

Weather and War
By John Fuller
United States Air Force Air Weather Service, 1974, page 1 - 22.

History's scrolls are replete with entries chronicling weather's effects on war, warriors and weapons. Some of the most illustrious personages used a rudimentary understanding of climatic and seasonal variations to gain an advantage, to snatch victory from defeat. Hannibal, for example, in 217 B.C. gained tactical and strategic positioning by placing himself between the Roman armies and their capital after marching 40,000 troops over the snow clogged Apennines passes north of Genoa and then through the treacherous Arnus marches - thought to be impassible during the spring floods. In the thirteenth century Genghis Kahn took advantage of a frozen Yellow River to defeat the Hsia and Chin Empires - a favorite Mongol tactic used frequently to enhance their mobility by conducting operations in winter over frozen marshes and rivers.

Weather victimized some. Sweden's Charles XII suffered a defeat at Poltava after the particularly fierce Russian winter of 1708-09 extracted a lethal toll in exhaustion and hunger from his invading army. Although he had studied Charles XII's experiences, a similar fate befell Napoleon a century later. In June 1812, he attacked Russia with nearly half a million men under his colors. "He will end by being decimated by winter, which has always been our most faithful ally," the Russian ambassador in London prophesied, according to the works of Winston S. Churchill.¹ Napoleon planned to winter at Smolensk. Resupply problems forced him on. He entered Moscow in mid September a victor after the battle of Borodino. But exhaustion gripped his troops. Morale deteriorated. Short of food, a retreat was ordered a month later. Snow, bitter cold, and tenacious czarist troops decimated the *Grande Armee* which exited Russia at the Nieman River in December with just over 10,000 stragglers. Weather played a key role too in Napoleon's most famous date with destiny two and one-half years later. Victor Hugo and other carefully noted the torrential rainstorm of 17 June 1815 that forced Napoleon to delay for twenty-four hours, until the ground dried, his pursuit of Wellington who took up a defense south of Waterloo. It was a fatal delay for Napoleon's ambitions. And it was he who allegedly said that "the military strategist who leaves weather calculations out of his plan can never be a marshal in the armies of France."²

Some of Clio's navies fared little better. Herodotus wrote that in the fifth century before Christ, Xerxes lost nearly half his fighting strength when severe storms shattered his plans for invading Greece by inflicting great damage on his Persian fleet off the Magnesian Peninsula. It was a *Kamikaze*, a divine wind, of 1281 which fanned the storms and wrecked most of the fleets, thereby breaking the back of the second Mongol invasion of Japan. In 1588 violent gales and unfavorable winds were critical factors in the destruction of the seemingly invincible Spanish

¹ Winston S. Churchill. *A History of the English-Speaking Peoples*, Vol III, *The Age of Revolution*. (New York: Dodd, Meade & Company): 336.

²Isaac Monroe Cline. *A Century of Progress in the Study of Cyclones: Aids in Forecasting Movements and Destructive Agencies in Tropical Cyclones, and Bibliography*. (New Orleans: Privately Printed, 1942): 2.

Armada. His expedition defeated by the elements as much or more than by the English Navy under Lord Howard and Francis Drake, Spain's King Philip II reportedly said, "I sent them to fight the English, not storms."³ During the Crimean War heavy storms wrecked some thirty ships of the combined British and French fleet in the Black Sea, destroying most of the existing stores of rations, forage, and clothing earmarked for British troops ashore engaged in the Siege of Sevastopol. Coupled with a cholera outbreak, the British effective strength was thus reduced from 52,000 to 12,000 troops.

American military history likewise logged weather's effects. Arnold was refueled at Quebec with a force of 1,000 after attacking under the cover of a September 1775 snowstorm. Washington crossed a frozen Delaware River north of Trenton on Christmas night, 1776. The next day, his force of X000 defeated 1,400 Hessians in a victory that fanned the revolution's fading embers. After a desperate scheme to evacuate part of his troops across the York River was thwarted by a storm on 16-17 October 1781, Cornwallis capitulated to Washington at Yorktown. In January 1863, in the middle of the Civil War, General Burnside was forced by torrential rains to abort his infamous "Mud March" in the Battle of Fredericksburg. Ten days of rain and mud in July of that year slowed Lee's retreat from Gettysburg. General Meade, who as a Captain in the Army's Corps of Topographical Engineers began taking meteorological observations at twenty-five Great Lakes stations in 1857, failed to exploit his victory by not vigorously pursuing Lee.⁴

In the war that President Wilson hoped would make the world "safe for Democracy", weather played its most important role to date as the fledgling science of meteorology was put to use. Weather information was applied chiefly to artillery, but it was also used by aviation and with gas attacks. With long range artillery pieces, it was known that the distance and azimuth of the projectiles, which attained heights of several thousand feet, were affected by winds aloft, and that the wind velocities and directions varied with altitude. Allied aviators found the prevailing westerly winds one of their biggest concerns. They speeded flights eastward, but severely hindered the slow-flying aircraft's return flight. Weather observers were assigned to German gas regiments, but in late January 1915, when poison gas was used for the first time during Germany's winter offensive on the Eastern Front, it was rendered relatively ineffective because of the freezing temperatures. Later four regiments of Prussian Guards were reported to have suffered during a gas attack at Armentieres when the wind suddenly shifted direction.

For Germany and the Allies, the annual summer and fall campaigns were a race against the weather. Each side hoped to use it to advantage. German offensives on both fronts in 1915 were either suspended or arrested by rains that turned roads into muddy quagmires. General Haig, the following November was forced to abandon an offensive because of abominable weather. When he resumed operations the next summer weather again confronted him. In what he labeled the "mud and blood" of that 1917 offensive, Cyril Falla wrote that "the weather in

³Steve Harvey. "Strategy of the Storm in History's Great Wars." *Los Angeles Times*, 26 April 1970.

⁴U.S. Department of Agriculture (Weather Bureau), *Monthly Weather Review*, January 1931: 3-4.

August, and still more in late October and early November, is the chief factor in the horrible reputation which hangs about him about (the) Third Ypres,” and that “those who saw it will never forget that battlefield in the wet: as far as the eye could see a vision of brown mud and water.”⁵ On the other side, however, Crown Prince Ruprecht of Bavaria, in October 1917, wrote “*Erfreulicherweise Regen, unser wirksamster Bundesgenosse*”- welcome rain, our most effective ally.⁶

As the fighting stagnated into trench warfare during those years, trenches filled with water almost as fast as they were dug in some area because subsoil water lay so close to the surface. In wet weather, and occasionally throughout the winter, trenches were apt to fill to a depth of two feet or higher, making the occupant’s existence miserable. Frost brought relief because the cold kept the men dry. Yes, with the thaw, unless stoutly revetted, trench walls collapsed.

A *New York Times* reporter quoted an unidentified French military authority who, when asked why the Allies did not rush ahead in September 1918 and crush the Germans at once, said that “there is one Generalissimo whom all belligerents take orders from, General Mud.”⁷ A month later another correspondent wrote that the battle may be said to be almost as much against the weather and the mud as “against the Germans.”⁸ But for the German soldier, by then, the mud and weather was no better. Referring to that period, Remarque, who captured in terrible authenticity the war’s savagery through a disheartened German soldier’s eyes in his classic *All Quiet on the Western Front* wrote:

Behind us lie rainy weeks - grey sky, grey fluid earth, grey dying. If we go out the rain at once soaks through our overcoat and clothing - and we remain wet all the time we are in the line. We never get dry. Those who still wear high boots tie sand bags around the top so that the mud does not pour in so fast. The rifles are caked, the uniforms are caked, everything is fluid and dissolved, the earth one dripping, soaked, oily mass in which lie the yellow pools with red spiral streams of blood and into which the dead, wounded and survivors slowly sink down.⁹

At Versailles in 1919 following the cessation of hostilities, the world’s war weary people

⁵*The Great War*, (New York: Capricorn Books, 1959): 304.

⁶ _____: 302.

⁷Charles H. Grasty. “Only Five Weeks More of Fighting Weather: Germans Counting on Autumn Rains and Mud to Stop Allied Offensive Next Months,” *The New York Times*, 12 September 1918: 2.

⁸Robert DeC. Ward. “Weather Controls Over the Fighting During the Autumn of 1918,” *The Scientific Monthly*, January 1919: 9.

⁹Erich Maria Remarque. *All Quiet on the Western Front*. (Greenwich, CT: Faucett Publications, Crest Book paperback edition, 1961):9.

saw hope that armed conflict would be forever banned from mankind's repertoire of political machinations. It was a dream fleshed out by the Washington Treaties of 1921-22 and by the League of Nations. Additional substance was provided by the promise of permanent peace by the Kellogg-Briand Pact which naively renounced was "as an instrument of national policy." But while the remainder of the world was disillusioned with war, Germany slowly and covertly rearmed itself under Hitler. When he plunged the worlds into war again by invading Poland in September 1939, he did so with the aid of an unusually dry and favorable weather for *blitzkrieg* tactics which was accurately forecast by German meteorologists. From 1935 on, the case of the *Luftwaffe*, the meteorologists were present at every orientation session, every conference in which combat orders were issued and at every situation briefing, and their tactical weather maps rested on the planning tables beside the strategic situation maps.¹⁰

Undue liberty would not be taken with history by suggesting that in the planning and execution of every major campaign by all of the combatants during the Second World War, be it on land, sea, or in the air, weather factors and weather played a role - sometimes one of the utmost criticality. Each engagement could have been recorded in terms of the movement of air masses, frontal passages, phases of the moon, and the sway of the world's tides. Only a few of the most prominent examples need be recalled illustrating the fact.

With the speedy subjugation of Poland Hitler turned his attention westward. On 20 November 1939 he issued directive number eight for the conduct of the war which outlines plans for the destruction of Holland and Belgium, and which ordered a continual state of alert so as to be able to "exploit favorable weather conditions immediately."¹¹ The attack was to have commenced in mid January 1940 but he postponed it because of the "meteorological situation."¹² In fact, before Germany's western offensive was finally launched in May 1940, it had been postponed some sixteen times primarily because Hitler's injunction that the attack be made in favorable flying weather.¹³

In the meantime Hitler also gave his final approval for the invasion of Norway in the spring of 1940 - but only after being assured that the nights would be of sufficient duration to afford cover for his naval forces, that Baltic ice would not impede their movements, and that

¹⁰Richard Suchenwirth and Harry R. Fletcher (eds) USAF Historical Study No. 160, *The Development of the German Air Force: 1919-1939*. (Maxwell AFB, AL. USAF Hist. Div. Aerospace Studies Institute, Air University June 1968), p.113.

¹¹William L. Shirer, *The Rise and Fall of the Third Reich: A History of Nazi Germany* (New York: Simon and Schuster, 1960), p.656.

¹²*Ibid.*, 671.

¹³Hugh M. Cole, *The Ardennes: Battle of the Bulge*, from the *United States Army in World War II: The European Theater of Operations*, ed. Stetson Conn (Washington D.C.: Office of the Chief of Military History, Department of the Army, 1965), p. 38.

flying weather would be satisfactory.¹⁴ Two months later, after his armies' lightning strikes across the low countries and northern France, he prematurely ordered his armor to stop and a third of a million British and French troops were evacuated from Dunkerque. The epic eight day exodus was protected first and foremost by the Royal Air Force, but also because of a pea-soup fog that blanketed the English Channel and because the *Luftwaffe* was grounded part of the time by bad weather.¹⁵ In addition it was Hitler's belief that the invasion of England, planned for as soon after the fall of France as possible, was thwarted that autumn because the *Luftwaffe* did not attain air superiority in the Battle of Britain, and that bad weather prevented that attainment.¹⁶

Hitler thus opened an Eastern Front by retracing the footsteps of Charles XII and Napoleon. His invading armies crossed the Nieman on 22 June 1941, the day that Napoleon crossed that river in 1812. He suffered identical consequences at the hands of Russia's "most faithful ally." *Barbarossa*'s launch was delayed several weeks by the German campaign in the Balkans and because of an extremely late thaw that spring in Russia. While the relatively clear dry summer and fall, and the late advent of fall, permitted the *Wehrmacht* to drive within the shadow of Moscow's gates, the weather invariably turned in November and December. "Like the supreme military genius who had trod this road a century before him," Churchill later wrote, "Hitler now discovered what Russian winter meant."¹⁷ "General 'Mud' and 'Winter' supported the enemy most effectively, and finally with decisive results," an ex-*Luftwaffe* staff officer in Russia recalled years later; "driving rains, endless tracts of deep, sticky mud, and snow storms and freezing cold...proved to be decisive factors" in 1941.¹⁸ Not only did bad weather blunt *blitzkrieg* tactics but the German army was ill prepared to fight in a Russian winter. Winter clothing and shelter was in short supply. Frostbite cripples the ranks. Weapons not conditioned for the sever cold jammed. To start tank engines fires were lit beneath them. Fuel froze on occasion. Oil became viscous.¹⁹ Worse still, for the Germans, on 6 December, in snow and fog

¹⁴Earl F. Ziemke, "The German Decision to Invade Norway and Denmark," *Command Decisions*, eds. Kent Brothers Greenfield (Washington D.C.: Office of the Chief of Military History, Department of the Army, 1960), p. 69.

¹⁵Shirer, *The Rise and Fall of the Third Reich*, 736; Thunder over the North Atlantic," *Fortune*, Vol XXX, No 5, (November 1944), p.155.

¹⁶Shirer, *The Rise and Fall of the Third Reich*, 771.

¹⁷Churchill, *The Second World War*, Vol III: *The Grand Alliance* (Boston: Houghton Mifflin Company, 1950) pp 536-37.

¹⁸Generalleutnant Hermann Plocher and Harry R. Fletcher (ed.) *The German Air Force Versus Russia, 1941*, (Maxwell AFB, AL: USAF Hist Div, Aerospace Studies Institute, Air University, July 1965). pp. 240, 249.

¹⁹Heinz Guderian, *Panzer Leader*, than. Constantine Fitzgibbon (New York: P. Dutton and Co, Inc., 1952), pp 214, 248, 251-52, 258, 260.

and forty below zero temperatures, the Russians counter attacked.²⁰ While that particularly Soviet offensive eventually lost momentum, it was a phenomenon the Germans were subjected to in other instances before finally being driven from Russia. Through the disastrous course of the war for the Germans on the Eastern Front, however, they had occasions to look upon the weather as a divine intervention. “In the present stage of the war the thawing weather is for a gift of fate,” Heinrich Himmler wrote Generaloberst Heinz Guderian in February 1945 after suddenly rising temperatures began to thaw the rock-hard ground and bog down the onslaught of Soviet tanks: “God has not forgotten the courageous German people.”²¹

In February 1942 the German battle cruisers *Scharnhorst* and *Gneisenau* were saved by persistent fog as they escaped up the English Channel from Brest, undetected by the British Navy.²² That same year in North Africa Field Marshal Erwin Rommel used sand storm in the Libyan desert to screen his movements in fighting with the British in Libya and Tobruk. During the winter of 1943 and 1944, following the successful Allied invasion of Italy, fighting in the Apennines slowed to a snail’s pace as alternate rains and frost muddled roads to a borscht consistency. “The land and the weather were both against us,” reported war correspondent Ernie Pyle in vividly describing the war there: thousands of “our troops were living in almost inconceivable misery” in the “knee-deep...mud” of valleys and “had not been dry in weeks;” while “other thousands lay at night in the high mountains with the temperatures below freezing and (with) the thin snow sifting over them” the “lived like men of prehistoric times, and a club would have become them more than a machine gun.”²³

Without a question the most famous weather forecast ever issued was for *Overlord*, the Allied cross channel invasion of France on 6 June 1944. The weather equation was critical and complex. There could be no prolonged period of high winds to produce swells heavy enough to hamper the landing craft. Paratroopers wanted cloudy skies to protect them from German aircraft; Allied pilots wanted clear skies. The ground forces wanted onshore winds; the naval forces wanted offshore winds with the resultant small waves. Landings had to be made at low tide and the Allies needed at least three ensuing good weather days for resupply. After compromising on the conditions that seemed best for all, the high command asked the meteorologists to calculate the climatological chances of getting the desired weather because, as General Dwight D. Eisenhower, the Supreme Allied Commander, noted, “the selection of the

²⁰Earl F. Ziemke, *Stalingrad to Berlin: The German Defeat in the East*, from the *Army Historical Series*, ed. Stetson, Conn (Washington, D.C.: Office of the Chief of Military History, U.S. Army 1968), pp 13-14.

²¹*Ibid.*, 427. Referring to an early thaw a year earlier on that front, in March 1944, Ziemke wrote (p. 265) of reports of “Soviet tanks ... sometimes sinking up to their turrets in mud.”

²²Churchill, *The Grand Alliance*, 120.

²³*Brave Men* (New York: Popular Library Paperback Edition, Scripps-Howard Newspaper Alliance, 1943), pp. 137-38.

actual day would depend upon weather forecasts.”²⁴ The odds against it were 24 to 1 for May; 13 to 1 for June; and 50 to 1 for July.²⁵ June 5 was tentatively chosen but if the weather conditions were wrong, the invasion from that standpoint would have to be postponed for a year. As Churchill wired Russia Premier Joseph Stalin on the invasion’s eve, “the difficulties of getting proper weather conditions are very great, especially as we have to consider the fullest employment of the air, naval, and ground forces in relation to tides, waves, fog, and cloud.”²⁶

A joint meteorological staff was established for the invasion, divided into three centers and quartered separately in England so that a single German bomb could not get the all. Professional disagreements over each days forecast were ironed out in telephone conference so that James Martin Stagg, Eisenhower’s chief weatherman, could present a consensus forecast to the General and his staff. “In less than a half an hour,” Stagg later recalled in alluding to the “desperate quandary” he found himself in following one such telephone conference on 2 June, “I was expected to present General Eisenhower and ‘agreed’ forecast for the next five days which covered the time of the launching of the greatest military operation ever mounted: no two of the expert participants in the discussion could agree on the likely weather even for the next 24 hours.”²⁷ It was obvious the next day that the weather would not be good enough so Eisenhower postponed it until the sixth, tentatively. At that point “the weather now began to cause anxiety,” Churchill noted.²⁸ On the evening of the fourth, Stagg and his weathermen forecast relatively good weather for the sixth. The signal was given to process. On 5 June, Stagg announced that the bad weather predicted the 3 previous day had verified and that if the Allies had launched it would have ended in disaster. “This they probably told us to inspire more confidence in their next astonishing declaration,” Eisenhower wrote afterward, “which was that by the next morning, a period of relatively good weather, heretofore completely unexpected, would ensue, lasting probably thirty six hours.”²⁹ The General decided to go and the weather was essentially as predicted.

D-Day, as the invasion was referred to, caught the Germans off guard. In May there had been eighteen days of meteorological conditions favorable for landings and the Germans took note that Eisenhower had declined to take advantage of them. On 4 June the German

²⁴*Crusade in Europe* (Garden City, NY: Doubleday & Co., 1948), p.239.

²⁵Patrick Hughes, *A Century of Weather Service: A History of the Birth and Growth of the National Weather Service, 1870 -1970* (New York: Gordon and Breach, Science Publishers, Inc., 1970), p. 89.

²⁶Churchill, *The Second World War, Vol V: Closing the Ring* (Boston: Houghton Mifflin Company, 1951), p. 611.

²⁷Stagg, *Forecast for Overlord: June 6, 1944* (New York: W.W. Norton * Company, Inc., 1971), pp.86-87.

²⁸Churchill, *Closing the Ring*, 624.

²⁹*Crusade in Europe*, 345.

meteorologists advised their superiors that an invasion on either the fifth or sixth would be impossible owing to the stormy weather expected for at least a fortnight. Rommel composed a situation report the next morning, before departing for his home in Germany, indicating that the invasion was not imminent. If the invasion had been postponed until the next time moon and tide conditions were favorable, 17 through 21 June, it would have encountered the worst June storm in the English Channel in twenty years.³⁰

Actually, disturbed weather dominated the continent from then through the end of 1944, a factor the Germans readily took advantage of in their last-gasp offensive in the Ardennes. Hitler chose the place and it was he who stipulated among other prerequisites, that the offensive's initial phase be shielded from Allied air support by a period of bad weather extending for at least ten days. For such weather he either overlooked or more likely, disregarded the effects it could have on his ground operations - a hazard he was probably willing to undergo in view of the *Luftwaffe's* general state of deterioration. The original target date for the offensive, established by the German meteorologists, was late November, even after that date was slipped, because the tactical support could not be marshaled, the bad weather from Mid November on concealed the German concentration of resources from Allied aerial reconnaissance.³¹ When the Ardennes offensive was finally launched on 16 December, it caught the Allies by surprise.

For the first seven days of the Battle of the Bulge inclement weather critically limited the help that could be rendered friendly ground forces by Allied air power. "As long as the weather kept our planes on the ground it would be an ally of the enemy worth many additional divisions," Eisenhower wrote.³² Inability of the Allies to operate aircraft in a close support role at night and in bad weather provided a built-in guarantee that the minimum supply and reinforcement requirements of Hitler's armies would be met. On the other hand, alternate rains, snows, and thaws muddied roads and hampered the German armor. When the weather broke for five days beginning on 23 December, providing superb flying weather, Allied air power helped break the back of the German offensive.³³ "weather is a weapon the German Army used with success, especially in the Ardennes offensive," General field marshal Ger von Rundstedt, the German commander in chief in the West, was quoted as saying following his capture five months later: "this Battle of the Bulge, as you call it, might have changed the entire course of the war, had it not been for the fact that the United States (Army) Air Force so quickly took advantage of the

³⁰Stagg, *Forecast for Overlord*, 122-26, Shirer, *The Rise and Fall of the Third Reich*, 1036-1037, and Churchill, *Closing the Ring*, 630-31.

³¹Cole, *The Ardennes: Battle of the Bulge*, 18, 22; Charles V.P. von Luttichau, "The German Counteroffensive in the Ardennes," *Command Decisions*, p. 453; David G. Rempel, "Battle of the Bulge," in *The Army Air Forces in World War II, Vol III: Europe: Argument to V-E Day, January 1944 to May 1945*, ed. Wesley Frank Craven and James Lee Cate (Chicago: University of Chicago Press, 1951), pp. 672-72, 675.

³²*Crusade in Europe*, 345.

³³Cole, *The Ardennes: Battle of the Bulge*, 649-50, 663; Craven and Cate, *Europe: Argument to V-E Day, January 1944 to May 1945*, 686, 668-89.

break in the weather.”³⁴ It was ironic too, whether by divine providence or sheer coincidence, that on 23 December General George S. Patton, whose American Third Army had been directed to help relieve the pressure on the “bulge,” and whose armor had been slowed by the same weather, summoned his chaplain and ordered him to distribute a prayer among his troops. “Almighty and most merciful Father, we humbly beseech Thee, of thy great goodness, to restrain these immoderate rains with which we have had to contend,” the prayer read; “Grant us fair weather for Battle.”³⁵

On 3 January 1945 the Allies commenced a counter attack to destroy the Ardennes salient. But the van of armor had hardly passed through the infantry when more hostile weather began to take effect. Fog was so pervasive that not a single tactical aircraft could support the attack at any time that day. The pattern changed little in the next fortnight. Only once in two weeks did visibility permit tactical aircraft to operate all day; and on only two other days were fighter bombers able to get airborne. In all of January 1945 Eighth Air Force strategic aircraft were totally nonoperative for eleven days because of weather; day fighters, fighter bombers and medium bombers were entirely non-operative for thirteen days.³⁶

While Ernie Pyle and his beloved foot soldiers might have taken issue with the pronouncement, it was the position of the United States Army Air Forces, set forth in its official account of World War II, that weather, while it affected a variety of military operations, “had its greatest continuing importance for air operations.”³⁷ Indeed, Pyle noted that “the weather was the fliers biggest complaint,”³⁸ and Eisenhower wrote that “in Europe bad weather was the worst enemy of the air force.”³⁹ Recognizing the impending possibility of that fact and wishing to make his bomber command as independent of the Royal Air Force as possible, Major General Ira C. Eaker, in March 1942, asked for a prompt dispatch of Army Air Forces Weather Service

³⁴Charles Rabiner, “Weather is a Weapon: AAF Weather Service Story,” P. 2 - test of the Icavalcade of America” radion program broadcast on 14 May 1945 under the sponsorship of, and copyrighted by, E.I. du Pont de Nemours & Company, on file in the AWS historical archives.

³⁵Hanson Baldwin, *Battles Lost and Won: Great Campaigns of World War II* (New York: Harper & Row, Publishers, 1966), p. 345.

³⁶Craven and Cate, *Europe: Arugment to V-E Day, January 1944 to May 1945*, pp 708; Charles B. MacDonald, *The Last Offensive*, from the *United States Army in World War II: The European Theater of Operations*, ed. Maurice Matloff (Washington D.C.: Office of the Chief of Military History, U.S Army, 1973).pp 29,51.

³⁷Jonas A. Jonasson, “Weather and Communications, in *The Army Air Forces in World War II, Vol II: Services Around the World*, ed. Craven and Cate (Chigaco: University of Chicago Press: 1958), p.312.

³⁸*Brave Men*, 319.

³⁹*Crusade in Europe*, 324.

officers to England “to begin the study of this beastly weather.”⁴⁰ Before long Eaker and other found that weather conditions, as the official accounts relate, “were to provide one of the greatest obstacles to daylight precision bombing”;⁴¹ that their “interference forms a monotonous theme running throughout the history of air operations over western Europe”;⁴² and that they were the air forces’ “worst opponent.”⁴³

For one thing the aircraft of World War II flew higher, faster and farther than ever before. In so doing they encountered some unique meteorological manifestations. It was on some of the early bombing runs over Europe that the airmen encountered the problem of the jet streams aloft. With the English winters moisture in the aircraft components and systems turned to ice at 15,000 feet. At combat altitudes trim tabs, gun-actuating, turret, and bomb-door mechanisms became inoperative when the lubricants froze. Often engine superchargers would fail because of congealing oils in the regulator lines. When new oils and lubricants were found to eliminate such problems, it became necessary to completely cover guns with oils to ensure their operation at high altitudes. Aircrews suffered too when oxygen mask valves stuck with ice, and electrically heated boots failed to prevent frostbite on many an occasion.⁴⁴

Even more troublesome for the exponents of high altitude precision bombing was the number of days when weather conditions would permit successful operations were limited because of cloud cover and visibilities at either the target or home plate.

Some of the war’s best remembered air raids in the European theater of operations were so affected. During a raid on the Schweinfurt ball bearing plants on 14 October 1943, eight Air Force bombers ran into particularly dense concentration of German fighters because German meteorologists accurately forecast it to be the only area over all Germany in which daylight bombing was possible under prevailing conditions.⁴⁵ On the other side of the coin it was weather forecasts by Army Air Forces Weather Service meteorologists which determined the

⁴⁰Alfred Goldberg, “Establishment of the Eighth Air Force in the United Kingdom,” in *The Army Air Forces in World War II, Vol I: Plans and Early Operations, January 1939 to August 1942*, ed. Craven and Cate (Chicago: University of Chicago Press, 1948). P. 625.

⁴¹Arthur B. Ferguson, “Routen-Scottville No. 1, 17 August 1942,” *Ibid.*, p. 661.

⁴²Remple, “Check at the Rhine,” in *The Army Air Forces in Word War II, Vol III: Europe: Argument to V-E Day, January 1944 to May 1945*. P.602.

⁴³John E. Fagg, *The Climax of Strategic Operations, Ibid.*, p. 723.

⁴⁴Roger Freeman, *The Mighty Eighth: Units, Men and Machines (A History of the U.S. 8th Army Air Force)* (New York: Doubleday and Company, Inc., 1970) pp. 11,24,73,and 125.

⁴⁵Ferguson, “Pointblank,” in *The Army Air Forces in World War II, Vol II Europe: Torch to Pointblank, August 1942 to December 1943*, ed. Craven and Cate (Chicago: University of Chicago Press, 1949), p. 702.

timing of bombing attacks against the heart of Germany during "Big Week" in February 1944.⁴⁶ And it was those same weathermen who painstakingly screened weather maps of the previous forty years to find the climatologically best period for ensuring the success of the 1944 raids against the Ploesti oil refineries - negligible headwinds at altitude both to and from the target, protective cloud cover both ways, and clear skies and southerly winds over target.

Weather factors played a similar role in the Pacific theater. The Japanese took advantage of an extensive storm zone in the Pacific to conceal the approach of their aircraft carriers to Pearl Harbor in December 1941. Some fifteen months later a miscalculation in the Bismark Sea cost them dearly when the storm under whose canopy their convoy sought to reinforce New Guinea dissipated and the Fifth Air Force won a major victory.⁴⁷

Weather exerted its chief limiting effect on the United States air supply operations in Burma through the monsoonal rains that incapacitated forward airfields and necessitated the parachuting of supplies.⁴⁸

"That element," the official Army Air Forces accounts recorded in referring to the weather, proved to be "the worst hindrance to the B-29 campaign against Japan."⁴⁹ The first mission by a United States bomber force over the Japanese homeland since the Doolittle raid of April 1942, comprised of the new B-29s, was originally scheduled to depart Saipan's Isley Field on 17 November 1944. However, winds and rain at the field forced the long-awaited mission to be scrubbed, On the morning of the eighteenth weather forced another cancellation. The schedule and scratch routine continued through another frustrating week. In Washington General Henry H. "Hap" Arnold and his staff grew impatient. Aircrews complained. Their enthusiasm waned. When the Isley weather finally broke on 24 November, 111 B-29s launched. But the Tokyo weather made bombing difficult. Formations at altitudes from 27,000 to 33,000 feet were pushed by a 120-knot tailwind into ground speeds of about 445 miles per hour: the target below was nearly completely obscured by an undercast. Post strike reconnaissance, which indicated that the bombing results were somewhat less than encouraging, were also hindered by clouds over the target.⁵⁰

⁴⁶Ferguson, "Big Week," in *The Army Air Forces in World War II, Vol III: Europe: Argument to V-E Day, January 1944 to May 1945*, p. 31.

⁴⁷Jonasson, "Weather and Communications," 312.

⁴⁸Joe G. Taylor, USAF Historical Study No. 75, *Air Supply in the Burma Campaigns* (Maxwell AFB, AL: USAF Historical Division, Research Studies Institute, Air University, April 1957), p. 137.

⁴⁹Cate and James C. Olson, "Precision Bombardment Campaign," in *The Army Air Forces in World War II, Vol V: The Pacific: Matterhorn to Nagasaki, June 1944 to August 1945*. ed. Craven and Cate (Chicago: University of Chicago Press, 1953), p. 557.

⁵⁰*Ibid*, 557-560.

“There are two salient problems,” said Lieutenant General Millard F. Harmon one month later while summing up for newsmen that and subsequent raids on Tokyo and other Japanese industrial centers, “one is distance and the other is weather.” Bad weather was hampering the B-29 raids but not halting them, the Commanding General of the Army Air Forces in the Pacific remarked. The Superforts flew over most of the bad weather en route, he said, but weather over the target was a tricky problem. “Between Saipan and Tokyo, the weather is mostly bad.” Harmon went on:

Nowhere else is there such turbulence, such unpredictable and sudden changes. Miles high over Tokyo, there are gales blowing harder than any other place in the world, including Mount Everest. They reach a velocity of higher than 200 miles per hour. This weather extends a thousand miles south of Tokyo. Always at some point it is violent.

“The real problem,” the general continued, was that “our targets are frequently clouded over.” “With the weather more variable than that in the notorious Aleutians,” Harmon concluded, “Japan will prove to be the war’s most difficult target for sustained precision attack.”⁵¹

Weather thus proved to be the most serious obstacle to high altitude daylight precision bombing over Japan, a fact noted by the post war United States Bombing Survey. Severe frontal conditions, often encountered on the trip north from the Marianas, increased fuel consumptions, decreased bomb loads, scattered formations, and made navigation so difficult that many crews missed their land fall completely. Over the target, crews seldom found atmospheric conditions suitable for precision bombing. With the wind velocities that Harmon noted, drift was difficult to correct, and bomb runs had to be charted directly upwind or downwind. Bombing Japan’s best defended cities directly in the teeth of 200 knot winds was unthinkable; going downwind the B-29s reached ground speeds in excess of 500 miles per hour, in which case neither bombsights nor bombardiers could function properly. Additionally, the high winds made it impossible for crews to make a second pass if the run-in failed; if a navigational error brought a plane in downwind from the target it might be unable to attack at all.⁵²

It was the weather, therefore, as much or more than any other factor, which led Major General Curtis E. LeMay, while commanding the XXI Bomber Command in March 1945, to make his famous switch in tactics and order night, low level (5,000 to 15,000 feet) attacks by individual aircraft - as opposed to mass formations - using incendiary bombs against Japan’s urban areas. At night the cloudiness over Japan tended to thin out and Loran reception cleared making navigation easier. Low altitude bombing runs reduced fuel consumption, thereby permitting heavier bomb loads; they also lengthened the engine and airframe life of the B-29 and, most important, increased bombing accuracy. On the return flight the B-29s met an early dawn somewhere near Iwo Jima making it easier to ditch damaged planes. The results were

⁵¹Anonymous. *Background of the Air Weather Service: 700 B.C. - 1948 A.D.*, no date, p. 38, Unpublished Manuscript in AWS Historical Archives.

⁵²Cate and Olson, “Precision Bombardment Campaign,” 575-576.

spectacular.⁵³ “It is recognized that a large measure of the success of recent operations of the 21st Bomber Command has been attributed to the accuracy with which weather, particularly at the target, has been predicted,” LeMay wrote in commending his weathermen.⁵⁴

It was General Lemay who helped usher in the age of atomic warfare at Hiroshima on 6 August 1945⁵⁵ - one of the most significant dates in history and a date determined by the general based on target weather forecasts. In order issued by letter on 25 July General Spaatz was directed to drop the “first special bomb as soon as weather will permit after about 3 August 1945.⁵⁶ Weather was the critical factor because with only two bombs available the drop had to be made by visual means, and Spaatz delegated to Lemay the job of deciding when the weather would permit the war’s most important mission. Original plans were for the drop to be on the fourth, but Lemay postponed it because of unfavorable weather over the target. On the fifth the weather forecasts for the next day were favorable. When the B-29 *Enola Gay* broke ground from Tinian at 0245 on 6 August the pilot was under instructions to select the target based on reports from three weather planes preceding him over the primary, secondary and tertiary targets, but to return with the bomb if all three were covered by clouds. At 0815 he got the Hiroshima report: two-tenths cloud cover at the lower, middle and 15,000-foot altitudes. That weather report “sealed the cities doom” noted the official history.⁵⁷ Three days later Nagasaki’s fate was similarly sealed because of a meteorological quirk: while the weather plan reported visual conditions over the primary target, Kokura, because of a nearly fifty-five minute delay at the rendezvous point off Japan the B-29 with the bomb aboard was forced to divert to the secondary target, Nagasaki, after finding Kokura socked in when it finally got there. At Nagasaki the crew encountered eight-tenths cloud cover but at the last second, under orders to bomb visually, found a hole and released the second and last atomic bomb of the war.⁵⁸ Japan sued for peace the next day.

⁵³Cate and Olson, “Urban Area Attacks,” and “The All Out B-29 Attack,” in *The Army Air Forces in World War II, Vol V: The Pacific: Matterhorn to Nagasaki, June 1944 to August 1945*, 612-613, 623, 645.

⁵⁴Anonymous. *Background of the Air Weather Service: 700B.C. - 1948 AD*, p. 39.

⁵⁵Two other dates could be cited as opening the atomic age: 2 December 1944 when Enrico Fermi succeeded in producing a chain reaction; an 16 July 1945 when the first atomic bomb was detonated at Alamogordo, New Mexico

⁵⁶See a photographed copy of the letter in Robert Frank Futrell and James Taylo, “Reorganization for Victory, in *The Army Air Forces in World War II, Vol V: The Pacific: Matterhorn to Nagasaki, June 1944 to August 1954*, facing p. 696.

⁵⁷Cate and Craven, “Victory.” in *The Army Air Forces in World War II, Vol V: The Pacific: Matterhorn to Nagasaki, June 1944 to August 1945*, 716.

⁵⁸*Ibid.*, 719-720. See also Louis Morton, “The Decision to Use the Atomic Bomb,” *Command Decisions*, 514-515.

Following V-J Day, the world's power politics revolved around a bipolar axis. Anchoring one end was the United States which deflated its diplomatic muscle through the return to civilian life of some 12,000,000 in the rapid post war demobilization. At the other end was Russia, possessor of a frightening diplomatic tool - the world's largest land army. The lack of military forces in, and the absence of a concrete plan for the rehabilitation and stabilization of, Western Europe created a political void. By March 1946 Churchill was able to inform his audience at Westminster College in Fulton, Missouri, that "an iron curtain has descended across the continent." So, it was that about the ides of March 1946, the cold war between the two-principle eastern and western isms commenced. In the ensuing four years the cold war warmed considerably as communism made giant strides in its avowed quest for world domination, mainland China came under the banner of the Red Star, and ominous storm clouds gathered over Korea's horizon as differences between two political regimes, north and south of the Thirty-Eighth Parallel, became irreconcilable. Early on the morning of 25 June 1950, artillery and mortar fire opened and North Korea invaded its southern neighbor. Scattered but heavy rains fell along the Thirty-Eighth Parallel that morning. Such conditions could be expected in the upcoming weeks because the summer monsoons had just set in.⁵⁹

Documents captured later revealed that it was not by accident that the North Koreans struck with the advent of the monsoons. From the initial attack they habitually times their ground assaults to coincide with periods of poor flying weather because the United Nations Command enjoyed air superiority. There was also reason to believe that the Chinese Communists, knowing that the United Nations' forces would destroy most North Korean bridges, waited until the inland waterways froze before launching their attack in late November 1950.⁶⁰

Harsh extremes in the Korean temperatures regimes, coupled with its topography, levied tolls on the United States ground forces before 1950 was out and thereafter. Temperatures that initial summer sometimes reached 100 degrees and above in humid furnace like weather. Daylight broke at 0500 and lingered for sixteen hours. There was little vegetation in South Korea to provide shelter from the relentless sun. Good water was scarce. The blazing sun together with the exertion expended climbing steep slopes frequently cause throbbing headaches. Initially the United States lost as many men from heat exhaustion as from gunfire. By mid-November 1950, when the bottom dropped from the thermometer and temperatures plummeted to twenty and twenty-five degrees below zero, sick bays filled with frost bite and exposure cases. Stimulants were necessary to accelerate depressed respiration. Water-soluble medicines froze. Morphine could be maintained in satisfactory condition only by keeping it against the body. Plasma was useful only after a sixty-to-ninety minute preparation period in a warm tent. Canteens froze and burst. And in the field it was found that ordinary entrenching tools could not

⁵⁹Roy E. Appleman, *South to the Maktong, North to the Yalu: (June-November 1950, from the United States Army in the Korean War*, ed. Stetson, Conn/Washington D.C.:Office of the chief of Military History, Department of the Arm, 1961), p. 21.

⁶⁰Futrell, USAF Historical Study Non. 72, *United States Air Force Operations in the Korean Conflict: 1 November 1950-30 June 1952*, (Maxwell AFB, AL: USAF Historical Division, Air University, Department of the Air Force, 1 July 1955), pp 46, 251, hereinafter cited as *USAF in Korea: 1 Nov 50-30 Jun 52*.

penetrate the rock-hard, frozen ground.⁶¹

Climatology assumed a role of importance to United Nations' operations. The state of the tide dictated the invasion day for the Inchon Landing in September 1950, for example. Two typhoons early that month affected both the troop loading operations in Japan and the cruise of the invasion fleet to Korea - one producing 110 miles per hour winds ashore at the loading ports, the other 60 miles per hour winds that whipped up the seas.⁶² And United Nations' air attacks against the Sinuiju bridges received renewed attention only after the Yalu River ice thawed sufficiently enough in March and April 1951 to prohibit communist vehicular traffic.

“Korean operations demonstrated... that the USAF had not become an all-weather air force,” noted the official Air Force account of that war.⁶³ So called “all weather” squadrons simply could not operate in all manner of weather, in particular low ceilings and visibilities. “Although the importance of weather in military operations had been increasingly played down as the all-weather potentialities of the armed service have been emphasized,” the 1952 Air Force history noted, “weather remained a major factor in planning and operations in Korea.”⁶⁴ Long range flights by aircraft required accurate and extended wind, route, target, and terminal forecasts. Some targets in Korea were physically unsuitable for radar bombing and pattern bombing by medium bombers required good weather.

In the war's initial stages, the Far East Air Forces' Bomber Command usually selected targets and determined a strike's timing based to a large degree on the weather forecast. But because the weather forecast. But because the prognosis proved so frequently to be inexact, it began dispatching a weather aircraft ahead of the main striking force on all formation missions. The senior officer aboard had authority to direct the method of attack, to decide whether the target could be attacked by radar, or to divert the missions to alternate targets. Its attempts as close-interval bombing attacks were plagued by the high velocity, hard to predict, winter winds aloft over Korea which varied so markedly with altitude that aircraft at lower altitudes frequently under flew those higher up. Moreover, forecasts of winds aloft were so often in error that the average bomb release time was sixteen minutes off, early or late. At one stage, in the war's final

⁶¹Appleman, *South to the Naktong, North to the Yalu*, 139,262, and 744. See also Walter G. Hermes, *Truce Tent and Fighting Front*, from the *United States Army in the Korean War*, ed Stetson Conn (Washington, D.C. : Office of the Chief of Military History, U.S. Army, 1966) pp. 178-180.

⁶²James A. Field, Jr. *History of the United States Naval Operations: Korea* (Washington D.C., Government Printing Office, 1962), pp 176-178. See also Appleman, *South to the Naktong, North to the Yalu*, 498-502

⁶³Futrell, *USAF in Korea: 1 Nov 50 - 30 Jun 52*, 251.

⁶⁴Futrell, USAF Historical Study No. 71, *United States Air Force Operations in the Korean Conflict: 25 June - 1 November 1950* (Maxwell AFB, AL: USAF Historical Division, Department of the Air Force, 1 July 1952), p. 112. Hereinafter cited as *USAF in Korea: 25 Jun-1 Nov 50*.

year, while conducting radar bombing operations at night against searchlight defended targets, the Bomber Command looked for forecasts of bad weather, in particular extensive cloud coverage between the B-29s and the target. On 28 November 1952, after weeks of waiting for forecasts of bad weather, the Bomber Command dispatched a mission to Senega. Expecting to encounter the predicted instrument weather at the target, the forty-four bombers were met instead with a clear, bright night without a cloud in the sky and the moon at its zenith. From that mission on, the Bombing Command recognized that the accuracy of forecasting required to successfully utilize weather cover could not be obtained and it gave up further efforts to use weather prediction as mission planning factors.⁶⁵

Yet the air war in Korea was primarily a tactical air war and some of the tactical air commanders harbored the belief that the Air Force's Air Weather Service meteorologists could not forecast well enough for their purposes. By early 1951 the continues inaccuracy of the weather forecasts, together with crew inexperience and poor target intelligence, had lowered the efficient of the bridge destruction efforts. Cloudiness over targets cause more photographic reconnaissance mission aborts than any other single factor.⁶⁶ Particularly were the complaints valid after July 1952 when the air-pressure strategy shifted from one of targets of opportunity, which could be satisfactorily met by general area forecasts, to one requiring pinpoint forecasts that were not easily or completely met.⁶⁷

One method of overcoming the forecasting problems in Korea, which were aggravated by the topography – a mountainous peninsula surrounded by warm water currents – and the fact that weather systems flowed from territory occupied by unfriendly nations, was the weather reconnaissance mission flown daily over North Korea, as noted above, most of them by Air Weather Service WB-29s. In fact on 13 July 1950 a WB-29 with Major General Emmett O'Donnell, Jr., the Bomber Command's commanding general - aboard led the first B-29 strike from Japan against North Korean targets.⁶⁸ While the B-29 reports were often the determining factor in whether or not to launch fighter strikes from Itazuke, Japan, tactical weather reconnaissance missions were conducted by other units much the same as was done during the Second World War. Beginning in late July 1950 weather forecasters were placed aboard bomber or reconnaissance aircraft in missions over North Korea. In October 1950 two "all weather F-82s from one squadron commenced pre-dawn weather reconnaissance missions over North Korea. And in February 1951, a special flight of six WB-26s from a tactical reconnaissance wing began flying missions over the Yellow Sea and North Korea on routes precoordinated with

⁶⁵Futrell, USAF Historical Study No. 127, *United States Air Force Operations in the Korean Conflict: 1 July 1952-27 July 1953* (Maxwell AFB, AL: USAF Historical Division, Research Studies Institute, Air University, Department of the Air Force, July 1956, pp. 72-73, 76. Hereinafter cited as *USAF in Korea: 1 Jul 52 - 27 Jul 53*.

⁶⁶Futrell, *USAF in Korea: 1 Nov 50 - 30 Jun 52*, 53, 251.

⁶⁷Futrell, *USAF in Korea: 1 Jul 52 - 27 Jun 53*, 304-305.

⁶⁸Futrell, *USAF in Korea: 25 June - 1 Nov 50*, 113.

the Fifth Air Force staff weather officer.⁶⁹ Yet because of their slow speed and inability to defend themselves the WB-26s' usefulness declined as the war continued and by its end nearly one-half of the tactical weather reconnaissance sorties were logged by RF-80, F-86s and F-94s in prestrike reconnaissance of targets to look at the weather.⁷⁰

Less than a year after the armistice was signed in Korea in July 1953, the remnants of French colonialism in Indochina crumbled at a little outpost in a valley whose name became synonymous with siege warfare: Dien Bien Phu. French meteorologists knew that the valley received fifty percent more rainfall than any other in northern Indochina and it was a contributing factor in the fortress' doom. On nine days during the fortnight prior to 7 May 1954, the day Dien Bien Phu fell, it was inundated with heavy monsoon rains that made the parachuting of personnel and supplies nearly impossible and, at one time, forced men in the bunkers to fight in water up to their belts. "One must add to all this the continuous rain which causes complete flooding of the trenches and dugouts," wired Brigadier General Marie Ferdinand de la Croix de Castries, one of the French officers in command at Dien Bien Phu while outlining the troubles he faced. "The situation of the wounded is particularly tragic," he continued in a dispatch sent three days before the surrendering; "they are piled up on top of each others in holes that are completely filled with mud and devoid of any hygiene."⁷¹

The French experience with Indochina's monsoonal climate was a precursor of ills which befell the United States when, after the Geneva Accords of July 1954 partitioned Vietnam at the Seventeenth Parallel, it chose to offer assistance to the South against a northern neighbor dedicated to its subjugation. After North Vietnamese aid to Viet Cong guerrillas in South Vietnam was backed with large scale troop infiltrations in 1964, and two United States destroyers were attacked by North Vietnamese patrol boats in the Gulf of Tonkin, the United States retaliated with air strikes against North Vietnam. By 1965 the Rubicon was forged: American troop levels spiraled, and an intense air campaign was initiated.

But weather dogged the Americans as it had the French. Leeches communicated, and the moisture-laden heat incubated exotic, and hitherto unknown, diseases such as meliodosis - akin to tuberculosis. While hospital admissions were lower than in World War II or Korea, high incidences of malaria among Americans in Southeast Asia were a significant problem.⁷² Untreated lumber used for construction was subjected to attacks by beetle borers, termites, dry

⁶⁹Futrell, *USAF in Korea: 1 Nov 50 - 30 Jun 52*, 253.

⁷⁰Futrell, *USAF in Korea: 1 Jul 52 - 27 Jun 53*, 307.

⁷¹Bernard B. Fall, *Hell in a Very Small Place: The Siege of Dien Bien Phu, Great Battle of History*, ed. Hanson W. Baldwin (Philadelphia: J. B. Lippincott Co., 1966) pp. 6, 343-44, 358, 360, and 366-67.

⁷²U.S. Congress, House, Subcommittee on Department of Defense of the Committee on Appropriations, *Hearings, Department of Defense Appropriations, 90th Congress, 1st Session, Part 5, 1967*, pp 351, 356-57.

rot and fungus. Its “final failure” was a likelihood inside two years.⁷³ Yet, treating the lumber was inadvisable because of the irritating nature of the chemical used and the impossibility of painting over lumber treated with coal or tar derivatives. The dark colors of standard issue tents absorbed the tropical heat and the environment deteriorated the fabric. In the dry season dust and blowing sand created severe maintenance problems. During the monsoons many roads were rendered impassable. Supply points and assembly areas turned into quagmires. And the resultant surf conditions and severe high tides affected over-the-beach operations. The monsoon humidity and salt air speeded mildew, rust and corrosion. The Army normally budgeted to replace equipment about every eight years. In South Vietnam it was cut to two.⁷⁴

Sophisticated Air Force gear fared little better. The average life expectancy of pilots anti-G suits was one year. In South East Asia it was nine months.⁷⁵ Dense water concentrations in monsoon rain clouds cause compressor stalls in intricate jet engines. The heat and humidity caused canopy fogging problems for the F-5s at low altitudes, and it caused the sealant of the shelters they and other aircraft were parked in to fail. It lengthened takeoff rolls and reduced payloads. For a period, it grounded the F-4s because it melted an inferior potting compound used to insulate electrical connections - eventually Congress was advised that 367 “RF” and F-4s needed potting compound rework at an average cost per aircraft of \$59,000.⁷⁶ Monsoon rains accentuated the F-4's notoriously poor handling characteristics - hydroplaning - on wet runways. They quickly washed away subsoil beneath aluminum runway matting. Six hundred feet of it shifted nine yards from the runway centerline at Nakhon Phanom in 1968-69, necessitating runway closure for barely forty days while 3,500 feet of matting was removed and the laterite base repaired.⁷⁷ At Phan Rang at one point in 1966 ninety percent of the runway settle six inches. While repairing it temperatures two feet above the matting reached 125

⁷³Directorate of Civil Engineering, HQ USAF (AFOCE), *Civil Engineering in SEA*, Sec 69, pp 276-279, a Project Corona Harvest input for the period 1 January 1965 - 31 March 1968.

⁷⁴U.S. Congress, Senate, Subcommittee of the Committee on Appropriations, *Hearings, Department of Defense Appropriations for Fiscal Year 1967*, 89th Congress, 2d Session, Part 2, 1965, p. 93.

⁷⁵U.S. Congress, House Subcommittee on Department of Defense of the Committee on Appropriations, *Hearings, Department of Defense Appropriations for 1970*, 91st Congress, 1st Session, Part 3, 1969, p. 1,145.

⁷⁶*Ibid.* p 845; U.S. Congress, House, Subcommittee on Department of Defense of the Committee on Appropriations, *Hearings, Department of Defense Appropriations for 1970*, 91st Congress, 1st Session, Part 2, 1969, p. 811

⁷⁷U.S. Congress, House, Subcommittee on Department of Defense of the Committee on Appropriations, *Hearings, Department of Defense Appropriations for 1968*, 90th Congress, 1st Session, Part 1, pp. 307-308: Lt Derek H. Willard, USAF, Project CHECO Rpt, *Project Red Horse*, 1 Sep 69, p. 33.

degrees. Panels became too hot to handle with bare hands.⁷⁸

Weather tempered the targeting, tactics, timing and the type of ordnance employed by the Air Force in South East Asia. Referring to the air campaign against North Vietnam during the first four months of 1966, Admiral Ulysses S. Grant Sharp, the commander in chief in the Pacific, reported that weather “caused a high percentage of cancellations or diversions and greatly limited the information obtained from bomb damage assessments” because “often...pilots found 100 percent cloud cover or haze to 12,000 or 14,000 feet” over target areas.⁷⁹ “Weather is often a limiting factor in planned operations,” a Senate report issues the following year read while addressing the air war against North Vietnam.⁸⁰ As if to substantiate the report, Secretary of Defense Robert S. McNamara testified before the House of Representatives in February 1967 that “at the present time the level of activity {against North Vietnam} is limited not by aircraft but by weather.”⁸¹ The fact that the Seventh Air Force’s two major omnibus air plans were entitled “Northeast Monsoon Campaign” and “Southwest Monsoon Campaign” underscored the respect paid to weather’s influence on the air war, and the fragmentary strike orders issued in their name were often laced with the qualifying phrase “weather permitting.” “We have a problem of weather in North Vietnam at this time of year,” General John P. McConnell, the Air Force Chief of Staff testified before Congress in February 1968: “as soon as the weather opens up then we will start attacking those targets again.”⁸² Two months later in similar testimony Defense Secretary Clark M. Clifford said, “I have grave doubt that the state of the art has reached that point where we can bomb in all kinds of weather with the kind of accuracy that is required.”⁸³ As it turned out the Navy’s A-6, and the Air Force’s B-52 and the F-111 were the only aircraft that approached the “all weather” capability attributed to other. And the so called “smart bombs”, the EO - Electro-Optical -ordnance were “smart” only when launched in the

⁷⁸*Ibid.*, “History of the Pacific Air Forces, 1 Jul 70-30 Jun 71, pp. 206-208.

⁷⁹Sharp, “Report on Air and Naval Campaigns Against North Vietnam and Pacific Command - Wide Support for the War, June 1964 - July 1968, in *Report on the War in Vietnam* (Washington, D.C.: U.S. Government Printing Office, 1969), p. 24.

⁸⁰ U.S. Congress, Senate, Preparedness Investigating Subcommittee of the Committee on Armed Forces, *Report, U.S. Air Force Tactical Air Operations in Southeast Asia*, 90th Congress, 1st Session, 1967, p. 4.

⁸¹U.S. Congress, House, Subcommittee on Department of Defense and Military Construction of the Committee on Appropriations, *Hearings, Department of Defense Appropriations for 1968*, 90th Congress, 1st Session, Part 2, 1967, pp 54-55

⁸²U.S. Congress, House, Subcommittee on Department of Defense of the Committee on Appropriations, *Hearings, Department of Defense Appropriations for 1969*, 90th Congress, 2^d Session, Pt 1, 1968, p. 803

⁸³U.S. Congress, House, Committee on Armed Services, *Hearings on Military Posture and an Act (S.3293)*, 90th Congress, 2nd Session, 1968, pp 8, 625-26.

absence of weather.⁸⁴

“Never in the history of warfare have weather decisions played such an important role in operational planning as they have here in Southeast Asia,” wrote General Creighton W. Abrams in late 1968 while serving as the commander of all United States forces in Southeast Asia: “Khe Sanh, the A Shau Valley and Kham Duc are only a few of the many areas where weather has been a primary consideration in operational and intelligence planning.”⁸⁵

From Phantom pilots over Hanoi through the highest levels of the Pentagon to the President, Southeast Asian weather was a factor frustrating their plans. It was true from the Gulf of Tonkin until the war’s end nine years later, for both air and ground campaigns. On 7 February 1965, in the wake of a Viet Cong attack on the American compound in Pleiku, President Lyndon B. Johnson authorized retaliatory air raids against three targets in North Vietnam, with the South Vietnamese scheduled to attack a fourth. However, adverse weather caused a large number of sorties to abort with the result that only one of the targets was struck with force. “Three of the four authorized targets had been fogged in,” President Johnson later wrote; “only one had been struck.”⁸⁶ “On the night of the bombing of Pleiku,” a Pulitzer prize winning journalist wrote in referring to Mr. Walter Rostow, the presidential assistant for national security affairs, Rostow wandered around the White House clapping Air Force officers on the back, asking about the weather, reminding them that he had once picked targets (during World War II), and he knew that weather was important.⁸⁷

Six days later, on 13 February, according to the *Pentagon Papers*, President Johnson approved a sustained air campaign against North Vietnam and “Rolling Thunder I,” the code name assigned for the first strike, was set for 20 February. Political events caused the cancellation of it and a succeeding mission. Another, set for 26 February, was postponed and ultimately cancelled when weather blanketed the entire target area of North Vietnam. The weather remained bad for four days. It was 2 March before the first of the new raids, dubbed Rolling Thunder V was actually carried out. Rolling Thunder VI was set by Washington for 13 March and the execution message to Saigon carried passages such as “if weather precludes

⁸⁴ U.S. Congress, House, Subcommittee on Department of Defense of the Committee on Appropriations, *Hearings, Department of Defense Appropriations for 1970*, 91st Congress, 1st session, Part 4, 1969, p. 462; U.S. Congress, House, Committee on Armed Forces, *Hearings on Military Posture....* 91st Congress, 2nd Session, Part 1, 1970, p. 8, 283; and U.S. Congress, Senate, Subcommittee of the Committee on Appropriations, *Hearings, Department of Defense Appropriations for Fiscal Years 1973*, 92nd Congress, 2nd Session, Part 4, 1972, p.12.

⁸⁵Ltr, Abrams, Commander, USMACV, to Commander, 1st Wgp, “Letter of Commendation,” 13 November 1968.

⁸⁶Johnson, *The Vantage Point: Perspectives of the Presidency, 1963 - 1969* (New York: Holt, Rinehart, and Winston, 1971), p. 125.

⁸⁷David Halberstram, *The Best and the Brightest*, (New York: Random House, 1969). P. 157.

effective strike,” and “earliest date weather will permit effective US strike.” “Washington’s anticipation that the strike might be weathered out proved correct,” the *Pentagon Papers* noted: the raids set for 13 March were cancelled due to weather and were not carried out until 14-15 March.⁸⁸

During the North Vietnamese Tet offensive of early 1968 and the highly publicized siege of Khe Sanh, weather was “another critical factor (that) had to be considered,” reported General William C. Westmoreland, who preceded General Abrams; “we were in the midst of the northeast monsoon with no prospect of relief from bad weather until the end of March,” he continued and the “poor visibility...because of low clouds and persistent ground fog made helicopter movement hazardous if not impossible much of the time” and “posed major problems for close air support and supply by air.”⁸⁹ Referring to the battle of Hue in February, a United States Marine Corps account recorded that Lieutenant General Robert E. Cushman, Jr, the Commander of the III Marine Amphibious Force in Vietnam, “has established that with a break in the weather the (26-day) battle would have been fought and won in half the time.”⁹⁰ During any one day the best weather at Khe Sanh lasted only six hours during which clouds were in a scattered to broken condition between 1,000 and 2,500 feet with visibilities never much better than five miles. In the early morning, afternoons, and late evening weather and fog reduced visibilities to less than one mile.⁹¹ The Chairman of the Joint Chiefs of Staff admitted to a Congressional committee that Westmoreland had a “weather problem,” and General McConnell testifies that “we are supporting Khe Sanh by airdrop, because the weather is so bad you cannot land.”⁹² Actually, after a system had been devised for air dropping badly needed supplies to the Khe Sanh defenders, the adverse weather proved a blessing in disguise as it shielded the radar-directed cargo aircraft at low altitudes from enemy ground fire. While B-52s were able to bomb the Khe Sanh perimeter with the help of radar, tactical reconnaissance sorties were cut in half

⁸⁸“Evolution of the War: The Rolling Thunder Program Begins,” Bk 4 of 12 bk of *United States-Vietnam Relations, 1945 - 1967: Study Prepared by the Department of Defense* (Washington D.C.: U.S. Government Printing Office) pp 1, 25,45, 59, 64-65, and 71.

⁸⁹Westmoreland, “Report on Operations in South Vietnam, January 1964 - June 1968,” in *Report on the War in Vietnam* (Washington: U.S. Government Printing Office, 1969), pp. 162-63.

⁹⁰Brigadier General Edwin H. Simmons (USMC, Ret), “Marine Corps Operations in Vietnam, 1968,” in *The Marines in Vietnam, 1954-1973: An Anthology and Annotated Bibliography* (Washington D.C. History and Museum’s Division, HQ, U.S. Marine Corps, 1974), p. 101.

⁹¹U.S. Congress, House, Subcommittee on Department of Defense of the Committee on Appropriations, *Hearings, Department of Defense Appropriations for 1969*, 90th Congress, 2d Session, Part 4, 1968, pp. 1006-1007.

⁹²U.S. Congress, House Subcommittee on Department of Defense of the Committee on Appropriations, *Hearings, Department of Defense Appropriations for 1969*, 90th Congress, 2nd Session, Part 1, 1968, pp 55, 709

during February, for example, because of weather, and close air support was markedly hampered. When, after more than seventy days, the siege of Khe Sanh was lifted, Westmoreland's attention was diverted to the A Shau Valley where elements of three divisions, including the First Cavalry Division (Airmobile) under the command of Major General John J. Tolson, launched an attack designed to pre-empt enemy preparations for an attack in the Hue area. Under Tolson's stipulation that he have three full days of good weather for his airmobile and ground operations, the attack was postponed two days, to 19 April 1968. Yet weather plagued him throughout the twenty-nine-day operations during which his division lost twenty-one helicopters, according to Tolson, many because the weather channeled them into paths below the clouds where they fell prey to enemy ground fire. "Weather has been the key planning factor on the time of this operation from the beginning." Tolson later wrote:

The urgency to ... go into the A Shau Valley was based on inches of rain to be expected after the month of April, not *ceilings* and *visibilities* which would prove so critical. In other words, the forecast monsoon rains (which did occur) never produced the terrible flying conditions of low ceilings and scud which preceded them in April. An air cavalry division can operate in and around the scattered monsoon storms and cope with the occasional heavy cloudbursts far better than it can operate in extremely low ceilings and fog.... The lesson learned, then was that one must be very careful to pick the proper weather indices in selecting an appropriate time for an airmobile operation. An inch of rain that falls in thirty minutes is not nearly as important as a tenth of an inch which falls as a light mist over 24 hours, according to the long range forecast based on old French records, April was supposed to have been the best month for weather in the A Shau Valley. As it turned out, May would have been a far better month - but you can't win them all.⁹³

In early May 1970, after being summoned before Congress regarding the United States "intrusion" into Cambodia a few days earlier, Defense Secretary Melvin R. Laird testified that the timing for the invasion was predicated on two factors, primarily: politics - a new regime in the Cambodian government - and the weather. "I am sure that the motivation of the President," he said, "was to take advantage of this 3 - to - 6-week period (of good weather) while we have an opportunity to destroy these (North Vietnamese) sanctuary facilities and enable us to protect American lives in Vietnam in the future." Asked at another point why he estimated it would take the enemy four to five months to rebuild and resupply the sanctuaries, Secretary Laird replied: because of the weather situation that exists in the area."⁹⁴

With few exceptions - the so-called "protective reaction strikes", for example - a moratorium on the air war against North Vietnam had been in existence since 1968 while the

⁹³Tolson, *Airmobility: 1961 - 1971*, from *Vietnam Studies* (Washington, D.C. Department of the Army, 1973), pp 184-88, 191-92.

⁹⁴U.S. Congress, House Subcommittee on Department of Defense of the Committee on Appropriations, *Hearings, Department of Defense Appropriations for 1971*, 91st Congress, 2nd Session, Part 6, 1970, 796, 809, and 832.

peace talks in Paris dragged on. By November 1971, however as the “Vietnamization” program continued, and American troops levels were steadily reduced actions by the North Vietnamese. Thus, beginning on Sunday, 26 December 1971, following the traditional Christmas cease-fire, President Richard M. Nixon authorized five straight days of the most sustained air attacks since 1968 against North Vietnam. But because of the weather, primarily, the air strikes conducted under the code name, “Proud Deep Alpha,” were something less than an unqualified success. According to press reports, of the nearly 150 United States fighter-bombers in the first attack wave that Sunday, all but 46 returned home without expending their ordnance on target because of the low clouds, rain, and fog over North Vietnam caused by a “freak weather change” which had not been forecast.⁹⁵ Asked by Congress to comment on the validity of such reports, Air Force chief of staff General John D. Ryan admitted that “it was bad weather during all five days in which we were bombing by instruments, and we could have accomplished more had it been clear weather.”⁹⁶

“On the 30th of March,” 1972, commented Admiral Thomas H. Moorer, the chairman of the Joint Chiefs of Staff, “under the cover of very low ceilings and low visibility, in North Vietnam, for the first time in this war, moved anti-aircraft guns, across the demilitarized zone while launching a large offensive into South Vietnam. It was 20 April and the admiral had been called before Congress to explain why the invasion had proceeded virtually unchecked. He prefaced his entire testimony with a detailed weather synopsis, explaining to the solons that “weather programs play a greater part with respect to the military activities in South Vietnam than in any other part of the world,” that the transition between monsoons had produced low clouds, fog, and poor visibilities in the invasion zone worse than normal and that “it was under these conditions (that) they (the North Vietnamese) were able to operate without much air opposition for a rather long period.”⁹⁷ Weather hampered air power’s attempt at blunting the invasion. With the aid of radar, the B-52 were used, but during the first twelve days following the invasion there was only one in which tactical aircraft were able to effectively attack the fleeting targets. “Let’s get the weather cleared up,” President Nixon told his aids during that period, according to the published transcripts of some Watergate tapes; “the bastards have never been bombed like they’re going to be bombed this time, but you’ve got to have weather.”⁹⁸ Within a few days the United States resumed the air war against North Vietnam by hitting Hanoi and Haiphong, and in May President Nixon ordered the mining of all North Vietnam ports in an attempt to limit arms importation.

⁹⁵“Weather Curbed Raids,” St Louis Post-Dispatch, 3 January 1972, p. 1A.

⁹⁶U.S. Congress, House Subcommittee on Department of Defense of the Committee on Appropriations, *Hearings, Department of Defense Appropriations for 1973*, 92nd Session, Part 1, 1972, p. 52.

⁹⁷U.S. Congress, House Subcommittee on Department of Defense of the Committee on Appropriations, *Hearings, Department of Defense Appropriations for 1973*, 92nd Congress, 2nd Session, Part 8, 1972, pp. 31, 33, and 39.

⁹⁸“Transcripts on Air Raids, GOP Meeting,” *St. Louis Post Dispatch*, 30 June 1974, p. 1a.

Nine months later Admiral Moorer was again summoned to brief on the resumption of the bombing of North Vietnam by the United States north of the Twentieth Parallel on 18 December 1972, thereby lifting restrictions imposed by the President in late October. Code named "Linebacker II," the renewed air strikes helped prompt the North Vietnamese to negotiate for peace. But the weather forced the United States to rely on "all weather" aircraft, and in the case of the B-52, fifteen of them were shot down or lost in the twelve days of Linebacker II. "I could say just a little about the weather," Moorer testified,

Because the weather is quite seasonal in North Vietnam and in the whole Southeast Asia area. We were then in the middle of...the northeast monsoon period. This meant, then, that there would be very few days in North Vietnam during the Christmas period when it would be possible to make visual attacks. Therefore, it was necessary to use those resources; namely, the B-52, the F111, and the A-6, that had an all-weather capability. As a matter of fact, as it turned out, during that period that we were conducting the operations, which lasted from December 18 to 29, with the exception of a 36-hour standdown for Christmas, there were actually, only about 12 hours which were suitable for visual bombing, including use of the so-called "smart" bombs.⁹⁹

One of the briefing aids Admiral Moorer used to illustrate for the Congressmen the extent of the bad weather over North Vietnam was a photograph from a weather satellite. He and other Defense Department officials had often used the satellite pictures for similar purposes throughout the war. They were an indispensable aid to the decision maker as well as the military weatherman in Southeast Asia. In the course of a televised interview seen one night in early May 1967 by millions in the United States watching the popular newscaster Walter Cronkite, Lieutenant General William W. Member, the Seventh Air Force commander said that,

as far as I am concerned, the - this weather (satellite) picture is probably the greatest innovation of the war. I depend upon it in conjunction with the traditional forecaster, as a basic means of making my decisions as to whether to launch or not launch the strike.... This is something that no commander has ever had before in a war.¹⁰⁰

Something else that appeared in Southeast Asia which no other combatant ever had in time of war was the capability to make it rain. The theory went that if the normal monsoon season could be extended the resultant mud on the main lines of communication from North Vietnam through Laos and Cambodia into South Vietnam – in the general vicinity of the Ho Chi Minh trail - would measurably reduce the flow of men and material to the enemy. According to the *Pentagon Papers* rainmaking was a course of action first proposed to President Johnson in February 1967 based on successful tests during "Operation Pop Eye" in Lao the previous

⁹⁹U.S. Congress, House Subcommittee on Department of Defense and Military Construction of the Committee on Appropriations, *Hearings, Department of Defense Appropriations*, 93rd Congress, 1st Session, 1973, p.5

¹⁰⁰Test of interview with General Momyer in Saigon, Republic of Vietnam, 4 May 1967, by Mr. John Hart, CBS news correspondent, on file in the AWS historical archives.

October.¹⁰¹ While the program came under fire from certain segments of Congress, top secret Defense Department testimony made public in May 1974 revealed that Air Force WC-130s and RF-4Cs dropping silver iodide during each southwest monsoon from 1967 to 1973 increased rainfall by approximately thirty percent in certain areas, according to some estimates, and slowed the flow of enemy supplies.¹⁰² When feeling was that, as a cost of \$3.6 million annually rainmaking was less costly than the traditional air interdiction methods. More important it saved lives. It was more humane. Successes with the original rainmaking tests in Laos led one American ambassador to observe that the United States should “make mud, not war.”

¹⁰¹Vol II, U.S. Ground Strategy and Force Deployments: 1965-1965,” Book 5 of 12 Books of *United States - Vietnam Relations, 1945-1967: Study Prepared by the Department of Defense* (Washington D.C.: U.S. Government Printing Office, 1971), pp 50-51.

¹⁰²U.S. Congress, Senate Subcommittee on Oceans and International Environment of the Committee on Foreign Relations, *Hearings: Weather Modification*, 93rd Congress, 2nd Session, 1974, p. 103