** tons of bombs, ~~and~~ rockets, and napalm.

combat sorties, but the fluid military situation had required that major emphasis be given to close support of combat troops. In that year, rapid changes in the battlefield and the use of fighter-bombers as support artillery were not conducive to a sustained, well-organized interdiction program.

B. Railroad Interdiction -- OPERATION STRANGLE.

OPERATION STRANGLE had two principal objectives: (1) the knocking out of the North Korean rail system by maintaining continuing rail cuts at numerous points, and destroying rolling stock and equipment, and (2) disrupting rail services so that the North Korean and Communist Chinese forces would have to use the highways, which could be brought under effective attack, to transport the bulk of their military supplies. The resulting damage was expected to exert unbearable pressure upon the enemy in spite of the absence of large-scale ground action.

For the first three months OPERATION STRANGLE was successful. Major rail lines were disrupted and fighter-bombers destroyed railroad track faster than the enemy could rebuild it. By early October 1951, rail movements ceased, even on the double-tracked line from the capital of Pyongyang and

south to Sariwin just north of the battle zone. By November 1951, virtually all direct major rail routes to Manchuria had been severed although limited serviceability existed by shunting traffic inland and then back to either coastal or other interior rail lines. Interdiction and armed reconnaissance accounted for over 60 percent of all combat sorties from the start of OPERATION STRANGLE through the end of 1951. As shown in Table 2 below, the numbers of sorties flown and bomb tonnages expended reached a peak in October when 9,700 interdiction and armed reconnaissance sorties were flown and more than 10,000 tons of bombs were dropped. In the first two months of OPERATION STRANGLE interdiction and reconnaissance targets claimed more than 90 percent of the total weight of bombs dropped by B-26's, F-51's, F-80's and F-84's.* During the same period of OPERATION STRANGLE, interdiction targets claimed over 80 percent of the bomb tonnage dropped by the World War II vintage B-29's which in Korea were classified as medium bombers. For the most part, B-29's were used to

* The B-26 had been a high-speed medium bomber in World War II although at this stage of the Korean War it was classified as a light bomber and was used mainly for night interdiction attacks. The F-51, the propellor driven Mustang of World War II, played an important combat role in Korea because of its range, bomb and napalm capacity, and ability to operate from secondary air fields. The F-80, Shooting Star, the first jet aircraft accepted for operational service by the Air Force, and the F-84, Thunderjet, were also used extensively for ground support and interdiction. The F-86, Sabre, a swept-wing fighter was used mainly for counter air-offensive missions against the large numbers of enemy MIG-15's operating out of Manchuria.

Table 2.

Sorties Flown and Bombs Expended, OPERATION STRANGLEHOLD, August 1951-June 1952
USAF,

	1952											
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Sorties												
Total Combat *	10,204	14,056	15,953	13,678	13,641	11,953	10,690	12,620	12,628	16,736	12,565	144,172 154,527
Interdiction and armed reconnaissance	6,565	8,686	9,753	8,735	8,347	6,805	6,268	6,437	6,288	8,126	5,603	51,417 51,417
Percent of total	64.3	61.7	61.1	63.8	61.2	56.9	58.6	51.0	49.7	44.6	44.6	35.6
Total bombs expended, tons	8,357	10,458	11,257	10,125	10,522	11,650	10,493	11,814	10,291	11,603	11,221	117,785
Interdiction and armed reconnaissance	7,576	9,570	10,323	8,698	9,466	10,101	9,636	10,449	9,182	10,504	8,599	104,104
Percent of total	90.7	91.5	91.7	85.9	89.9	86.7	91.8	88.4	89.2	71.5	76.6	88.8

* Including close support, combat air - offensive, combat air - defensive, reconnaissance and interdiction and armed reconnaissance. Excludes combat support missions, tactical control, reserves, cargo.

① USAF, Report on Bombing as a means of controlling the situation, including a table of sorties, reserves, cargo, etc.
②

attack strategic bridges and railroad marshalling yards. Fighter-bombers, mainly F-51's and F-80's were used in glide-bombing and, later when antiaircraft fire increased, for dive-bombing attacks against rail targets; B-26's were used to strike railroad marshalling yards and to lead night attacks against rail and highway traffic.

These attacks reached a peak of destructiveness in September through November 1951. In September Air Force pilots alone claimed the destruction of 38 locomotives, 558 freight cars, 5,400 vehicles and about 1,400 buildings. Rail lines were severed about 15,000 times* Table 3 lists the total damage-claims of the USAF for the 11 month period in which OPERATION STRANGLE was underway.** Excluded, however, is the damage inflicted by Navy pilots operating from carrier task forces in the China Sea and Sea of Japan who were also striking heavily at transportation targets along the coasts.

* The official USAF Historical Study of Air Operations in the Korean War recognizes that pilot's claims of vehicles destroyed were greatly exaggerated, the results of night attacks being especially hard to evaluate or check. In September 1951 the Fifth Air Force issued a directive permitting night-intruders to claim enemy vehicles destroyed only when the vehicles were seen to burn or explode. Yet, even this requirement probably did not prevent multiple claims. For example, North Korean truck drivers carried oily rags which were lighted when they were under attack to feign destruction and be spared further attack. Eventually, claims of locomotive "kills" were only allowed when attacks were made using 500-pound bombs or larger and after which the locomotive was observed to be derailed or in at least three separate parts.

** The attacks were not without cost. Through February 1952 the Air Force had lost 243 aircraft and an additional 290 aircraft had received major damage. During the period OPERATION STRANGLE was underway, about 400 aircraft were lost due to enemy action.

Table 3
 Damage to North Korean Transport - OPERATION STRANGLE
 August 1951 - June 1952

	1952												Total	
	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June			
Bridges														
Destroyed	28	29	38	19	4	28	24	22	12	14	5			223
Damaged	149	193	130	23	47	48	46	39	31	33	24			763
Tunnels														
Destroyed	-	23	2	-	-	15	1	-	-	-	-			41
Damaged	14	108	32	10	14	28	26	12	5	5	3			257
Locomotives														
Destroyed	7	38	42	51	33	25	33	20	13	8	2			272
Damaged	8	78	55	47	33	13	35	25	8	34	9			345
Freight Cars														
Destroyed	226	558	642	601	305	326	293	238	125	227	97			3,638
Damaged	786	2,413	1,204	465	716	487	295	222	154	251	76			6,769
Buildings														
Destroyed	918	1,381	1,097	959	1,259	558	764	476	213	955	629			9,209
Damaged	2,439	4,482	3,860	2,614	1,256	978	647	342	271	307	186			17,382
Vehicles														
Destroyed	1,803	5,412	6,407	4,318	3,586	2,116	1,991	1,630	1,648	2,473	1,826			33,210
Damaged	3,206	9,788	1,718	5	-	-	51	-	-	-	-			14,768

In retrospect, immense damage was done to the transportation system of North Korea, even admitting as does the official Air Force history that many claims of destruction were exaggerated. The first intense blows did not knockout the system, however, and in the following months the serviceability of the North Korean transport system improved materially. Tonnages being moved on the railroads and highways were only a small fraction of peacetime "capacity", but the supplies getting through were more than sufficient to support the Communist armies in the field. Furthermore, in the fall and winter of 1951-52, when the intensity of air attacks decreased slightly, the North Koreans and Chinese showed an increasing capability to repair damage from air attacks and to get both rail and highway traffic moving again. Repairs were being made so rapidly that by late December 1951 the Fifth Air Force under FEAF recognized that the ". . . enemy had broken our railroad blockade of Pyongyang and . . . won the use of all key rail arteries."

In February 1952 OPERATION STRANGLE was modified -- and renamed OPERATION SATURATE -- to reflect the lessons of the previous six months. Railroad interdiction was still emphasized, but attacks were concentrated against specific pre-targeted segments of the rail line. The change in air operations, and its successes and failures, can be seen in an officially documented description of one attack. In a lead off attack in late March 1952, 307 fighter-bombers dropped 530 x 1,000-pound bombs and 84 x 500-pound bombs. The following day, 160 fighters dropped 322 x 1,000-pound bombs. During the night B-26's dropped 42 x 500-pound

bombs on what had already become a major gap in the rail line. However, the ability of the North Korean's to repair rail damage had further improved -- within six days the roadbed was almost completely rebuild and the tracks were replaced. The 48-hour attack and the expenditure of 450 tons of bombs had interdicted the rail line for 6 - 7 days but had required the virtual commitment of the entire fighter-bomber force. At the same time other rail lines had remained open. Further experience in another attack area which contained approximately 600 miles of rail lines showed that no more than 6 continuous cuts in rail traffic could be maintained, too few to interdict successfully the entire rail system under attack.

In April 1952 a penetrating staff study by the Air Force recognized that in spite of the vast damage inflicted the interdiction operation had not achieved its objectives and such operations were becoming more costly in terms of casualties to air crews and aircraft lost and damaged. Furthermore, some of the most modern US weaponry, spearheaded by expensive aircraft and highly trained pilots, was being effectively countered incongruously by hordes of unskilled labor and minimum amounts of easily attainable materials. Replacement rails frequently were obtained by cannibalizing a double-track system or stripping damaged railroad marshalling yards. Bridges were repaired frequently with simple prefabricated wooden spans and extensive crib work.

Policy changes which emerged from the staff study emphasized the need to inflict maximum damage upon the enemy and to minimize US losses, and

included some shifts in targets. Thus, while locomotives, motor vehicles, and other transportation targets were still rated as prime targets, equal or greater emphasis was given to radar, guns, supply depots, mines, power plants, and military schools. In effect, the new targeting took account of economic principles. From attempts to physically cut the rail and highway systems the attack moved to inflict maximum damage upon the enemy's limited stock of military and transport capital in North Korea, capital which would not be replaced by the labor of unskilled peasants. Nevertheless, the new attack policy, announced in July 1952, admitted that ". . . obstruction of enemy supply movement in Korea cannot prevent the enemy from gradually building up his stockpile." Although the Air Force continued to bomb selected bridges and rail targets during the remaining year of the war, OPERATIONS STRANGLE and SATURATE were at an end.

C. Evaluation of OPERATION STRANGLE

1. Introduction

OPERATION STRANGLE and OPERATION SATURATE failed to achieve their objectives not only because there were insufficient numbers of aircraft to maintain an adequate number of rail cuts, but also because enemy counter-measures were more successful than had been estimated. Communist antiaircraft defenses increased markedly, and the Communists showed an increasing ability to improvise repairs, build bypass lines, and mass peasant labor to maintain and repair essential supply lines.

The declining returns from OPERATION STRANGLE can be gleaned from an analysis of bombs expended and damage achieved. During July 1951, the month before OPERATION STRANGLE got underway, approximately 6,600 tons of bombs had been dropped on interdiction targets in North Korea. Bombs expended increased sharply in August to 8,300 tons. From August to September bombs expended increased by about 2,000 tons or 26 percent and the estimated value of destruction increased by about 50 percent, indicating increasing returns from bombings. After November, however, there was a steady trend of diminishing returns from the bombing attacks. A fairly steady expenditure of bombs, between 10,000 to 12,000 tons per month, resulted in less and less physical damage. As shown in Figure 1, the index of value of damage per ton of bombs expended declined from a peak of 100 in October 1951 to 40 in January and a low of about 26 in April and June.

It is apparent that the initial attacks found more lucrative targets and through November the air strikes were able to inflict heavy damage on the North Korean transport system. After November, however, more effective enemy countermeasures probably abetted by winter weather greatly reduced the destructiveness of the air operation. When operations concentrated on maintaining physical rail cuts in the winter of 1951-52 even less damage was being done to the enemy's stock of capital in Korea. It was the implicit recognition of the declining returns of the bombings which led the Air Force staff study, previously mentioned, to recommend that the emphasis be shifted from rail cuts to hardware-type targets.

2. Railroad Interdiction

The North Korean rail system, during 1950-53, consisted of about 2,300 miles of line, largely standard gage, and included approximately 1,800 bridges and 400 tunnels. During the initial stages of OPERATION STRANGLE the Air Force engaged in a multi-prong attack against bridges, rolling stock, tunnels, road beds and rails. Tunnels, used extensively to protect trains and supplies in daytime attacks, proved in most instances to be impossible to destroy. Bridges were difficult targets, but were destroyed consistently. Nevertheless, the enemy showed a rapidly increasing capability to restore damaged bridges, including the ability to build one or more bypass-bridges in the vicinity of a bombed bridge and to resort to frequently effective deception. For example, in some instances key bridge spans would be removed from a reconstructed bridge during daylight hours and replaced at night.

After the interdiction campaign had been underway for several months construction materials were being stockpiled near key bridges even before US attacks. Simple bypass bridges were built frequently in from 2 to 4 days. Rail cuts were repaired in from 2 to 6 hours. Priority was placed on getting a bridge back in partial operation so that some supplies could again begin to flow although traffic might remain far below capacity levels. The damage from an Air Force "maximum effect" operation against one segment of the rail system was repaired in from 4 to 7 days.

The North Korean and Chinese stationed railroad construction troops along all main supply routes which were under attack. Units of 50 troops

were located at all major rail stations and crews of 10 men were located every 4 miles along the route. In addition rail walkers spotted damage to the rail or roadbed. Nearby inhabitants were recruited for common labor, and sometimes as many as 1,000 persons were used to repair a damaged section. At dark, experienced railroad construction crews would move in and make the actual repairs to the rail line. Further, in portage-like operations, rail service was maintained on very short stretches of usable track -- as short as 11 miles -- and freight was unloaded and carried around rail cuts or damaged bridges, and reloaded on another train.

3. Highway Interdiction

The road network in North Korea, originally developed by the Japanese, had always been of secondary importance to the railroads. Trucks had been used typically for short hauls and served as links between industrial and commercial centers and the major railroads. North Korea's principal highways roughly followed the major rail routes from Manchuria southward. Altogether about 10,000 miles of highways existed, at best surfaced with gravel or crushed stone.

Although the major interdiction effort of OPERATION STRANGLE was against the North Korean rail system attacks against trucks were also pressed, especially night attacks led by B-26's. On one occasion, an Air Force Wing reportedly sighted 3,800 motor vehicles and attacked 2,600 vehicles in 1 day. The Air Force claimed that 6,400 trucks were destroyed in October 1951 alone. Highway bridges were also attacked, but proved more difficult to interdict

effectively than rail bridges. Bypasses were built, sometimes at considerable distance from the original bridge and were thus not easily sighted; fords were build and used during much of the year.

Truck traffic was uncommon during the daylight hours, and at night truck movements were hard to locate and to attack effectively. The results of night attacks against motor vehicles, as well as rolling stock, were especially difficult to assess. Before dawn trucks were hidden in caves, extensively camouflaged, or parked in protected ravines or log bunkers. Communist highway repair battalions were stationed along all main supply routes and platoons of highway repair companies were stationed about 3 kilometers apart along important routes undergoing attack. Although these platoons relied almost entirely on simple equipment such as picks, shovels, sandbags, and wicker baskets, a highway crater could be filled, or a blocked tunnel cleared, in a matter of hours.

Trucks usually traveled in convoys of 15 to 20 vehicles, usually under blackout conditions. When speed and safety required other measures, however, convoys did at times use headlights. On these occasions drivers depended upon sentries stationed at intervals along the main routes to warn of approaching aircraft. The mileage norm for trucks per night was about 60 miles. For example, a roundtrip from the Manchurian border to the battle zone and back required about 10 night's travel.

4. Night Operations

Even before OPERATION STRANGLE began the North Koreans had begun to move virtually all rail and road traffic at night. The B-26 bomber was used extensively as a night intruder to harass trucks and trains along major enemy supply routes. During OPERATION STRANGLE 1,500-2,000 sorties were flown monthly by B-26 bombers, about 90 percent of them at night. The heavier B-29 bombers were used to attack fixed targets at night.

In the absence of bright moonlight, B-26's attacks achieved only limited success and numerous experiments were conducted with flares to light the targets. Various tactics were developed. Flares were dropped by B-26's operating alone, in pairs, and by supporting B-29's and C-47's with varying results. Under foggy conditions flares tended to blind the attacking pilots and frequently flares caused more harm than help by making the attacking aircraft visible targets for ground fire.

Infra-red detection systems were used on a limited scale to locate targets such as locomotives, tanks, vehicles and industrial locations. Tests of such equipment were somewhat promising, but water vapor, haze and ice crystals interfered with the operation of the equipment and restricted its use to clear weather.

In 1952 as OPERATION STRANGLE disrupted railroad lines the North Koreans and Chinese made more intensive use of trucks to transport supplies to the front. In the fall and winter months, sightings of vehicles declined,

and the B-26 night attacks were shifted to rail cutting, and to harassing North Korean night repair activities.

The major lessons from US night-intruder operations during the Korean War were: (1) aircraft, especially the B-26 that had been designed for day operations, had only limited success in detecting, identifying and attacking moving targets at night; (2) air crews required careful selection and special training for night operations; and (3) a strong need existed for a family of "denial" weapons that would successfully interdict rail lines and highways for periods that would eliminate the need for essentially inefficient night operations. Night operations were hampered throughout by the inadequacy of night photography to adequately assess bomb damage.

5. The Wa-dong Chokepoint

The Korean War offers an excellent example of the difficulty of successfully interdicting a transportation chokepoint by large-scale aerial bombing. In the winter of 1952 while OPERATION SATURATE was getting underway target specialists located what appeared to be a vital chokepoint near the village of Wa-dong in central Korea about 20 miles north of the 39th Parallel. Here a major east-west railroad passed over a highway from Wonsan on the east coast to the capital at P'yongyang. About 100 yards further to the west the railroad entered a short tunnel. The railroad and highway did not follow identical alignments across North Korea but came together only at Wa-dong. Adjacent hills rising to about 300 feet above the valley floor would have made Wa-dong stand out as an ideal chokepoint to even the most unimaginative target

analyst. The North Koreans had used both the lateral highway and the railroad to shuttle supplies between the east and west coastal railroads thus substantially increasing the flexibility of the badly damaged rail system. The objective of the attacks was to block all rail and vehicle movement in the area. Due to the area's rough terrain bypassing the chokepoint would have proved very costly.

For 44 days, from 26 January to 11 March 1952, 77 B-29 and 126 B-26 sorties saturated the target of about 18 acres with 3,928 x 500-pound GP bombs, one bomb for every 22 square yards of target. Bomb assessment reports which were available for 24 days of the 44 day attack period showed the following results:

Railroad

serviceable	10 days
unserviceable	1 complete day
unserviceable for a portion of	7 days
status unknown	6
	<u>24</u> days

Highway

serviceable	15 days
unserviceable	4 days
status unknown	5 days
	<u>24</u> days

Bomb assessment reports also revealed that the total effort had resulted in only 18 actual rail cuts and 15 highway cuts from a total of 3,929 bombs dropped. The effort at best resulted in the railroad being interdicted for 7 days and the highway for 4 days. Except for temporary disruptions the North Koreans had suffered very little damage. The bombs had done little more than churn up the countryside; hoped for landslides did not occur.

Evaluations made of the Wa-dong experience during the Korean War concluded that it is a fallacy to assume there is an "area target" for traffic interdiction and the Far East Air Forces recommended that in future interdiction attacks air power concentrate on pin-point bombing against definite targets in preference to area bombing.

IV. Strategic Bombing

A. The Targets

North Korea's modern industry, which was developed by the Japanese, was in 1950 considerably greater in total capacity and range of output than that of North Vietnam in 1965. Indeed production of basic industrial products such as electric power, coal, iron ore and concentrates, chemicals and cement were greater in North Korea during 1944 than in North Vietnam in 1965. The production of crude steel and rolled steel in North Korea during 1944, though not great, exceeded the capacity and variety planned for the first stage of the North Vietnamese iron and steel plant presently approaching completion at Thai Nguyen. Although the production of industrial machinery and equipment in North Korea was not great in 1950 it probably was not far behind the present capacity of North Vietnam, which consists of one small modern machine tool plant in Hanoi plus a number of small shops. It is probable that important machinery repair facilities of various types in North Korea -- notably railroad repair facilities, for example, exceeded those presently in North Vietnam both in number and in size.

Production of electric power in North Korea during 1944 amounted to over 8 billion kwh (most of it hydropower) compared with 550 million kwh in North Vietnam in 1964. North Korean production of coal totalled 4 million tons in 1949 compared to North Vietnam's 1962 production of 3.5 million tons. The Hungnam Fertilizer Factory in North Korea, with a capacity of 500,000 tons of ammonium sulfate, was the largest of its kind in Asia. North Vietnam's chemical industry is still small.

B. Early Strategic Bombing

During the initial months of the Korean War the B-29's available in the war theater were engaged in close tactical support of the hard-pressed US and South Korean forces. It was not until mid-July 1950 that attacks on industrial targets in North Korea were feasible. In the next 3 months the FFAF Bomber Command dropped 10,000 tons of bombs, with excellent results, on the major targets listed below in Table 4.

By late August 1950 the FFAF Bomber Command had difficulty locating undamaged priority targets in North Korea and the advancing Eighth Army made it appear that there was little need for additional effort against industrial targets. Of 20 strategic targets designated by the Joint Chiefs of Staff 18 had been destroyed or severely damaged by late September.

In September 1950 plans were underway to destroy the modern complex of hydroelectric generating plants that had been built by the Japanese. On 26 September, 17 B-29's attacked and inflicted minor damage on the Pujon

Table 4

Attacks on Strategic Targets in North Korea, 1950

Location	Target	Bomb Tonnage	Percent Destroyed or Damaged
Wonsan	Dock area	244	50
	Locomotive shops	372	70
	Railroad yards	477	70
	Chosen oil refinery	327	95
Hungnam	Bogun Chemical Plant	695	70
	Chosen Nitrogen Fertilizer Company	563	85
	Chosen Nitrogen Explosives Company	500	85
Pyongyang	Arsenal	99	70
	Kan-Ni	500	15
	Shunting yards	356	30
	Railway shops and yards	584	70
Chongjin	Harbor and submarine base	249	5
	Mitsubishi	132	30
Chongjin	Japan Iron Works	203	20
	Railroad yards and shops	1,063	55
Rashin	Oil Storage	49	Neg
	Dock area	218	Neg
	Railroad shops and yards	110	Neg
Chinnampo	Marshalling yards	121	80
	Port and sub-base	5	Neg
	Japan Mining and Smelter	248	35
	Chosen Riken Metals Co.	284	70
Changjingang Reservoir	Pujon hydroelectric plant#1	39	10
Hanhung	Railway shops and yards	547	70
Haeju	Chosen Nitrogen Explosives Company	568	10
	Railway shops and yards	104	70

Table 4

Attacks on Strategic Targets in North Korea, 1950 (continued)

Location	Target	Bomb Tonnage	Percent Destroyed or Damaged
Kyonipo	Japan Iron Works	252	40
	Marshalling yard	23	Neg
Kowon	Railway shops and yards	102	10
Songjin	High frequency heavy industry	326	90
	Magnesite Chemical Industry	183	30
	Railway shops and yards	280	60
Yangdok	Railway shops and yards	75	85
Namgungni	Storage area	58	80
Munpyongni	Rising Sun Oil Storage	2	No BDA
Chongju	Railway shops and yards	170	10
Kilchu	Marshalling yards	99	50
Sunchon	Chemical industry and marshalling yard	138	30
Sariwon	Marshalling yard	81	50
TOTAL		10,446	

Hydroelectric Plant, which had an installed capacity of 128,000 kw. The same day, however, the JCS suspended attacks on strategic targets. The question as to whether or not to bomb the hydroelectric installations, which exported large amounts of electric power to Manchuria, was to be argued at length over the months ahead.

By late September, the Commander of FEAF, was able to claim ". . . practically all of the major military targets strategically important to the enemy forces and to their war potential have now been neutralized." In a few weeks North Korea's modern industry had been destroyed. Yet, although such destruction obviously inflicted "punishment" on North Korea's leadership the military effect of the strategic bombing was of little consequence. Military equipment and ammunition was flowing into North Korea from China and the USSR, areas immune from strategic bombing.

C. Later Strategic Bombing Efforts

1. Hydroelectric Power

In Korea the Japanese had developed ^{before World War II} what was at the time one of the world's largest hydroelectric complexes. Although a major hydroelectric plant had been bombed in September 1950 the hydroelectric facilities had become "politically sensitive" targets and immune from air attacks. At that time, some US officials and most UN partners in Korea became fearful that attacks on these installations would further antagonize the Chinese. It was not until June 1952 that the hydroelectric installations were again considered a legitimate target.

Over a 3 day period in June 1952, 730 fighter-bomber sorties by the Fifth Air Force, supported by sorties from a Navy Task Force, were flown against the power complexes including the Sui-ho Generating Plant on the Yalu River. Post-strike evaluation of the bombing attack indicated that 90 percent of North Korea's electric power capacity had been knocked out. Eleven of 13 plants in 4 major complexes were unserviceable. For more than two weeks there was almost a complete blackout in North Korea until small thermal plants and undamaged hydroelectric plants restored a small portion of North Korea's pre-attack capacity.

Although the small dispersed "war-industries" in North Korea obviously suffered from the loss of electric power, the extent of the damage to industry in Manchuria was difficult to assess. It was known that much of the power generated by the damaged Korean facilities had been exported to Manchuria. Intelligence reports of the period did indicate that power shortages occurred in Manchuria. Communist China's concern was indicated by the large numbers of antiaircraft weapons which were soon deployed at the dam sites, especially at Sui-ho. At the end of hostilities in July 1953 a number of bombed hydroelectric installations were still out of operation although partial operations were continuing at several sites.

Attacks against the hydroelectric installations came much too late in the Korean War to have much impact on the outcome or do serious damage to North Korea's war effort. The attacks were designed more to exert continued

air pressure on the North Koreans and Chinese to accept UN truce proposals.

Over time, however, it became harder and harder to locate significant targets in North Korea.

2. Irrigation Dams

In the spring of 1953 only slow progress was being made at the Panmunjom truce talks. Air Force targets specialists seeking additional means of increasing air pressure against the Communists recognized the importance of the irrigation dams to Korean rice production. Two provinces in western Korea annually planted 422,000 acres and produced more than 280,000 tons of rice. Production was dependent upon water from 20 large reservoirs. While Air Force studies showed that attacks against the reservoirs were feasible, ranking officers were hesitant to attack targets that would expose the US to charges of destroying civilian food supplies. Military commanders saw no objection, however to destroying dams where floodwaters would interdict the enemy's transportation lines -- and incidently also harm rice production. There followed a large-scale and highly successful attack against a 2,300-foot earth-and-stone dam about 20 miles north of Pyongyang. Along with severe damage to a major rail line the floodwaters also damaged 5 square miles of prime rice crops.

Other Korean dams were attacked by US fighter-bombers and B-29's ostensibly to interdict transportation lines. These later attacks were less successful because the North Koreans, as in other circumstances, improvised countermeasures. For example, by rapidly lowering the water level it became

much more difficult to destroy or seriously damage the dams. The North Koreans were depriving themselves of the stored water but avoiding floodwaters and preventing more serious damage to the reservoirs. Again massive labor forces were engaged to rapidly repair the destruction caused by floodwaters and the damage to the dam itself. Although there was vitriolic Communist reaction to attacks on reservoirs the continuing threat of USAF destruction of the reservoirs may have been of some help in persuading the Communists to negotiate for a truce. In fact, a truce agreement was reached not long after this phase of operations began.

V. Lessons from the Korean War

A. Introduction

The 250,000 tons of bombs, napalm and rockets expended on enemy targets in South and North Vietnam last year was equal to about 45 percent of the total tonnage of bombs dropped by Air Force, Navy and Marine aircraft during the Korean War. However, the total number of sorties flown against North Vietnam through December 1965 -- 24,169 -- was only a small fraction of the 220,000 interdiction sorties flown by the Air Force alone in the Korean War. During the 11 months of OPERATION STRANGLE the Air Force alone flew almost 82,000 sorties and dropped almost 118,000 tons of bombs on interdiction and armed reconnaissance targets. In addition, Navy aircraft operating from carriers probably dropped about one-third the Air Force's tonnage on interdiction targets.

Even allowing for exaggerated damage claims it is clear that there were far more lucrative targets in North Korea than are being located and destroyed presently in North Vietnam. The tabulation below compares destruction achieved in the 11 months of OPERATION STRANGLE in Korea with destruction achieved by ROLLING THUNDER in Vietnam through December 1965:

	<u>OPERATION STRANGLE</u>	<u>ROLLING THUNDER</u>
Locomotives	272	6
Freight cars	3,638	227
Vehicles	33,210	483
Bridges	223	161
Buildings	9,209	1,837
Barges and boats	225	1,098

The greater destruction achieved in Korea compared to North Vietnam is not solely a function of the number of sorties and tons of bombs dropped. North Korea's railroads and highways had to supply almost 1 million troops, 600,000 of which were at the front. North Korea possessed almost 2,300 miles of rail lines and 10,000 miles of highways compared to North Vietnam's meager 485 miles of rail lines and 5,800 miles of highways. North Korea possessed a much larger park of both rolling stock and trucks. In addition, although the population of North Vietnam substantially exceeds North Korea's there was more modern and semi-modern industry in North Korea than is found in North Vietnam. In many respects, North Vietnam is an underdeveloped country compared to the North Korea of 1950-53, a comparison which will sound strange to former target analysts of the Korean War.

B. Failure of Interdiction to Strangle

At the time OPERATION STRANGLE was underway it was estimated that each Chinese division required 50 tons of supplies per day.* With 60 divisions at the front approximately 3,000 tons of supplies had to be moved from Manchuria to the battle front each day.

Peace time capacity of the double-tracked line in western Korea from Sinuiju to P'yongyang was estimated to have a capacity of from 6,000 to 9,000 tons per day. After maximum interdiction efforts it was conservatively estimated that only 500 to 1,500 tons per day were getting through to the battle zone. The east coast line with a peace time capacity of 5,000 tons per day was reduced to less than 500 tons per day. Thus railroads were still able to transport about one-half of the daily requirements. In addition the North Koreans and Chinese also relied heavily on trucks and on peasants carrying supplies strapped to A-frames, and even bicycles for moving supplies to the front. A staff study completed in April 1952 by two Air Force officers concluded that after 7 months of maximum effort the Communists still were more than meeting minimum supply requirements. ". . . The accepted figure for the enemy's minimum supply requirements is 2,700 tons per day, in the present static situation. It is an established fact he is getting more than this . . . HQ FEL estimates 1,000 tons per day average, over and above his daily requirements . . . the enemy has been able to stockpile approximately 100,000 tons, or a 37 day supply during the 7 months of the rail interdiction program."

* About 48 percent food, 22 percent clothing, weapons and equiPAGE, 10 percent POL, 20 percent ammunition.

Another logistic study from the Korean War illustrates how difficult it is to prevent what was called seeping resupply. During 3 months in the winter of 1951-52 the Chinese and North Koreans were firing 15,000 mortar shells per month, or 500 shells a day. Each shell weighed 10 pounds so that a peasant could carry 5 of them on an A-frame. One hundred peasants (or about 1 truck) could supply all the enemy's daily needs for mortar ammunition.

OPERATION STRANGLE clearly did great damage to the transport system of North Korea and conceivably may have been responsible for preventing Communist China from mounting additional large-scale offensives in Korea. At the same time, it is also clear that the Chinese and North Korean troops received sufficient logistic support to continue to resist the offensive pressures exerted by the Eighth Army. In short, the defensive capabilities of the Chinese and North Koreans showed no sign of collapsing as a result of the interdiction campaign. As the Air Force study pointed out the enemy's supply situation had indeed improved.

The air interdiction campaign had failed because the North Koreans and Chinese had been able to take effective countermeasures. One major lesson that emerged from the Korean War was that US planners underestimated the effectiveness of the enemy countermeasures. The North Koreans and Chinese had shown increasing rapidity in rebuilding damaged rail and road bridges and other key installations. Chokepoints, often given exaggerated importance, were frequently bypassed without undue enemy effort. Darkness shrouded most of the enemy's movements from effective attack. A major lesson of the Korean

War was the clearly demonstrated need for the development of a family of weapons that could successfully interdict night railroad and highway traffic. Portage operations over short segments of several rail lines kept the required minimum tonnages of supplies moving. Trucks, moved only at night and during bad weather, were used to supplement the rail lines. Vehicle traffic was dispersed along a maximum number of routes and vehicles were well hidden during day light hours. In addition, greatly increased concentrations of antiaircraft weapons took an increasing toll of US aircraft, and decreased bombing accuracy while requiring a greater number of flak suppression sorties.

C. Air Pressure Tactics and Psychological Warfare

It is difficult to judge the overall effect of US interdiction and strategic bombing on the will of the political leadership and the morale of the civilian population of North Korea. There are numerous examples, however, of the North Koreans and Chinese responding with effective countermeasures to each new phase of air operations against North Korea. In the early months of OPERATION STRANGLE the damage to the rail lines and rolling stock was so great that a less resolute enemy might have abandoned rail traffic completely in favor of supplying front line troops by trucks, ox-carts and peasants carrying supplies on A-frames. Rather than yield, however, the North Koreans were able to devise effective means to counteract the massive rail interdiction program. The North Korean response to the bombing of irrigation dams -- also illustrates the tenacity and cleverness with which the Communists met new phases of US air operations. The Communists voluntarily gave up water supplies

that would later be needed for the rice crops, but at the same time made the dams much more difficult to destroy.

The threat to bomb numerous other irrigation dams in the spring of 1953 may have made the Communists more willing to reach a truce agreement. However, claims by some historians that air operations were almost solely responsible for the North Koreans and Chinese initially coming to the conference table and finally signing a truce agreement are gross exaggerations of the effectiveness of air power.* The Chinese and North Koreans came to the conference table mainly because their total losses accruing from the war had become greater than their total gains, all military, political and economic factors considered. US air power played an important role in convincing the Communists to come to terms, but air power probably was not the decisive factor.

In retrospect, because of a host of factors including the unique nature of UN "police action" in Korea, and the uncertain position of US officials about the advantages and disadvantages of psychological air warfare, the psychological warfare phase of US operations in North Korea was little understood and only intermittently applied. The Air Force was under constant pressure to restrict bombings to specific military targets and to avoid indiscriminate attacks against North Korean cities. Even the use of warning leaflets became a controversial issue. For example, on the day before a large-scale air attack in July 1952 against military targets in Pyongyang, more than 150,000 leaflets were dropped to warn the population to stay away

* One Air Force historian, for example, in discussing FEAF operations in Korea in mid-1952 wrote ". . . the destructive force of FEAF's air power had broken the stalemate."

from military targets. The purpose of the leaflet drops was not only to prevent civilian casualties, but to destroy the people's faith in the government's ability to defend them. It was also believed that the fear of impending air attacks would disrupt economic activities. Some US officials, however, questioned whether leaflet attacks would be misconstrued and backfire against the US throughout the Far East. Other UN partners in Korea tended to be critical of any US attempt to apply psychological warfare against the civilian population of North Korea.

D. Lessons for Vietnam

The lessons from the Korean War indicate that it will prove difficult to cut off supplies flowing from North Vietnam to South Vietnam. The total daily tonnages needed by the Viet Cong and North Vietnamese regulars -- 12 tons a day moving to South Vietnam compared to 3,000 a day in Korea -- are so much less than in the Korean War that trucks, carts, and human bearers should be able to maintain more than the enemy's minimum requirements. Furthermore, the experiences of the Korean War suggest that as long as they continue to receive support from China and the USSR the Communists in Vietnam will show an increasing capability to develop and improvise countermeasures to circumvent a continuing US air offensive. As a result of such countermeasures the Korean War suggests that diminishing returns can be expected from continuing air strikes, especially in an economy initially poor in capital and unwedded to modern technology for its strength. The rebuilding of bridges, the building of bypasses and the other countermeasures

in evidence in North Vietnam in no way suggest a less determined enemy than was encountered in Korea. The primitivism of North Vietnam, the lack of hard military and significant industrial targets, combined with effective and increasing numbers of antiaircraft weapons, will make it difficult if not impossible for air power alone to extract a heavy price for North Vietnamese intransigency. Only the application of new interdiction weapons in large numbers infinitely more effective than those that were available in the Korean War would tip the scales in favor of successful, long-term interdiction.

The bombing of "strategic" industrial targets in North Vietnam, based on the experience of the Korean War, would probably have little effect on the course of the war. Communist leaders in North Vietnam would most certainly prefer not to lose the rudimentary modern industry that has been established in recent years. However, the much larger and more diversified industry of North Korea was destroyed in the first three months of the Korean War and neither deterred China from entering the war nor seriously impeded the North Korean military effort. Strategic air power can be expected to have little effect upon an enemy whose bases of supply are outside the theater of operations. In North Korea there was not sufficient industry to test the importance of strategic air power. In North Vietnam there is even less reason to believe that the loss of a small modern industry would alter the course of the war or make the Communists more prone to negotiate.