

Doctor Werner Schwerdtfeger

A Short Biography

The Wetterflieger Project

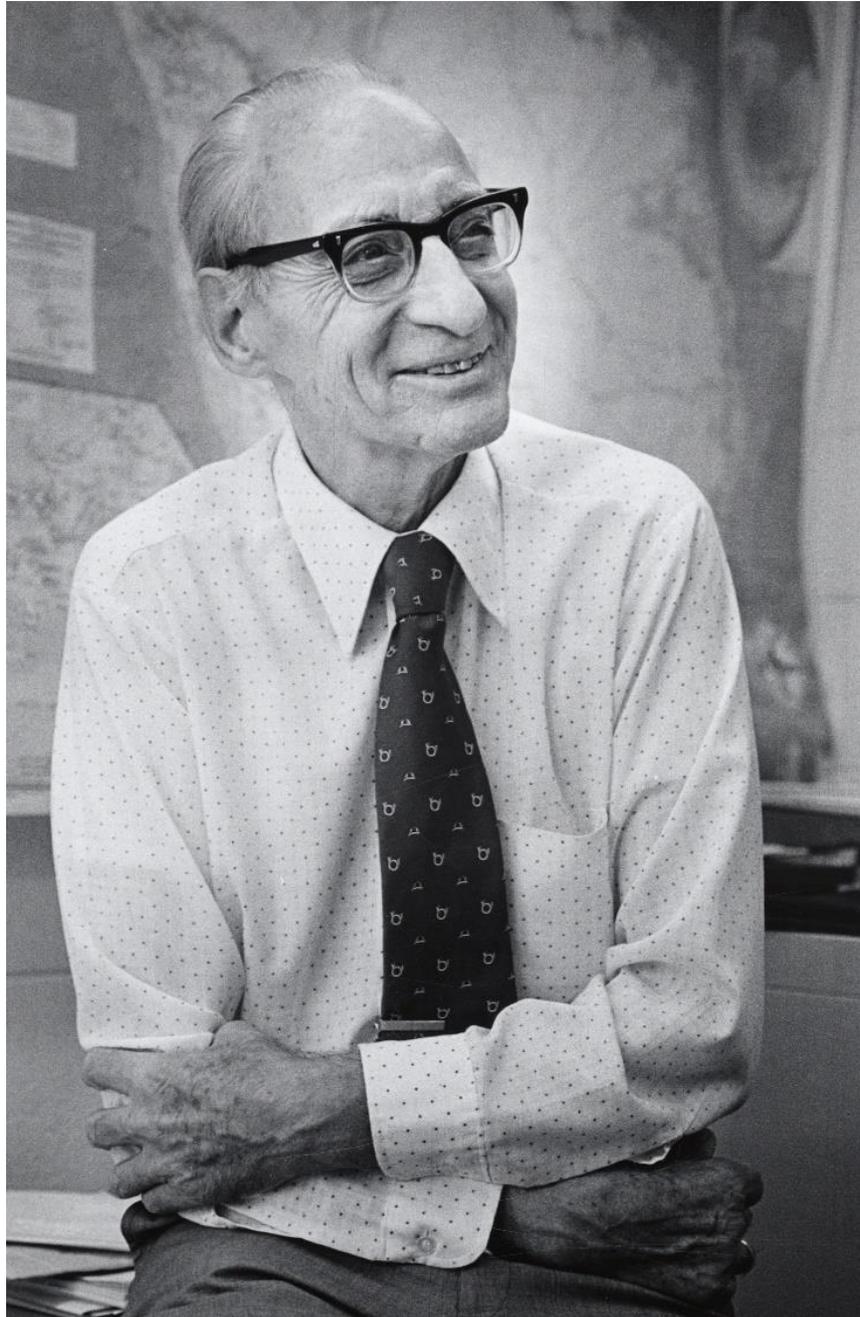


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Preface

This is a short biography of a man whose life was filled with enough experiences, friendships, and drama to serve the lives of several men. Father, husband, friend, scientist, educator, researcher, mentor, aeronaut, and warrior, he comes as close to a true “Man for All Seasons” as many of us could likely imagine. His experiences in wartime, as a uniformed civil service official in the *Luftwaffe* and flight meteorologist in combat and later as director of the *Luftwaffe*'s principal forecast agency, would have been the high points of most men's lives, as wartime service undoubtedly was for many of his comrades.

Not one to settle for dwelling on the past, Doctor Werner Schwerdtfeger went on to become a world-famous atmospheric scientist. He became if not the leading authority on weather and climate in South America and the Antarctic, then certainly a principal authority on those regions as well as on weather in the Arctic. Settling in the United States for the last part of his life, he continued his interests in polar climates while educating new generations of atmospheric scientists at the University of Wisconsin in Madison, Wisconsin until his passing in 1985.

Doctor Richard Savage has managed a project regarding a book published after the war by Schwerdtfeger and Franz Selinger, *Wetterflieger in der Arktis 1940-1944*. The collective “we” or “us” used in the following refers to participants or interested parties in that project.

Initially, we thought the book, in German, was about Schwerdtfeger's own experiences in wartime. Savage soon realized that the book was instead a memorial to the wartime experiences of Schwerdtfeger's long-time friend and wartime comrade, the highly-decorated pilot Rudolf Schütze, the *wetterflieger*. Based on a journal kept by Schütze during the war and on other materials, Schütze's saga is a fascinating and detailed story of combat and flying from Norway into some of the world's worst weather and of exploring, landing, and operating at inhospitable locations north and east of Norway.

While researching, we discovered various materials dealing with Schwerdtfeger's own service as the chief flight meteorologist in the principal *wettererkundungsstaffel* (weather reconnaissance squadron), usually abbreviated as *wekusta* or *westa*. He served in *Wekusta 1* of the *Luftwaffe*'s High Command from its organization in 1938 until he was transferred to become the Chief (*Chef*) of the *Luftwaffe*'s Central Weather Service Group (*Zentral Wetterdienst Gruppe* or *ZWG*) in August 1943.

Wekusta 1, Ob.d.L. (*Oberbefehlshaber der Luftwaffe* or Commander-in-Chief of the *Luftwaffe*) flew combat weather reconnaissance, provided technical training for meteorologists and other aircrew members, and developed equipment and procedures for aircraft weather reconnaissance operations. Schwerdtfeger led those activities and flew 250 combat missions from 1939 until 1943.

Werner Schwerdtfeger

On this planet's coldest and most barren continent are monuments to two gentleman scientists from the University of Wisconsin. Once known to many German meteorologists of the early 1930s as "The *Austausch* Twins,"¹⁴ together they used manned hydrogen balloons to collect data for assessing the fine structure of vertical winds in studying *Austausch* Theory ^a and atmospheric turbulence. The "Twins," Dr Werner Schwerdtfeger and Dr Heinz Lettau, became friends at the *Institut für Geophysik und Meteorologie* ^e in Leipzig where they received their doctorates under the direction of the famed German meteorologist Professor Ludwig Weickmann ^j. They remained friends and frequently colleagues for more than five decades.

Lettau's legacy is honored by a University of Wisconsin automatic weather station (AWS) ²⁶ on the Ross Ice Shelf not far from a similar AWS named for Schwerdtfeger. The Lettau Bluff ⁱ is a rock and ice bluff that forms the central part of the western edge of Beaufort Island. Named for Lettau, an authority on Antarctic meteorology, the bluff rises some 660 feet above the Ross Sea of Antarctica.

In the Royal Society Range ^m at the head of the Renegar Glacier near the Ross Ice Shelf and McMurdo Station rises Mount Schwerdtfeger, a 9860 foot ice-and-snow-covered peak named for the subject of this biography, Doctor Werner Schwerdtfeger^{29,30}. Schwerdtfeger, a senior meteorological researcher at the University of Wisconsin late in his life, was a driving force in the study of Antarctic meteorology, particularly the barrier winds east of the Antarctic Peninsula. He lived a life filled with adventures, pioneering science, huge challenges, defeats and victories, and great and lasting friendships.

Early Years

Werner Schwerdtfeger's early life was marked by tragedy, privations, hardships, love, and scientific achievements. This time in his life spanned The Great War to End All Wars, World War I, as a boy, as well as the rise of Adolph Hitler and National Socialism while he was a young adult. These large events in Germany formed the background in his life, intruding into it in his early years as they did for all Germans, and ultimately forced hard choices after the next war as well.

Beginnings

Werner Schwerdtfeger was born on July 12, 1909 in Köln, Kalk District, in a Germany ruled by Kaiser Wilhelm II. He was the son of a Prussian Major, Otto Dietrich Schwerdtfeger^{1,25}, and his wife, Helene Laura Hueck. 1909 would prove to be an important year in his life for another reason: three of the most important people in his life were also born in that year. *Rudolf Schütze* was born December 6, 1909 in Königsberg, East Prussia; *Heinz Helmut Lettau* was born November 4, 1909, also in Königsberg; and, most importantly, his future wife *Marianne Margaritha Noack* was born May 11, 1909 in Leipzig, and all proved seminal influences in the development of Werner in the years before and after the second world war.

Tragedy struck early in his young life when he was just five years old. His father, Major Schwerdtfeger, a tall and imposing figure of a man, was killed early in the war on December 10, 1914 near Lowicz, Poland at the start of the German campaigns against Russia. He is buried in

Göttingen, home to the Schwerdtfegers and where young Werner grew to manhood with his mother and older brother Hans.



Major Otto Schwerdtfeger, third from left, and his brothers Erich, Heinrich, and Ernst.¹

Living conditions in Germany steadily deteriorated as the war was prolonged and the Allied blockade in particular had an ever-increasing negative economic effect on both the home front and the armed forces. Conditions improved some after the war but privations continued and the Weimar Republic struggled to maintain stability in the face of increasing labor agitation and the growing strength of the Communists and other factions during the Twenties.

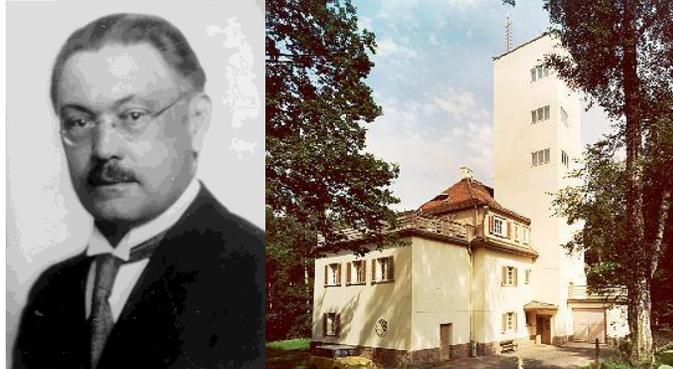
The National Socialist German Workers' Party, or Nazi Party, emerged during this time from the German nationalist, racist and populist *Freikorps* paramilitary culture, which fought against the Communist uprisings in post-World War I Germany. The party was created to draw workers away from Communism and into *völkisch* nationalism. A charismatic young leader, Adolph Hitler, began to assume a greater and greater role in party politics.

Against this background, young Werner attended Göttingen's prestigious *Humanitische Gymnasium*^{17, d}, with its very demanding high school curriculum. In 1927, he began university studies at the University of Freiberg and then transferred in 1929 to the University of Leipzig where he studied under the direction of Professor Ludwig Friedrich Weickmann^j at the *Institut für Geophysik und Meteorologie*^e.

He later told Heinz Lettau how he became interested in the atmospheric sciences. Bored with the abstract subject matter of mathematics¹⁷, he was browsing through the library stacks at Freiberg when he found the 400-page "Textbook on Meteorology"^h by Julius von Hann^g and

Reinhard Suring⁹. Fascinated by the subject that applied mathematics to nature, he decided to matriculate at the University of Leipzig.

Part of his time there as a student included mandatory service in data collection and observations from the *Institut's* mountaintop tower observatory, under construction and somewhat primitive, at Collmberg (“Hill, mound”)° about 30 miles west of Leipzig at an altitude of 312.8 m (1026.3 ft). In 1931 he earned a Doctor of *rerum naturalium* (Doctor of Natural Sciences) degree at the *Institut*. His doctoral thesis analyzed pulsating outbreaks of polar airmasses during a Northern Hemispheric winter season.



Professor Ludwig Weickmann and the *Collmberg Observatory* as it is today (Bergen and Ziemann).^{4a}

In Leipzig during this time, he met at university and became friends with Heinz Helmut Lettau who also received his doctorate in 1931 under Weickman's direction. It was while at the *Institut* that Schwerdtfeger first met his future wife, Marianne Margaritha Noack, and that Lettau met his future wife, Katherine.¹⁷

Researcher, Aeronaut, Teacher

In the 1920s and 1930s, civilian and military meteorological and weather forecasting activities were rapidly evolving as was technology for observing weather conditions. Upper air observing techniques were developed using pibals and vertical data-collection ascents by aircraft in weather flights from selected airfields. Radiosondes were designed and developed although they did not reach limited operational use until the very late Thirties. Weather forecasting techniques became more sophisticated as knowledge of atmospheric structure and climatological weather patterns grew in greater detail. International cooperation in exchanging weather observations and data became common, especially in Europe. It was an exciting and challenging time to be a meteorologist.

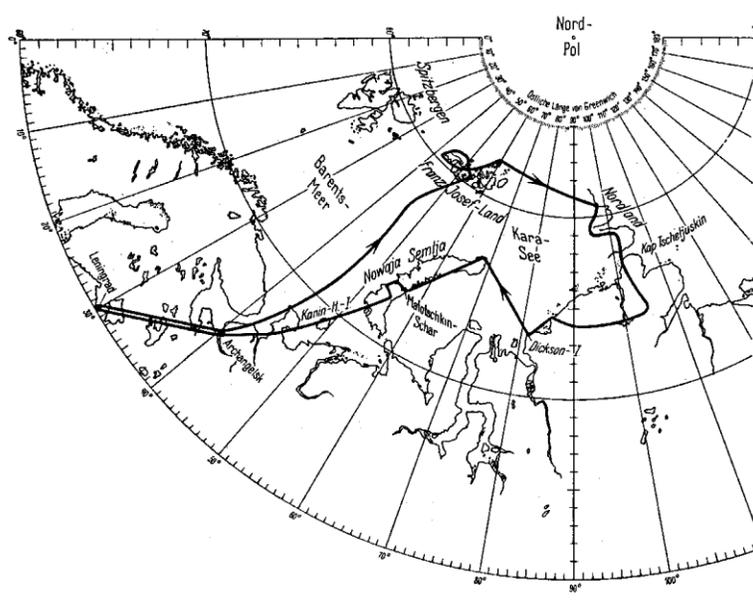
The rise of the Nazi Party continued apace in the 1930's and by 1932 it was the largest political party in Germany. On January 30, 1933 Hitler was appointed Chancellor by President Hindenburg. Shortly after, the *Reichstag* passed the Enabling Act of 1933 which began the process of legally transforming the Weimar Republic into Nazi Germany. When Hindenburg died in August 1934, Hitler became both President and Chancellor, thus becoming both head of state as well as head of government and essentially the *de facto* legal dictator of Germany.

The rise of Nazism led Werner's older brother Hans, an outspoken critic of the Nazis, to leave Germany clandestinely in 1934, settling his family first in Prague, then Zurich, and then Grenoble. He and his family finally managed to emigrate from war-torn Europe to Sydney, Australia; he was later appointed a lecturer in mathematics in Adelaide in 1940 where he taught for many years.^{2,17}

Meteorology in Germany had largely been a conglomeration of local state services and activities at universities. At the instigation of Professor Franz Linke from Frankfurt, one of the first German aeronautical meteorologists and a pioneer in observations from manned free balloons, the *Reichswetterdienst* ^P (*Reich Weather Service*) was created in 1934 and began a centralization of state meteorological services. At first, its activities were led by Weickmann as President of the *Reichsamt für Wetterdienst* ^P in 1935 and 1936, although he declined to hold the job permanently.¹²

Werner Schwerdtfeger began his professional career as a meteorologist with the German government's weather service at Berlin-Tempelhof aerodrome in 1931, followed by in-house service with the German equivalent of the US Civil Aeronautics Board (CAB). During this time Schwerdtfeger and Lettau, "supported by the venerable Suring," began collecting weather data in manned hydrogen balloon flights for researching atmospheric phenomena such as turbulence.¹⁷

They were perhaps influenced by the weather research ballooning adventures of their mentor, Professor Weickmann, Director of the *Institut für Geophysik und Meteorologie* during its two-decade heyday beginning in 1923. Likely Weickman's most famous such exploit was his participation as director of meteorological activities during the five-stage, over-one-month-long 1931 polar flight of the airship LZ-127, the famed *Graf Zeppelin*, sister ship to the LZ-129 *Hindenburg*.



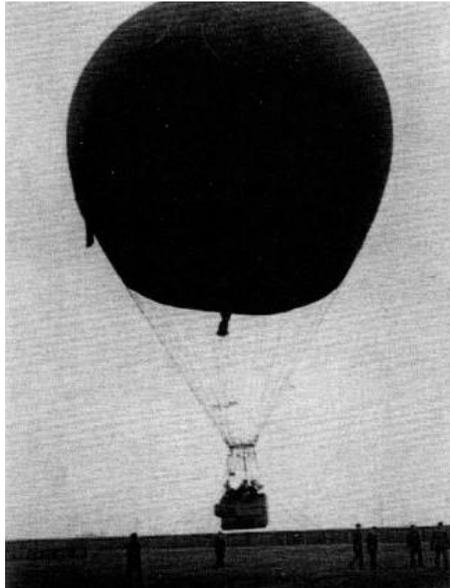
Route of the *Graf Zeppelin* on its 1931 polar flight (Bergen and Ziemann).^{4a}

Schwerdtfeger and Lettau's most interesting ballooning experiment was possibly their measurement of air motions below 4 kilometers using instrumented manned hydrogen balloons in free flight. The experiment was motivated by the work of Wilhelm Schmidt and Ludwig Prandtl on *Austausch* (Exchange) Theory ^a in the 20's and 30's.¹⁴

The first known experiments to determine *Austausch* coefficients (and associated turbulent structures) were conducted by Schwerdtfeger and Lettau in a series of flights in 1933 and 1934, with results published in a set of co-authored papers in the *Meteorologische Zeitschrift* ^k. At the 1933 Annual Meeting of the German Meteorological Society in Hamburg, Professor Schmidt dubbed the pair the "*Austausch* Twins" for their exploits. Their method for determining vertical

motion, w , does not appear to have been used by others although it appears that the accuracy of their method has also not been equaled by aircraft sensing or other techniques.¹⁴

Their open-gondola ballooning exploits were further enhanced by the participation of Werner's wife, Marianne, who served as a technical assistant in the gondola while Schwerdtfeger and Lettau were busy reading instruments that measured the fine scale structures of fluctuating vertical winds.¹⁴ Werner and Marianne Margaritha Noack were married in Leipzig in 1933.²⁵



Liftoff from Bitterfield Aerodrome on 25 Feb 1934 (H. Lettau).¹⁴



Crew and ground support team prior to the 25 Feb 1934 launch. The two men to the left are graduate students H. Koch holding the meteorograph and R. Faust of the ground support team. The four crewmembers are on the right: Marianne and Werner Schwerdtfeger; Robert Petschow, the pilot on the flights; and Heinz Lettau (H. Lettau).¹⁴

While continuing his meteorological research activities, Schwerdtfeger took over the aerological station at Königsberg in 1935. Königsberg was one of five such *wetterflugstellen* (meteorological

flight stations) in service at the time at airfields in Germany that collected daily weather data in vertical ascents by aircraft to at least 5000 meters (16,400 feet). Eight such stations formed a network later in the 1930's: Darmstadt, Hamburg, Königsberg, Munich, Berlin, Breslau, Köln, and Frankfurt. Schwerdtfeger accumulated over 1000 such aircraft ascents to the neighborhood of 500 mb (just over 18,000 ft above sea level), many of them in open-cockpit biplanes, while stationed at Königsberg. It was there that he met and flew with Rudolf Schütze, pilot for many of those flights and a lasting friend of the Schwerdtfegers in peace and at war.¹² And it was there that the Schwerdtfeger's first child, son Dietrich, was born on June 16, 1936.²⁵

Schwerdtfeger's goal was to become an academic, a professor teaching at a university. He lectured in meteorology at the universities at Königsberg and Vienna while continuing his research. To become a full professor and teach independently at the university level in Germany then, as now, required a second degree not based upon coursework; the candidate had to *habilitate* and be awarded the second degree, a Doctor *habilitatus*. The Doctor *habilitatus* could be awarded based either upon a second doctoral thesis or upon a significant body of research, the latter path followed by Schwerdtfeger. He completed *habilitation* in 1937 at Königsberg, prepared to assume a career as an academic, teacher, and researcher.

It was not to be. He was denied a teaching appointment because of politics. In his own words:

“Under these conditions, my personal situation became threatened. Through all the years since 1933 I had been under pressure to join the NS party, but nobody could convince me, which appeared to some people to be suspicious per se. My older brother, a mathematician, foresaw a new and terrible world war as early as 1934, though at that time nobody wanted to believe him. A few months later he left Germany for good, and finally found an academic position at the University of Adelaide, Australia. His departure from Germany without permit was known in 1937, when I was weather-flying at Königsberg and began teaching courses at the ‘Albertus Universität’. I had fulfilled all requirements for admission to an academic career but was informed rudely that I had not shown the right Weltanschauung † (political principles), and therefore had no chance for any teaching appointment. I sought safety in the military world (in which my father had died in 1914), and weather reconnaissance aviation had become not only my devotion, but also my refuge.”²⁰

Warrior Years

In 1938 Werner Schwerdtfeger became a member of the world's first dedicated weather reconnaissance squadron based at Berlin-Gatow Aerodrome: the *Luftwaffe's Grossraum Wettererkundungsstaffel* (Long-range Weather Reconnaissance Squadron), later in June 1939 designated *Wettererkundungsstaffel, Oberbefehlshaber der Luftwaffe* (Weather Reconnaissance Squadron, Commander-in-Chief *Luftwaffe*)ⁿ and abbreviated as *Wekusta*^s (or *Westa*), *Ob.d.L.* Both Rudolf Schütze and Schwerdtfeger continued their close association in the new unit, which developed weather reconnaissance equipment and operational procedures, evaluated aircraft for weather reconnaissance service, trained aircrews including flight meteorologists, and flew operational missions. Meteorologists in the *Luftwaffe* were *Beamte*^b, or civil servants, in military uniform and subject to military discipline and control.¹² Schwerdtfeger's initial rank was *Regierungsrat*, the equivalent of a *Luftwaffe* or USAAF Major.

Starting rank among *Luftwaffe* uniformed civil servants in technical fields such as civil engineering, air traffic control, medical, firefighting, etc., and in meteorology and other sciences typically was based upon education level or on demonstrated expertise. Individuals with a doctorate typically started with equivalent rank to a Major; a bachelor's degree earned a starting rank equal to a Lieutenant, equivalent to a USAAF Second Lieutenant. Pilot cadres were largely filled with enlisted ranks, with officers in lead, command, and staff positions. Rudolf Schütze, despite his extensive prewar *wetterflugstellen* experience, began his service in *Wekusta, Ob.d.L.* as a civil servant in uniform; when the unit was "militarized" in August 1939 his rank was *Unteroffizier*, equivalent to a Corporal in the US Army. Promotion was usually based on merit and accomplishment; by 1942 he was a *Leutnant* and by March 1943 an *Oberleutnant* (First Lieutenant), highly decorated and with extensive combat service. He flew more than 1000 weather reconnaissance missions.

Prior to World War 2, the German military was very aware that when hostilities commenced Germany would be cut off from "upstream" weather data by its adversaries. Several measures were implemented to mitigate that impact prior to and during the war, including extensive use of weather reconnaissance aircraft, automatic weather stations and weather buoys, weather ships, and observations from submarines and other warships. An extensive "weather war" was fought in the Arctic and North Atlantic regions during the war, by the Germans to obtain weather data and by the Allies to keep weather data from them. Weather reconnaissance squadrons were essential sources of weather data for both the Allies and Germany throughout the war in Europe.

Meteorologists in the *Luftwaffe* were nicknamed "*wetterfrosche*" ("weather frogs") by their comrades. Frogs and weather have had a close association in German lore and several emblems of *wekusta* units featured winged frogs as part of them. *Wekusta* "*wetterfrosche*," *Met. Beobachtern* (meteorological observers), were trained as weather observers, aircraft navigators, and aerial gunners. Twin-engine bomber cockpits were crowded, with the *Met. B.* sitting in what was normally the navigator's seat next to the pilot and navigating as well as observing weather. Crews normally consisted of one pilot (*Flugzeugfuhrer*), one meteorologist (*Met. B.*), one or more flight engineers (*Bordmechaniker*), and one or more radio operators (*Bordfuncker*). For self-defense, the meteorologist also manned the nose-mounted machine gun while the flight engineer(s) and radio operator(s) operated machine guns in other positions.¹²

Schwerdtfeger was no stranger to hazardous flight operations, beginning with flights in balloons filled with explosive hydrogen lifting gas in addition to the ever-present hazards from weather and mechanical failures. In over 1000 near-daily aircraft flights to collect data in vertical ascents at Königsberg, he had routinely dealt with hazardous weather and the always possible mechanical failures associated with biplane and early monoplane aircraft operations. *Wetterflugstelle* pilots, such as Rudolph Schütze, and flight meteorologists quickly became highly experienced in dangerous aircraft operations.

Wartime operations added the dangers from combat, with many *wekusta* aircraft and crews lost to enemy aircraft and antiaircraft fire. Single-engine performance of most of the modified twin-engine bombers was marginal at best; engine failures on long overwater flights frequently resulted in ditching the aircraft with little or no chance of survival in the frigid North Atlantic and Arctic regions. Rescue after ditching or crashing was unlikely, especially in areas routinely patrolled by Allied aircraft and ships.

Some 302 meteorologists, many with doctorates, were assigned to *wekusta*; at least 158 of them, over half, are known killed or missing in action during the war. Fourteen flight meteorologists from

Schwerdtfeger's squadron (*staffel*) were killed during the war, including seven with doctorates. Valor was a strong suit; *wekusta* had 75 crewmembers (out of several thousand in some 11 *staffeln*) earn the German Cross in Gold (*Deutsches Kreuz in Gold* or *DKG*) for combat service. The *DKG* was only awarded to personnel who had previously earned the Iron Cross First Class for combat service. Twenty-one *wekusta* *DKG* holders were meteorologists, including Werner Schwerdtfeger.¹²

After serving in weather reconnaissance since 1938, toward the end of the war Schwerdtfeger suddenly found himself transferred and in charge of the *Luftwaffe's* principal forecast center.^{12,20} Fortunately, we have his own summary of his service as the Chief (*Chef*) of the *Zentral Wetterdienst Gruppe* (*ZWG*) to draw upon for this biography. Those with experience as forecasters will readily recognize the difficulties he describes with demanding "customers" and with unrealistic customer expectations. Schwerdtfeger ended the war in charge of *ZWG*, having survived several demanding forecast challenges and the collapse of Nazi Germany.

Weather Reconnaissance Meteorologist

Schwerdtfeger entered *Luftwaffe* service as a uniformed civil servant in early 1938 as a *Meteorologische Beobachter Leiter* (Senior Meteorological Observer) in the *Grossraum Wekusta* at Berlin. He would serve in the unit in its various designations until his sudden transfer to the *ZWG* in August 1943. The unit was formally activated on March 15, 1938 at Berlin-Gatow airport and was equipped with Heinkel He 111 and Junkers Ju 86 P converted twin-engine bombers for operational missions; some twenty additional aircraft types were assigned for research and training. The mission of the *wekusta* was to gain experience and develop procedures for weather missions over broad areas; to test suitable aircraft and equipment; to train specialized personnel, particularly meteorologists as both observers and navigators; and to conduct operational weather reconnaissance missions. Those roles would remain with the *wekusta* throughout the war.¹²

Dr. Walther Kopp, a highly-experienced pilot and scientist, was the initial civil service commander of the unit. Kopp was the former leader of the *wetterflugstelle* at Berlin-Tempelhof and had been a key member of Alfred Wegener's Greenland Expedition and of the 1936-1937 *Lufthansa* Afghanistan Expedition. *Oberregierungsrat* Kopp led the unit into the start of the European war in September 1939. In September, the unit was further militarized and a regular *Luftwaffe* officer, *Oberleutnant* Kurt Jonas, became the commander, replacing Kopp. Kopp continued to serve as the senior meteorological observer in the unit until he was replaced on November 11th by Schwerdtfeger. Kopp later transferred to *Wekusta 26* at Munster-Loddenheide. Schwerdtfeger was likely promoted to *Oberregierungsrat* (Lieutenant Colonel) at that time (although there is some uncertainty as to exactly when in the records available to us).¹²

Just as the dedicated weather reconnaissance squadrons of the Germans were innovative, so were the procedures used and developed by the *wekusta*. Development of weather reconnaissance procedures had begun before the war and were further refined during the *wekusta* years by Dr. Schwerdtfeger and others in the *Grossraum Wekusta*, etc. A principal technique was the "saw-toothed" flight profile, or *sagezahn-flugprofil*, first devised in the mid-Thirties by Dr. Rudolf Reidat and Walter Schulze-Ekardt on meteorological flights between Berlin, Königsberg, and Munich in a Junkers Ju W 34 transport aircraft. In the "saw-toothed" profile, the altitude was changed several times during the flight to obtain vertical soundings along the track.¹²

At selected points, the aircraft would descend to near sea level to determine surface pressure. *At least one wekusta aircraft descended so close to the sea surface that the propeller blades were damaged by contact with the waves!* After collecting surface data, the aircraft would then climb to collect sounding data before descending again to the mission flight level, which usually varied from one leg of the track to another.

Collected weather observations were transmitted following the flight, as in early *wekusta* missions, or were enciphered by the radio operator and transmitted by the aircraft in flight as was the more common practice for most of the war. Weather data were summarized in a special format, or “code,” similar in part to that developed by the *wetterflugstellen* in the mid-Thirties. John Fuller was the highly-regarded long-time historian for the US Air Force’s Air Weather Service and author of Thor’s Legions, a history of weather support to the US Air Force and Army from 1937 to 1987. He credits Schwerdtfeger with developing the *Zenit* (“Zenith”) weather code used by the *wekusta*.⁷

Fuller, who described Dr. Schwerdtfeger as “Germany’s foremost weather reconnaissance expert,” wrote that the observations were encoded in the *Zenit* code and then enciphered using ciphers changed daily before being transmitted to a ground site where they were edited. The observations were then retransmitted to the *Luftwaffe*’s main weather central, the *Zentral Wetterdienst Gruppe (ZWG)*, at Wildpark near Berlin. All weather reconnaissance reports plus all data from about 325 *Luftwaffe* weather reporting stations were channeled to the *ZWG*.⁷ The *Zenit* code, in three successive versions, was used by the *wekusta* throughout the war.¹²

After the flight, the *Met. B.* would compile a report in “clear text” entries in which the essential details of the cloud and weather observed were summarized. These reports included vertical cross-section sketches and temperature-height graphs. After any transmission errors from the flight were corrected, the reports were sent to *ZWG* and other centers for analysis and forecasting use.¹²

Schwerdtfeger used much of the collected weather reconnaissance data in scientific work during and after the war. In 1942, he presented a report about the characteristic formations of frontal clouds based on observations made over a two-year period by *wekusta* in northern and western European sea areas. The results were presented in schematic cross-sections of warm fronts, cold fronts, and occlusions. Six years later he expanded his ideas in a comprehensive analysis of the structure of fronts and cold pools in an official report to the reconstituted German weather service.¹²

For many weather reconnaissance missions, especially tropical cyclone missions, customers want surface wind data. Before the development of the microwave stepped-frequency radiometers used today and capable of measuring surface winds throughout the weather reconnaissance mission, US Air Force weather reconnaissance crews estimated surface winds visually using techniques originally developed by the US Navy. Sea surface visual characteristics such as foam patches from breaking waves and the foaming crests of wind-driven waves could be used to estimate wind direction and speed with good accuracy, especially when at or below 1500 feet of the sea surface. *Luftwaffe wekusta* used a more esoteric observing method.

Years after the war, Schwerdtfeger would write about the *wekusta* method for surface wind estimation. The method, supposedly well-known to veteran seaplane pilots with a vested interest in knowing the surface winds before landing, was tested for *wekusta* use and adopted at Schwerdtfeger’s suggestion in 1939. *Wekusta* meteorologists were not only weather observers

and mission navigators but also aerial gunners, operating the nose-mounted machine gun for defensive purposes.

As Schwerdtfeger described the method, near the sea surface (not above more than 100 meters), the meteorologist would fire the machine gun downward at a slight angle of about 15 degrees. The impact of the bullets would create concentric patterns and slowly expanding circles on the surface. From each point of impact would rise a small cloud of spray carried away by the surface wind. By adjusting the downward angle of fire and airspeed, the aircraft would pass over the expanding reference circles; the meteorologist could easily determine the horizontal angle between the aircraft course and the direction of the sinking spray from bullet impacts. The surface wind could then be estimated for light winds.¹⁹

While not as accurate as the use of smoke bombs, etc., the method was simple and repeatable as long as ammunition remained. Schwerdtfeger noted that he used the method on flights across high pressure ridges over northern seas where he could study the location of the divergence line and winds surrounding it from observations taken every half-minute, roughly every two miles. He also noted that the method offered one of the "... few opportunities to apply a deadly weapon to a useful and peaceful purpose."¹⁹

With the formation of other *wekusta* for operational wartime service, the *Grossraum Wekusta* was redesignated as *Wekusta, Ob.d.L.* on June 1, 1939. The mission remained the same. Shortly after, Werner and his wife Marianne welcomed a new member of their family, daughter Antje, on July 30th.²⁵ World War II in Europe began on September 1, 1939 with the invasion of Poland and declarations of war against Germany by both the United Kingdom and France.

Wekusta, Ob.d.L. entered the war with at least 23 different types of aircraft, most used for training or research or for evaluation for operational mission suitability. Personnel consisted of 12 pilots, 10 meteorologists, six radio operators, and six flight engineers. The unit's first operational sorties were flown using twin-engine bombers, nine He 111 J-1s and a single Ju 86 P. Meteorological data were collected using a "meteorograph" which recorded pressure, temperature, and relative humidity. Initially externally-mounted under the wing, the data could only be read after the flight ended. The meteorographs were soon relocated under the cockpit nose where they could be accessed inflight by the meteorologist for weather observations.¹²

Wekusta, Ob.d.L., formerly the *Grossraum Wekusta*, and later *Wekusta 1, Ob.d.L.*, was the nucleus for all meteorological reconnaissance developments, providing new *staffeln* with experienced and trained personnel as well as specially-equipped aircraft. The new *staffeln* were assigned to regional air commands (*Luftkriegskommando*) of the respective "air fleets" (*Luftflotten*). On the eve of war, on September 1, 1939, there were five operational *wekusta* trained and ready for combat weather reconnaissance.^{12, u}

The period from September 1939 to May 1940 became known to many in the West as the "phony war" or "*sitzkrieg*" since combat operations were rare on both sides. That changed with the invasion of France and the Low Countries on May 10, 1940. More *wekusta* were formed and the need for a second *Ob.d.L. staffel* led to the formation of *Wekusta 2, Ob.d.L.* and the redesignation of *Wekusta, Ob.d.L.* as *Wekusta 1, Ob.d.L.* in July 1940. The mission remained the same. On July 3, 1940, the unit moved to Oldenburg in northwest Germany. The grass field proved too soft for sustained operations, and in January 1941 the unit transferred to Bad Zwischenahn west of

Oldenburg. A meteorological observer training school was established at that time as part of the unit.¹²



Ehrenpokal awarded to *Oberregierungsrat* Werner Schwerdtfeger in January 1942. The obverse depicts two eagles in mortal combat; the reverse bears an Iron Cross in high relief. Oak leaves and acorns adorn the stem (Wulf Schwerdtfeger).

On December 26, 1941, the Schwerdtfeger's third child, Wulf, was born in Berlin.²⁵ Then, at age 33 and with more than two years of wartime service, on January 19, 1942 Doctor Schwerdtfeger was awarded the Honor Goblet of the *Luftwaffe* (*Ehrenpokal der Luftwaffe*) for special achievement in combat in the air war. The *Ehrenpokal* award, established in February 1940, was made to honor aircrew that had already been awarded the Iron Cross ^f First Class; it was unique to the *Luftwaffe*. Not long after, on May 27, 1942, Schwerdtfeger was awarded the *Deutsches Kreuz in Gold* for sustained combat service, one of only 75 *wekusta* crewmembers so honored throughout the entire war.⁶ On August 20, 1942, *Wekusta 1, Ob.d.L.* completed its 1000th weather reconnaissance mission.¹²



The base of Schwerdtfeger's *Ehrenpokal*, inscribed with his name and "12 1 42," 12 January 1942; records of the award indicate 19 January 1942, the date the award was announced publicly (Wulf Schwerdtfeger).

Schwerdtfeger continued to serve as the Chief Meteorological Observer of *Wekusta 1, Ob.d.L.* throughout 1942. He was joined in that capacity by Dr. Otto Krug, former Chief Meteorological Observer of *Wekusta 26*, in September 1942. Dr. Krug substituted for Schwerdtfeger when he lectured in meteorology at the University of Vienna during late 1942 and early 1943. Schwerdtfeger continued to lead the development of operational and weather observing procedures, development of meteorological equipment, evaluation of new aircraft for weather reconnaissance, and the training of weather reconnaissance aircrews throughout his assignment to the lead weather reconnaissance *staffel*. In 1943, the *staffel* organized instruction classes numbers 14 to 17 for meteorological observers that were university-educated.¹²

During June and July of 1942, Schwerdtfeger inspected all the *wekusta* for *Ob.d.L.* to exchange information about experiences, investigate operational standards, and evaluate personnel. He then repeated the inspection assignment in June 1943; for the inspections, he was temporarily assigned to the *Luftwaffe Wetterdienst* staff as deputy chief. Following his inspection tour, Schwerdtfeger was sent to Greece. On August 3, 1943, he flew his 250th combat weather reconnaissance mission from Athens-Tatoi as a meteorological observer in a Junkers Ju 88 piloted by *Hauptman* Hans Bonath, the *staffelkapitan* (squadron commander) of *Wekusta 27*. It was his last weather reconnaissance mission as he found himself suddenly transferred a few days later to *Kurfurst*, at Wildpark-Werder near Potsdam, Germany as the new *Chef* of the *ZWG*.¹²

He was replaced by Dr. Otto Krug as Chief Meteorological Observer in *Wekusta 1, Ob.d.L.* Dr. Krug's service in that position proved short as he was killed in action in a Ju 88 on August 23, 1943. On August 26, 1943, Schwerdtfeger's close friend, one of only three *wekusta* crewmembers to hold the *Ritterkreuz*^f (Knight's Cross) during the war, *Oberleutnant* Rudolf Schütze of *Wekusta 5* was killed in the crash of an Arado 232 twin-engine transport following engine failure shortly after takeoff in bad weather from Banak, Norway.¹²

Zentral Wetterdienst Gruppe

During 1934, the *Reichsamt für Wetterdienst (RfW)*^p was created in Berlin as a department of the *Reichsluftfahrtministerium (RLM)*, the German Air Ministry. For the *RLM*, the *RfW* acted as the central controlling authority for all meteorological activities in Germany except those at universities and research institutes. The *RLM* directed the establishment of the *Grossraum Wekusta* in March 1938, led by Dr Walther Kopp.¹²

Coinciding with the establishment of the *Grossraum Wekusta*, the *RLM* directed the establishment at a higher administrative level of the *Zentrale Wetterdienst Gruppe (ZWG)* (Central Weather-service Group) of the *Luftwaffe*, headed by Doctor Kurt Diesing and subordinate for administrative purposes to the *Chef Wetterdienst* (Director of Weather Services) at *Kurfurst*, codename for the *Oberkommando der Luftwaffe (OKL)*ⁿ, or Headquarters of the *Luftwaffe*, at Potsdam-Eiche. Two *ZWG* meteorologists, Schuster and Bauer, were permanently detached to *Wolfsschanze*^u (Wolf's Lair), Hitler's personal headquarters.¹²

At the general officer level, *Chef Wetterdienst* played no direct role in weather analysis and forecasting activity; that was the province of the *ZWG*. The *ZWG* advised the *OKL* on all meteorological matters concerning operations and strategic planning. *ZWG* analyses and forecasts were based upon data from weather stations, weather reconnaissance missions, ships, dedicated weather ships (at the start of the war), and U-boats. Climatological analysis heavily influenced medium- and long-range forecasts. Doctor Diesing was a devoted and expert career

meteorologist with over 30 years' experience in synoptic analysis and forecasting. Beginning in 1938, Diesing quickly built the *ZWG* into an efficient and smoothly working organization.

Weather forecasting in Germany as elsewhere was still developing as the war began, possibly no longer in its infancy but certainly not much beyond adolescence. Forecasting practices beyond 24-36 hours were heavily dependent upon climatology, especially the long-range forecasts demanded then as now by military commanders and planners. The *ZWG* experienced great success with forecasts for the invasion of France and the Low Countries; Diesing's *ZWG* forecast for good weather was largely based upon a typical high pressure over Western Europe in mid-May. For those forecasts and subsequent favorable weather, Diesing was promoted to *Ministerialrat* (Colonel) and received an engraved gold pocket watch from Hitler. The continued good weather throughout the summer of 1940 and the Battle of Britain further highlighted success by the *ZWG*. However, the *Luftwaffe* campaign failure during the Battle of Britain made *Chef ZWG* a convenient target for dissatisfaction when the weather was bad and prevented bomber and fighter operations over Britain.

The *Luftwaffe's* failure in the Battle of Britain coupled with the onset of autumnal weather over Britain, the Channel, and the North Sea turned German interests toward the East and Russia. Hitler had long planned to invade Russia and military planning for the invasion had begun well before the invasion of Western Europe. The timetable was shortened and the invasion set for the onset of suitable weather in Eastern Europe. Fortunately for the Russians, Mussolini's abortive invasion of Greece coupled with the later Yugoslav uprising compelled Hitler to rescue his Italian ally by in turn invading and occupying Greece, Crete, Yugoslavia, and several Aegean Islands. Despite German success, the delay and serious losses in personnel and materiel, especially the heavy losses of *Luftwaffe* paratroops and transport aircraft in Crete, critically delayed the 1941 Russia invasion and arguably cost Germany the war.

Success can breed unreasonable expectations among "customers." Diesing and *ZWG* were heavily involved in planning for the invasion and its aftermath. The delayed start to the invasion coupled with logistical failures stalled the invading forces barely outside Moscow as a severe winter began. During the following summer of 1942, *Wolfsschanze* requested temperature conditions for the coming winter of 1942-3. A comprehensive study by climatologists using up to 150 years of data showed that statistically three very cold winters in four had never occurred; a very cold winter was not to be expected following three years with two very cold ones. Diesing signed the short version, condensed from the study, and became a lightning rod for dissatisfaction when Nature paid no attention to statistics and the subsequent winter again proved very cold instead.²⁰

The daily stress of briefing the high command at *Kurfurst* and supporting *Wolfsschanze* over nearly four years of war took a severe toll on Kurt Diesing and during early 1943 his health rapidly failed. He died in July. His deputy, who had to assume daily briefings of the high command generals, did not perform satisfactorily. A new *Chef ZWG* had to be found who could quickly regain the trust of the generals as well as maintaining the confidence of his colleagues.²⁰

Chef, Zentral Wetterdienst Gruppe ^{20,21,22}

Into that unwelcomed assignment walked Doctor Werner Schwerdtfeger, at age 34 already an accomplished meteorologist and researcher as well as a highly-decorated combat weather reconnaissance veteran. He later wrote that his first task was to get acquainted with the twelve

meteorologists for whose professional output he was suddenly responsible. He noted that three of them had already achieved strong reputations in scientific meteorology: Richard Scherhag, Horst Phillips, and Herman Flohn. Scherhag had developed a semi-empirical method for forecasting tomorrow's surface chart using today's surface analysis and transplanting the 24-hourly isallobar field to today's 500 mb flow fields, a method apparently later adopted by American and British weather centers. Phillips, a theoretician, developed a new aeronautical almanac particularly useful for navigating on long polar flights. Flohn, successor to *Regierungsrat* (Major) Heinz Lettau who left *ZWG* in early 1943 for another assignment, was one of the top climatologists of his generation.²¹

Schwerdtfeger's other key task in his first month at *ZWG* was to learn the correct form, level of detail, and amount of information to present at the intense briefing sessions chaired by the commander at *Kurfurst* and attended by other generals and selected staff. He noted that "An important point...was that I should rigorously confine myself to talk about weather features and forecasts of changes. Never should I say anything about the possibilities of flying. That was the prerogative of the 'real' air force officers."²¹

As sometimes happens, given his extensive operational experience, he inadvertently stepped across that boundary. On a day in September, the weather in Jutland was poor and expected to remain so into the next day. The commanding general inquired if a group of Ju 88s could land under such weather at Aalborg, a large airfield on flat land with no major obstacles around. The question was certainly addressed to the "1A," the executive officer. Since Schwerdtfeger had landed at least ten times at Aalborg under far worse conditions, he responded without thinking, "Yes sir, no fog to be expected." He drew an immediate and nasty reprimand. The next day brought a measure of vindication. While the Ju 88s were enroute to Aalborg, a new question arose: can they land tomorrow at Banak? Banak, Norway was home to part of *Wekusta 5* and several bomber units, and was one of the few forward bases for launching attacks on Allied convoys carrying supplies to Murmansk. An awkward silence ensued with all eyes on the "1A." He was obviously unprepared for a pro or con decision and finally said "never been there."²¹

Unlike Aalborg, Banak lay at the southeastern end of a fjord surrounded by mountains with steep escarpments. Offering few amenities, also unlike Aalborg, it was seldom visited and none of the staff officers present knew the place. The weather forecast for Banak was worse but similar to that for Aalborg a day earlier although with strong winds from the northwest. The awkward silence continued, finally broken by an angry general, "Anybody familiar up there?" No one responded. Uncertain as to what might result, Schwerdtfeger looked at the general and nodded very slightly. To his surprise, the general suddenly and humorously said, "You win, doctor, go on – tell us." There was relief all around as Schwerdtfeger, who had been at Banak three months earlier, explained the terrain so it was obvious that the flight of Ju 88s should be postponed. His forecast for improved weather at Banak for the flight the next day also came true. From then on, he was accepted as a real member of the *Kurfurst* briefing team.²¹

Nevertheless, friction continued at times with disagreement most often involving forecast reliability past a couple of days. The pressure of an increasingly gloomy outlook for Germany in the war contributed to the tensions as well. The differences between two- or even three-day forecasts based upon synoptic surface and upper air charts, given at any time and updated as necessary, and the twice-weekly five day "outlooks" prepared by Flohn and Phillips from current data coupled with climatology were frequent sources of displeasure from *Kurfurst* and *Wolfsschanze*. Constant efforts were necessary to distinguish between outlooks and forecasts and to stress that no one

could forecast details reliably for more than two or three days. It didn't help that the weather service of the *Kriegsmarine* (Navy) routinely issued ten-day forecasts, especially for the coasts of Norway and the English Channel, regardless of their accuracy.²¹

Normandy and the D-Day Forecast

Paraphrasing Samuel Butler, Schwerdtfeger has noted: ***“God cannot alter the past, but historians can.”***²⁰ Much has been claimed and written about the Allied forecasts for the D-Day landings in Normandy. Many authors have claimed Allied forecasting successes versus failures of German forecasting for that event, particularly in accounts written immediately following the war by the Allied principals involved. These accounts, often incomplete and frequently self-serving or even blatantly in error, have persisted in some more recent histories. Over the years, more comprehensive work, while acknowledging the overall success of the Allied forecast for June 6th, tends to credit the successful landings more to the overwhelming Allied forces employed *despite* adverse cloud, wind, and sea conditions worse than forecast and that seriously impacted efforts to land troops and equipment under enemy fire.

Allied assault landing craft were capsized or swamped in large numbers attempting to land in the face of enemy fire. Many of the unwieldy small craft were lost when tossed upon beach obstacles, many of them with explosive mines attached, or into other vessels. Almost all of the US “swimming” duplex-drive M4 Sherman tanks, never tested in such sea conditions, sank taking their crews with them. Most of the light artillery carried by amphibious DUKWs toward Omaha Beach was similarly lost at sea.¹⁶

Heavy bombers were unable to bomb visually, releasing their bombs well inland instead of on the beach defenses. The lack of bomb craters on Omaha Beach, expected by the landing troops, deprived the landing force of shelter from the intense German fire from the overlooking cliffs. Paratroops of the 82nd and 101st Airborne Divisions were scattered away from their landing zones when their transport aircraft broke formation in unexpected dense cloud cover over Normandy inland from Omaha and Utah Beaches.

Accounts by individual soldiers stress the rough seas and seasickness as well as the difficulties of getting ashore in wave action edging the broadly-exposed and difficult to cross sea bed at low tide.¹⁶ Some units had to use their helmets as bailers to keep their landing craft from swamping, bailing while seasick. Troops landed already exhausted from seasickness. Accounts by naval officers emphasize the difficulties of the small craft, “swimming” tanks, and amphibious vehicles in getting ashore. John Fuller in *Thor's Legions* pointed out the politics involved with the D-Day forecast and in achieving a consensus of sorts between individuals at the three independent Allied forecast centers in England, one American (USAAF) and two British (RAF and RN).⁷

William Logan, author of *Air: The Restless Shaper of the World*, noted that the Allied forecast succeeded “... not because of the brilliant work of any forecaster, but because a group of forecasters imitated the weather. They jostled, yelled, scribbled, and cast malevolent looks at one another. They fought it out and voted. And in the end, they were just right enough.”¹⁵ “*Just right enough*” ...that might seem a bit harsh. Yet the same teams and individuals were involved in the *disastrous* forecasts two weeks later that led to the loss due to weather of the Mulberry Harbors necessary for logistical support to the invasion.⁴ The consensus forecasting effort that largely worked for D-Day did not work well at all two weeks later. It was a forecast system primed for error as at least one staff meteorologist had quietly pointed out.⁷

Many Allied naval officers, including Eisenhower's naval aide, Captain Butcher, were dismayed by the differences between forecast and actual wind and sea conditions on June 6th and that largely remained on June 7th.⁷ Those conditions accounted for significant losses before assault troops and equipment could be landed. Nevertheless, the invasion succeeded, in large part because it had begun at low tide, timed to expose most of the beach obstacles and take advantage of darkness to hide the ships and assault boats for the initial approach, and also because Hitler and most of his key generals thought it was a feint and expected the "real" landings to take place further east at the *Pas de Calais*.^{4,7,16}

German planners had expected any invasion to begin at high tide to get landing forces past the obstacles and then only after several days of suitable weather. The assault landings had originally been planned for May, and were expected by the Germans then due to the typically good weather over the Channel and France in May (recall the Diesing forecast for the invasion of France and the Low Countries). Delayed a month by Eisenhower and Montgomery to add more troops and accumulate more landing craft, etc., Allied timing surprised German leaders and large-scale deceptions led them to look further east away from Normandy and toward Calais.⁷

Accounts by Schwerdtfeger, Lettau, and in some cases, Fuller, contradict the idea of poor German forecasting for D-Day.^{7,13,21} Schwerdtfeger stressed that the ZWG forecasts passed to *Kurfurst*, *Wolfsschanze*, and *Luftflotte 2* (in Paris) and by them to the Army during the critical period happened to be good, specifying winds of Beaufort Force 5, varying from 4 to 6, equivalent to 15-23 knots. Actual winds closely matched the ZWG forecast as the day progressed; the Allied forecast remained for Force 3 or less as opposed to an actual increase to Beaufort 4/5 by afternoon.^{7,21}

Note that Beaufort Force 3 tends to produce large "wavelets" with scattered whitecaps; Force 4 waves 1-4 feet with numerous whitecaps; and Force 5 moderate waves 4-8 feet with many whitecaps. Four-to-eight-foot seas severely batter small craft; as one result, the numerous German e-boats, desperately needed for attacking the landing forces, were unable to sortie due to the rough seas in the Channel and to tidal conditions.

The ZWG forecasts, as usual, were for weather only with no judgments regarding the probability of an invasion (then as now, that was the exclusive province of the commanders involved and not the meteorologists). Fuller reported that many of the more unreliable D-Day German forecasts came from *Kriegsmarine* and other sources, and Schwerdtfeger admitted that he did not know if different forecasts from other sources had been passed on to Army commanders, influencing their thinking.²¹

Given the pre-invasion German planning and expectations, there's little wonder that their commanders were caught by surprise not by bad weather forecasting but rather due to failure early on to recognize the seriousness of the invasion reports and act accordingly. A weather forecast is only one element in a command decision. To suggest that D-Day occurred or succeeded because of a weather forecast is naive. *No commander then or now risks success or failure solely on a weather forecast.*

Misinformation about German meteorological intelligence and forecasting continues to enter the literature, regrettably from British and American sources, and continues to be quoted by military historians. In 1979, however, the Polish historian Janusz Pielkiewicz discovered captured documents in US military archives that contradicted the notion that German weather forecasts in

June 1944 were inaccurate.¹² That report from Kington and Selinger has not been confirmed by us as of this writing.

A measure of the success of ZWG's forecasting at the time comes from Schwerdtfeger's own words:

“Regarding my own position, I can add that after the landing of the Allies my daily contact with members of the general staff at Kurfurst indicated more appreciation for the work of meteorologists than I had felt in my first nine months at ZWG. And there was another personal experience: General der Flieger (three-star general in the Air Force) v. Seidel [ed.: *Hans-Georg von Seidel (1891–1955)*] had frequently been present at the daily briefings. Older than most of the staff members, he was a man who inspired trust at the first glance. He had spoken little, but when he did, his judgment was respected by everybody. A few weeks after D-Day he had to leave Kurfurst. To my complete surprise, he gave me a photo of himself; on the back, handwritten, a very friendly dedication to me, his name, dated 30 June 1944. I was deeply moved by this unexpected gesture and, frankly, I still am. I value it at least as highly as any of my military decorations and medals, all still in my possession. It is just inconceivable that v. Seidel would have given me such recognition if a few weeks earlier I had substantially contributed to Germany's disaster at the beaches of Normandy by a wrong forecast of weather conditions.”²¹



Königsplatz Dr. Schwerdtfeger
für freundliche Erinnerung.
H. Seidel
General der Flieger und General-
inspektor der Luftwaffe.
Königsplatz
30. 6. 44.

Picture of *General der Flieger* von Seidel presented to Doctor Schwerdtfeger on June 20, 1944 at *Kurfurst* (Wulf Schwerdtfeger).

Another measure of the success of ZWG's forecasting over the Normandy invasion is more indirect but perhaps more suggestive. Five months later, Schwerdtfeger was charged under great secrecy with preparing a highly important forecast for an operation *critically dependent upon weather* for any chance of success. He suggested that he would not have been selected for that task if ZWG forecasts for the first week of June 1944 "had been deficient."²¹

Ardennes Counteroffensive Forecast

Heinz Lettau introduced Part 3 of Schwerdtfeger's ZWG account with the following:

"THE Allied invasion of Normandy, codenamed Overlord, had succeeded despite marginal weather conditions during the critical period. The forecast supplied by the German ZWG (Zentral Wetterdienst Gruppe) at the time of the landings had been accurate, and the prestige of its meteorologists had risen. As the allied armies closed in upon Germany the Wehrmacht made its last desperate attempt to ward off the inevitable. This action, to become known as the Battle of the Bulge, took place in the Ardennes and its timing was dependent upon the forecast issued by the Chef ZWG, Werner Schwerdtfeger."²²

Schwerdtfeger noted that the initial assignment was a "true mission impossible":

"Two days before occurrence in the coming month of December, you have to forecast the date of a period of five days or more in which fog and/or low clouds will cover continuously a wide area west of the River Rhine north of the 50°N parallel approximately, including the region of the Ardennes."²²

Even with today's technologies and forecasting techniques, that forecast would be a challenge to produce for such a large-scale, shrouded-in-secrecy military operation. Seventy-five years ago, it was indeed a virtually impossible forecast challenge with the data, techniques, and technologies available to the ZWG. Indirectly, it soon became obvious that such weather was needed for a last counterattack by the *Wehrmacht* against Allied forces advancing through France and Belgium. Since Allied air forces dominated the skies, success for such an operation depended upon keeping Allied air forces grounded long enough for a rapid and dominating advance by German *panzers* and infantry.

Schwerdtfeger noted that the "two-plus-five-day" forecast was "uncommon and really a severe challenge." He had previously been successful at times convincing the commanding general that such long-range forecasts were not worth the paper on which they were written. Some on the *Wolfsschanze* staff, perhaps even Hitler, may have recalled Dr. Diesing's success using "singularities," synoptic conditions (cyclonic or anticyclonic) tending to occur on or near a specific date with significant probability. That had worked well for the invasion of France and the Low Countries in mid-May 1940; December in the Ardennes was a different matter altogether. Schwerdtfeger tried a couple of times without success to get the general, who apparently had orders directly from *Wolfsschanze*, to change to a more reasonable order.²²

Schwerdtfeger later could not remember how many prior Decembers he and Flohn reviewed, but recalled the result: five-day periods none; four-day periods one doubtful; three-day periods a few. He found the statistics convincing; the general did not. He then decided, for the only time during his 20 months at ZWG, to ask Dr. Burkendorff, the *Chef Wetterdienst* or chief administrator of *Luftwaffe* weather services, for help. Burkendorff had connections at *Wolfsschanze* and two days later ZWG received "absolute minimum" requirements of a "forecast at least one day ahead, for

three days or more of no-flight weather conditions.”²² It was the best ZWG was to get, and still a serious, and at that time in Nazi Germany, *personally hazardous* challenge.

Over the remaining weeks, ZWG worked hard to find guidance on the development and persistence of the desired fog and low cloud over the Ardennes, Eifel, and surrounding terrain. Lack of upper air data was the most serious challenge even with aircraft weather reconnaissance; except for data from Köln, about 100 km northeast, and places further to the east, no data were available. Success of any forecast beyond 24 hours would depend more on pure luck than anything else; it was still “mission impossible” for a 72-hour forecast.

Beginning the first day in December, Schwerdtfeger was required to contact both *Kurfurst* and *Wolfsschanze* every evening. Each time he politely submitted a “not yet,” implying that a positive forecast would perhaps come before Allied forces reached the Rhine. In the evening of the 14th, he said, “...probably yes, confirmation tomorrow at noon.”²²

The next morning, controlling weather was dominated by relatively warm and moist air and weak winds, presumably throughout the whole troposphere over Western Europe. Without cold advection from the northeast, it looked promising for the 16th and 17th but “...none of my synopticians dared to say anything about the third day.” Shortly before noon on the 15th, Schwerdtfeger called his two prime customers with the message: “Fog and/or persisting low-level cloud deck with poor visibility underneath to be expected in entire region, for 16-18 December, W.S., ORR, ZWG.”²²

Schwerdtfeger later wrote:

“Strange things can happen in nature. It really was unbelievable. The three days came and passed. According to all information we could gather, the weather was exactly like the guessed forecast. The fourth day still was quite similar, only in the afternoon some rise of cloud-deck occurred and a few airplanes were visible or audible; even on the fifth day, apparently with stronger winds, thick low clouds prevailed over most of the critical region. We had found not one case of five continuous days of this kind in all the Decembers we had checked - but here it was. From the meteorologist’s viewpoint the entire event became even more bizarre because almost everybody forgot that we had restricted the number of forecast-days to one-plus-three.”²²

Even with favorable weather for five days, the Ardennes offensive failed and German forces soon retreated under relentless Allied attack. Schwerdtfeger was somewhat astonished that “...superfluous administrative functions were carried on as if nothing of importance was happening beyond them.” In the third week of January 1945, Schwerdtfeger and *Chef Wetterdienst* were summoned to the commanding general’s office at *Kurfurst*. In the presence of other officers, there was a short address recognizing the work done by ZWG at the start of the counteroffensive, and announcing Schwerdtfeger’s promotion to *Ministerialrat* (or full colonel). The second recognition and promotion, to the rank of *Oberregierungsrat* (lieutenant colonel), went to Oskar Schuster who through five years had served as meteorologist at *Wolfsschanze*.²²

Last Days of War ²²

The bitter end approached not long after. With Russian forces approaching Berlin from the east and the Americans, British and French at the Rhine, ZWG had to move to remain operational. Sufficient electrical power had to be available to maintain radio transmission of meteorological

information to weather units closer to the front. Telephone and teletype service had become less and less reliable. The second week in February, ZWG was ordered to prepare to move by special train from Wildpark to Neubiberg, a military airfield a few miles southeast of Munich in Upper Bavaria. The first step in uninterrupted ZWG services was to temporarily establish about a quarter of ZWG's personnel under Richard Scherhag at Quickborn near Hamburg. A large radio station there was still in working order.²²

The main ZWG group prepared for its railroad journey in three passenger cars and fourteen freight cars. The special train left Wildpark on February 24, 1945 also with *Chef Wetterdienst* and staff, and with numerous stops and changes of rail lines, arrived in Neubiberg on March 2nd. There was plenty of room in unused barracks. A few days later, ZWG was again in full operation. There was no *Kurfurst* general staff and no daily briefings. The number of weather reports continued to decrease, the number of customers diminished, and so did ZWG morale.²²

Morale particularly decreased among the some 60 “communications girls” who still worked for ZWG. Some had already been discharged at *Kurfurst* if they could reach home easily by rail. To those remaining, and who had any chance of reaching home and family, Schwerdtfeger arranged to issue official travel orders. *Chef Wetterdienst* had refused to do so, but the commander of the airfield (a *Luftwaffe* major) gave Schwerdtfeger the necessary authority and forms.²²

Chef Wetterdienst and staff left a week later for southeastern Bavaria where many generals and their staffs began to congregate near Hitler's lodge (*Berghoff*) above Berchtesgaden. The only orders received by ZWG were to incorporate two motorized weather units and to remain in touch with *Kurfurst* by telephone. No further orders were received and Schwerdtfeger had to plan what to do when American soldiers approached Munich. There were three basic problems to consider:

- How to prevent the remaining communication girls being made prisoners-of-war;
- How to preserve the daily weather charts and other valuable meteorological material, because of their historical value;
- What to do with the men who were obviously neither prepared nor willing for senseless fighting on the last days of the war.²²

The forty communications girls still at Neubiberg were called in for departure in civilian clothes. Guided by two native Bavarians, a meteorologist, and a technician, they left on foot and with a few bicycles, moving south. Almost everywhere the female ex-soldiers found refuge with local people. After the war, Schwerdtfeger heard from several of them that they had come to no harm.²²

The preservation of daily weather maps and other material of the past six years proved hopeless. Herman Flohn volunteered to remain at Neubiberg, where everything of value was stored in a basement. He tried in vain to convince an American officer that the maps were of significant value to meteorologists of any nationality. Flohn was carried off with other prisoners of war and told Schwerdtfeger about the loss about twelve months later. The loss was already known; wrapping paper was scarce in Germany at that time and one of the technicians found a purchase wrapped in half of an original 1944 ZWG surface analysis. Despite efforts, nothing was recovered.²²

ZWG's plan was to conceal the remainder of the unit for at least the first few days of the occupation of the southernmost portion of Bavaria. The hideout selected was a heavily-wooded area difficult to access from the main roads but not too close to the northernmost slopes of the Alps where

many units had already gathered. An appropriate spot had been located not more than 30 km south-southeast of Munich. Sonderdilching is enclosed on three sides by the sharply-turning Mangfall, a deep cut, narrow, fast-moving river with a timber forest close to and on the steep slopes. The rough road from Holzkirchen eastward became an obstacle course down an old wooden bridge and up to higher countryside. The vehicles could be targets in an open field so the four drivers of the “wrecks” moved them on their final trip to hide up in the nearest woods. That essentially established the “graveyard” of the ZWG.²²

For the next two days they almost constantly heard the noise of nearby American units moving southeast. It then became quiet in Sonderdilching. They had food for two weeks and were sleeping in two buses and the barns of local farms. Schwerdtfeger spent much of his time in the radio truck, waiting for news of the surrender. Finally it came on May 8, 1945. Schwerdtfeger called everyone to report the next morning on the meadow above the vehicles. On a brilliant spring morning, he told everyone what had been prepared for them: a document (of doubtful value) stamped and signed and declaring that the bearer was honorably discharged; a just portion of the remaining food; and his salary prepaid for May to July from the “ZWG war chest.” And then: “I hereby declare ZWG terminated and everybody now his own boss. I wish the very best for everyone.”²²

New Beginnings

Schwerdtfeger’s war ended in early May 1945 although its effects lingered long after. He became a prisoner of war and eventually was interrogated by a USAAF weather officer, Captain Gilbert Woods, of Detachment C, 21st Weather Squadron, who reported the results to his commander in mid-September.³¹ In autumn of 1945, Schwerdtfeger was freed and transferred by the Americans to direct civilian weather services for southern Bavaria.^{13,28}

Postwar Germany was a living nightmare for most Germans. Food, shelter, and basic services were in severely short supply and would remain so, especially in the Russian sector, for several years. A decimated Germany struggled to survive and recover. Divided into four sectors, American, British, French, and Russian, each had different military “governments,” governing policies, and weather services. Starting in 1946, civilian weather centers manned by German meteorologists were established by the French at a small town in the Black Forest, by the British at Hamburg, and by the Americans at Bad Kissingen in extreme northwestern Bavaria. Bad Kissingen was one of the few German towns not destroyed in the war.²⁸

The Bad Kissingen weather center was initially directed by Gerhart Schinze and then by Schwerdtfeger’s mentor from the 1930’s, Ludwig Weickmann. Weickmann was dedicated to reestablishing weather services and meteorological science in Germany. His efforts were largely successful in the American sector. Then in 1949, the Federal Republic of Germany (FRG) was established, consolidating the American, British, and French sectors into what became known as West Germany. Weickmann and other German meteorologists were then successful in establishing the *Deutscher Wetterdienst*, the German Weather Service, in 1952.²⁸

Schwerdtfeger remained in charge of civilian weather services in southern Bavaria until 1948 and also taught at the University of Munich starting in 1947. His oldest son’s health suffered, in part due to the poor diet experienced by most Germans at that time. Concern for Dietrich and other issues in postwar Germany led Schwerdtfeger to look for other options. Finally, in 1948 and to the dismay of Weickmann, Schwerdtfeger left with his family and settled in Argentina. Lettau, in

an interview after he had retired with his wife to South Carolina near Charleston, said that Schwerdtfeger's departure was "clandestine," apparently unannounced beforehand. The Schwerdtfeger family went to Genoa, and from there traveled by ship to Buenos Aires.¹⁷

Scientist and Teacher

Beginning in 1948, Schwerdtfeger was the scientific advisor to the *Argentino Servicio Meteorologico Nacional* in Buenos Aires. He also taught at the *Escuela Superior de Meteorologica de la Nacion*. In 1957, he became the scientific advisor to the Hydrographic Office of the Argentine Navy and taught meteorology and atmospheric physics at the local university. He maintained his association with the hydrographic office until 1961. In 1950, he published the diary of his friend Rudolf Schütze. In 1982, with Franz Selinger, an aeronautical engineer and established author, he republished the diary as *Wetterflieger in der Arktis 1940-1944*, a memorial to Schütze that details his experiences as a wartime *Luftwaffe wekusta* pilot. He published his first meteorological book in 1952, containing over 100 scientific publications in Spanish, German, and English.

In 1957 and 1958, during the International Geophysical Year, Schwerdtfeger was a visiting professor in Australia at the University of Melbourne and then later at UCLA and in Boulder, Colorado. In 1962, Schwerdtfeger was appointed professor at the University of Wisconsin; he was to remain at Madison after his retirement as Professor Emeritus in 1980. In 1979, he was elected a Fellow of the American Meteorological Society.

Schwerdtfeger's love of books was reflected in his abiding interest in and loving care of the Meteorology Department's reading room. From modest beginnings, he prepared the ground for establishing an official University of Wisconsin branch library.¹³ Upon his retirement, it was officially named the Schwerdtfeger Library. In 1983, the Schwerdtfeger Academic Award was established at the university; each year it is awarded to the first-year graduate student who has performed at the highest level academically during the intensive first year of core course work

Doctor Werner Schwerdtfeger suffered a massive stroke at his home and the next day, January 17, 1985, died at the University of Wisconsin Medical Center, six months after his seventy-fifth birthday. He was survived by his wife, Marianne, daughter Antje, sons Dietrich and Wulf, several grandchildren, and his older brother Hans.

During his eventful life, he had lectured at many universities in German, Spanish, and then English, including:

- Universities in Königsberg (1936-38), Vienna (1942-43), and Munich (1947) in German;
- *Escuela Superior de Meteorologica de la Nacion*, Buenos Aires (1949-51), and University of Buenos Aires (1957) in Spanish;
- University of Melbourne in 1957/58 in English;
- And finally in English, at the University of Wisconsin where he was appointed Professor in 1962 and where he retired as Professor Emeritus in 1980.

A list of his publications includes over 100 titles in German, Spanish, and English. His major works include:

- *El Problema de la Prevision del Tiempo*, 1952, in Buenos Aires;

- “The Climate of Antarctica,” a chapter in Volume 14 of the World Survey of Climatology series;
- Editor of Volume 12 of The Climate of Central and South America, in 1976, in the World Survey of Climatology series;
- and Weather and Climate of Antarctica, written and published in 1984.

Husband, father, friend; scientist and researcher; prolific author; aeronaut and flight meteorologist; teacher, professor, lecturer; leader and manager; warrior and combat flight meteorologist, aircraft navigator, and gunner. World-class meteorologist and recognized expert on weather and climatology of South America, Antarctica, and the Arctic. Read, wrote, and taught in three languages. Bibliophile. Strong of character and will yet gentle and patient when needed. Dedicated to excellence in everything he attempted and accepting no less from those he led and those he taught on four continents in three languages. He earned respect by deeds and not words, and was a staunch comrade and leader in a brutal war forced upon his nation by a brutal dictatorship.

Werner Schwerdtfeger was a Man for All Seasons.

Reminiscences

We asked several persons for their personal reminiscences of Werner Schwerdtfeger during his time at the University of Wisconsin in Madison, Wisconsin. Several have responded and their comments follow (*italics* are the editor’s). We believe their comments help capture some of the personality of Schwerdtfeger, especially his wry sense of humor:

Richard Savage:

“On one occasion, [*Schwerdtfeger*] **entered the classroom and began his lecture - in Spanish**. It took him only a minute to realize the students were more confused than usual. The course was Met 303, an introduction to Dynamical Met; a refresher course for students like me, who had been away from school for 10 years. It must have helped; I passed the comprehensive exams #3 out of 15. I remember my major professor, Jim Weinman came by and congratulated me and recognized me as a human being, suggested I call him Jim.”

“On another occasion, WS was asked by a student if he (WS) had a middle name. WS laughed and answered that, **‘With a name like Werner Schwerdtfeger, you don’t need a middle name.’**”

“I wish I had been smart enough to appreciate the irony of having WS on my committee. He had established the Wettererkundungsstaffel; I had been the Staff Weather Officer at McClellan AFB for 9th WRW [Weather Reconnaissance Wing]; as such, I was familiar with the difficulty of weather recon, though different from the experience of Wekusta 5. Wish I’d been aware enough to comment on my effort to develop satellite techniques to partly replace the aircraft and manpower toll on the USAF

Chuck Doswell:

In an online article titled “My Professional Mentors” updated on 30 Nov 2007 (<http://www.flame.org/~cdoswell/Mymentors.html>) offers some excellent insights:

“I had a nominal advisor assigned to me at the University of Wisconsin, but after a short time, I realized he was not very good at it and so I guided myself during the second semester freshman year through my sophomore year. In my junior year, I took my first course in dynamics, which actually was mostly meteorological thermodynamics. My professor for that course was Prof. Werner Schwerdtfeger. He had come to UW as a "rehabilitated" German weather officer in the German *Luftwaffe*. **He was gruff and intimidating and spoke with a thick German accent that I eventually got so used to that I simply didn't hear it after a while.** His course in thermodynamics was rigorous, with lots of homework, tough exams, and a painstaking attention to detail. **We studied things until we students got sick of them, and then we went on to study them even more thoroughly. He turned basic concepts upside down, inside out, and backwards.** We considered them from what seemed to be every imaginable perspective before moving on to the next topic. We drilled on how to solve problems using each concept until we students thought we surely must have run out of possible things to do - and then he would give us another set of problems using that concept in some wholly unanticipated way. **By the time we moved on to the next topic, unbeknownst to me, that concept had been irrevocably entered into my head. His devotion to a deep understanding had a huge payoff down the road for me, because those concepts he taught me have stayed with me my whole career.** He became my de facto advisor and as I got to know him, I lost my fear of him - **he was actually warm, patient with my questions, and always challenging as well as supportive. I learned to love his style of teaching and welcomed his toughness in the classroom.** He didn't do much research leading to publications - rather, **his focus was almost totally on being a great teacher. And he was.** One of my life's biggest regrets is that he died before I ever got the chance to thank him properly for being such a great teacher, friend, and supporter - for his "tough love". Oh yes, I got a "B" in that first class of his I took, but felt I had worked my tail off to achieve that.”

Tom Vonderhaar:

“Enjoyed Professor Schwerdtfeger's synoptic meteorology classes. During one lecture on observations he was showing some of his old, glass “lantern” slides.

When he showed a small, two passenger, open cockpit observation plane in flight with himself as the observer he would hold his hand over the screen to block out the swastika on the wing! Class enjoyed that one.”

Sharon Nicholson:

“I did take two courses from WS - the third of the core course and also cloud physics. All I remember is that in the former he was an extremely tough grader and that in the latter he was an excellent instructor. Otherwise **the image that comes to mind is him so frequently looking at the weather map (back then we had both barotropic and baroclinic models for forecasting), shaking his head, and muttering how it is impossible to forecast weather.** That led many of us to the speculation that he was, in fact, the person who "blew" the D-Day forecast. However, Lettau's interview shows that to be wrong.”

.....

He taught us about El Nino long before we knew it was a global phenomenon. I still use data that he gave us of rainfall changes during an El Nino year along the Peruvian coast.

Stefan Hastenrath:

“... as I remember: I came here in 1963; **he was kind, remember he took me on road trip through Wisconsin.** For "family-reunion" he was allowed to bring his oldest son from Argentina. His younger son studied engineering, was with us on 1964 expedition to Peru.”

Marian Hollingshead:

“One anecdote about WS: When I was his TA for the graduate intro class that Ed took, we were studying vorticity. **During one of the breaks, Ed and I started chatting with WS and Ed sang the ditty about "The air went over the mountain... and conserved vorticity. Conserved vorticity, a trough in the mountains' lee..."**

WS's response was "[jAy, caramba!]"”

Martin Sponholz:

(https://en.wikipedia.org/wiki/Martin_Sponholz):

Martin “Marty” Sponholz has written a very personal, powerful, and insightful online book about his experiences with Antarctic research and his relationship with both Werner Schwerdtfeger and Heinz Lettau: [Among the Magi, research tracks in the desert snow](https://www.antarctican.org/); available on the Antarctic website under diaries and memoirs: <https://www.antarctican.org/>²⁷. There is only room here for excerpts regarding Schwerdtfeger although the entire book is well worth the time to read for a variety of reasons not least of which is the strong scientific, at times seemingly mystical, relationship between the three scientists:

“As I showered and shaved, I wondered why Schwerdtfeger was to be at this meeting. My first impressions of Prof. Werner Schwerdtfeger were made in a three credit twelve hour Synoptic Meteorology lab. **He was tough and demanding. Two things stood out. The only name from my class that he could remember was that of my good lifelong friend, Donald Panzenhagen. The second was Prof. Schwerdtfeger's absolutely wild excitement while interpreting the processes of weather systems. His English was excellent but with a heavy German accent sprinkled with Spanish.**”

.....

“**The student generated rumor mill identified Prof. Schwerdtfeger as a general in the German Luftwaffe during the Second World War.** I do know he flew in aircraft a lot during the war and he spoke of collecting correct wind data over the North Sea when the British falsified their weather broadcasts. **His wind measuring device often was a machine gun and a stop watch to time the motions of salt spray raised by the bullets.** After the war, Prof. Schwerdtfeger served the government of Argentina, and again **the rumor mill had this tall colorful teacher in several revolutions in South America. The long hours of laboratory work, weather map analysis, and endless mathematical analysis led us all to understand and appreciate this famous world-renowned expert in Southern Hemisphere meteorology.**”

.....

“**Schwerdtfeger, it seemed to me at the time, built a major case on the casual statements of early explorers such as Paul Siple who said that when he aimed a flashlight upward in the polar night he could see ice crystals continually. I tried and indeed you could on some days see ice crystals in the air.** My daily observations showed ice crystal precipitation on more than sixty percent of the days, summer or winter. In my view it simply was too easy for ice crystals to be advected by wind from the thousands of miles on the plateau. The polar

plateau was already in the “alto” region of cloud layers. The thinnest of clouds could deposit snow or ice crystals, and if only thin clouds, they would go undetected by visual observations in the polar night.”

.....

“Precipitation from a clear sky when taking into account all other possible sources for ice crystals for me was simply too hard to accept. ***My arguments with my professor were recorded in his major work “The Climate of the Antarctic,” half of Volume 14 of the encyclopedia of climatic studies World Survey of Climatology, edited by Helmut E. Landsberg (1970). Later Schwerdtfeger would brilliantly argue how air in an intense temperature inversion would possess sinking qualities of motion.*** Even unsaturated air sinking in an inversion with a vertical temperature gradient of more than sixty Fahrenheit degrees, most common as confirmed by my own balloon ascents, would easily reach saturation and super saturations and almost certainly precipitate from a clear sky. ***Thirty years from my year on the Ice I am prepared to concede to my old Professor. He won.***”

.....

“In pure research work ideas and who had the idea first is everything. In free and open exchanges, as I always believed was the only purpose for Antarctic research, many ideas were traded and at times no one can say for sure who did the initiating. ***Men like Heinz Lettau and Werner Schwerdtfeger were always more than generous with me.*** Their idea of passive measurements of the air using optical views of light rays preserved with photographs of targets gave what I thought would be the most accurate method of determining the most detailed temperature profiles possible.”

John Zillman

John Zillman is an Australian meteorologist and former President of the World Meteorological Organization and of the Australian Academy of Technical Sciences and Engineering. He wrote of Werner Schwerdtfeger in his paper on the contributions of German scientists to Australian meteorology³²:

“Though Professor Werner Schwerdtfeger spent less than a year in Australia, filling in for Dr Loewe at the University of Melbourne in 1957–1958, ***he had a major influence on Australian meteorology through his teaching and writing and especially through his collaboration with Australian meteorologists, after he left Melbourne, on Antarctic and Southern Ocean research.***”

.....

“After serving as a senior meteorologist with the *Luftwaffe* during World War II, he worked for more than a decade in the Argentine Meteorological Service and at the University of Buenos Aires before coming to Melbourne on leave during the International Geophysical Year. He subsequently taught at the University of California (Los Angeles), the University of Colorado and, finally, at the University of Wisconsin until his retirement.”

.....

“At Wisconsin, Professor Schwerdtfeger emerged as the pre-eminent international authority on high southern latitude climatology and supervised a series of PhD students who soon made their way to Melbourne as the US government-sponsored members of the International Antarctic Meteorological Research Centre, headed by former Loewe student and Schwerdtfeger colleague Mr Henry Phillipot. The pioneering work by Schwerdtfeger protégé Dr David Martin on the interpretation of satellite imagery over the Southern Ocean provided the basis for several decades of operational practice in Southern Ocean synoptic analysis in World Meteorological Centre Melbourne. ***Professor Schwerdtfeger also served as father figure to***

a generation of young Australian meteorologists who passed through Wisconsin in the 1960s and 1970s.”

Postscript

As in any such effort with limited resources, there are deficiencies in the presentation and we are aware of many of them. While we are fortunate to have much information available to us regarding his wartime service, especially his own reminiscences of his service at ZWG, obtaining information on his life both before and after World War II has been difficult. Consequently, the most obvious deficiency is the uneven level of detail and content between sections addressing his early life and prewar professional service, the wartime years, and Schwerdtfeger's postwar life. Several sources were available to address particular parts of Werner's early life through until the start of the war.

Kington and Selinger's remarkably complete and detailed history of the *wekustas*¹² includes lead-in chapters on the early years of meteorology in Germany, both the science as well as the forecast practice, and contains much information regarding Schwerdtfeger's aviation service with the Königsberg *wetterstelle* as well as with the lead *wekusta* just before and during the war. The Kington and Selinger book, 256 pp, is out of print but is an essential source for anyone interested in the history of the first weather reconnaissance squadrons and their combat service as well as details of their meteorological instruments and procedures.

Schwerdtfeger's service at ZWG is covered in considerable detail in his own writings^{20,21,22}, published posthumously in three parts in *Weather*, a journal of the Royal Meteorological Society, as translated and edited by his friend Heinz Lettau. It is supported by the interview with Heinz Lettau¹⁷ and in part that with Flohn²⁸ and again in part by Fuller's detailed book on weather support to the US Army and Air Force.⁷

A great deal of care is necessary, as usual, in evaluating and possibly using web-based resources, particularly regarding *wekusta* history and the service of Schwerdtfeger during his *wekusta* time. Most *wekusta* web sources proved unreliable as regards Schwerdtfeger's *wekusta* experience; several have him erroneously serving in *Wekusta 5* in Norway along with his friend Rudolf Schütze. One such source has him with *Wekusta 5* but then lists known members of *Wekusta 5* with Schwerdtfeger glaringly missing from the roster! Apparently, many have confused Schwerdtfeger and Selinger's book, *Wetterflieger in der Arktis*²³, with Schwerdtfeger's own service, an easy mistake to make without more detailed knowledge of the very rich *wekusta* history.

Fortunately, some excellent web resources are available with careful research and correlation with other sources. No website was used in this biography without thorough vetting against other sources. While the confidence level in those web sources is high, the possibility is always there that there may be errors of substance or interpretation; in those cases, the error remains with this editor.

This is a product under the auspices of the *Wetterflieger in der Arktis*²³ translation project initiated by Dr Richard Savage and is intended for his use and that of his friends and acquaintances as his project develops. While stressing that any errors remain those of the editor, nevertheless we hope that this text will be useful both to those who knew Werner Schwerdtfeger as well as those learning of him for the first time.

Acronyms and Definitions

<i>Austausch</i> ^a	“Exchange”; as in <i>Austausch</i> Theory regarding vertical exchanges and turbulence in the atmosphere.
AWS	Automatic Weather Station; Automated Weather Station.
<i>Beamte</i> ^b	Civil servant. Civil servant <i>officials</i> in military service were <i>Wehrmachtbeamte</i> . There were various ranks and rank structures among the civil servant specialties within the German armed forces in World War II. <i>Civil servant officials in officer-equivalent ranks held assimilated command authority.</i>
<i>Bordfunker</i>	Radio operator.
<i>Bordmechaniker</i>	Flight engineer.
<i>Chef Meteorologische Beobachter</i>	Chief Meteorological Observer.
<i>Chef Wetterdiest</i>	The administrative head of the <i>Luftwaffe</i> weather service and senior meteorological officer in the <i>Luftwaffe</i> although not normally involved in operational meteorological services. Not always a trained meteorologist. Rank at the general officer level.
<i>Deutscher Wetterdienst</i>	German Weather Service. Established post-World War II. Abbreviated <i>DWD</i> .
<i>Deutsches Kreuz in Gold</i> ^f	German Cross in Gold. Abbreviated as <i>DKG</i> . Schwerdtfeger was awarded the <i>DKG</i> on May 27, 1942. Third in the “Cross series” of <i>Luftwaffe</i> primary military decorations. First in the series was the Iron Cross Second Class, then the Iron Cross First Class, then the <i>DKG</i> and then the <i>Ritterkreuz</i> or “Knight’s Cross. The awards were typically sequential with award of the Iron Cross First Class only to those who had already been awarded the Iron Cross Second Class, and so on. See <i>Ehrenpokal</i> and <i>Ritterkreuz</i> .
D-Day	The first day of the planned Allied invasion of Normandy. That day turned out to be June 6, 1944 with Americans landing on Utah and Omaha Beaches and United Kingdom forces landing on Sword, Juno, and Gold Beaches.
<i>DKG</i>	<i>Deutsches Kreuz in Gold.</i>
DUKW	Six-wheel-drive amphibious modification of the 2 1/2-ton CCKW trucks used by the U.S. military during World War. Powered by propellers and steered by rudders when in the water. Acronym from General Motors

design nomenclature: **D**(esigned in 1942) **U**(tility) **K** (all-wheel drive) **W** (dual-tandem rear axles).

<i>Ehrenpokal</i>	Schwerdtfeger was awarded the <i>Ehrenpokal</i> on January 19, 1942. The “Honor Goblet” was a <i>Luftwaffe</i> -only award created by Herman Göring. The <i>Ehrenpokal</i> was awarded for combat service to personnel who already held the Iron Cross First Class but whose service did not yet merit the award of the <i>DKG</i> .
<i>Escuelo Superior de Meteorologica de la Nacion</i>	Higher School of Meteorology of the Nation (in Buenos Aires, Argentina).
<i>Flugzeugfuhrer</i>	Pilot.
<i>Freikorps</i>	"Free Corps" were German military volunteer units that existed from the 18th to the early 20th centuries, which effectively fought as mercenary or private armies, regardless of their own nationality.
<i>Grossraum Wekusta</i>	“Long-range weather reconnaissance squadron”. The “parent” <i>Wekusta</i> formed in 1938. Renamed <i>Wekusta, Ob.d.L.</i> , and then <i>Wekusta 1, Ob.d.L.</i> as the war progressed.
<i>Habilitate</i>	Qualify for office, especially as a teacher in a German university.
<i>Hauptman</i>	<i>Wehrmacht (Luftwaffe)</i> officer rank equivalent to a USAAF Captain.
<i>Heer</i>	German Army of the Third Reich.
<i>Institut fur Geophysik und Meteorologie</i>^e	Institute for Geophysics and Meteorology (University of Leipzig).
<i>Kriegsmarine</i>	German Navy of the Third Reich.
<i>Kurfurst</i>	Codename for the <i>OKL</i> at Wildpark-Werder near Potsdam. <i>Luftwaffe</i> high command complex and headquarters. Home to the <i>ZWG</i> and <i>Chef, Luftwaffe Wetterdienst</i> for most of the war. The term itself refers to a “prince-elect” of the Holy Roman Empire.
<i>Leutnant</i>	<i>Luftwaffe</i> officer rank equivalent to a USAAF Second Lieutenant.
<i>Luftflotten</i>	“Air Fleet”; operational <i>Luftwaffe</i> organization responsible for a large area of operations and the <i>Luftwaffe</i> forces assigned therein. Reported directly to <i>Kurfurst</i> .
<i>Luftkriegskommando</i>	Literally “air warfare command”; regional air commands under <i>Luftflotten</i> .

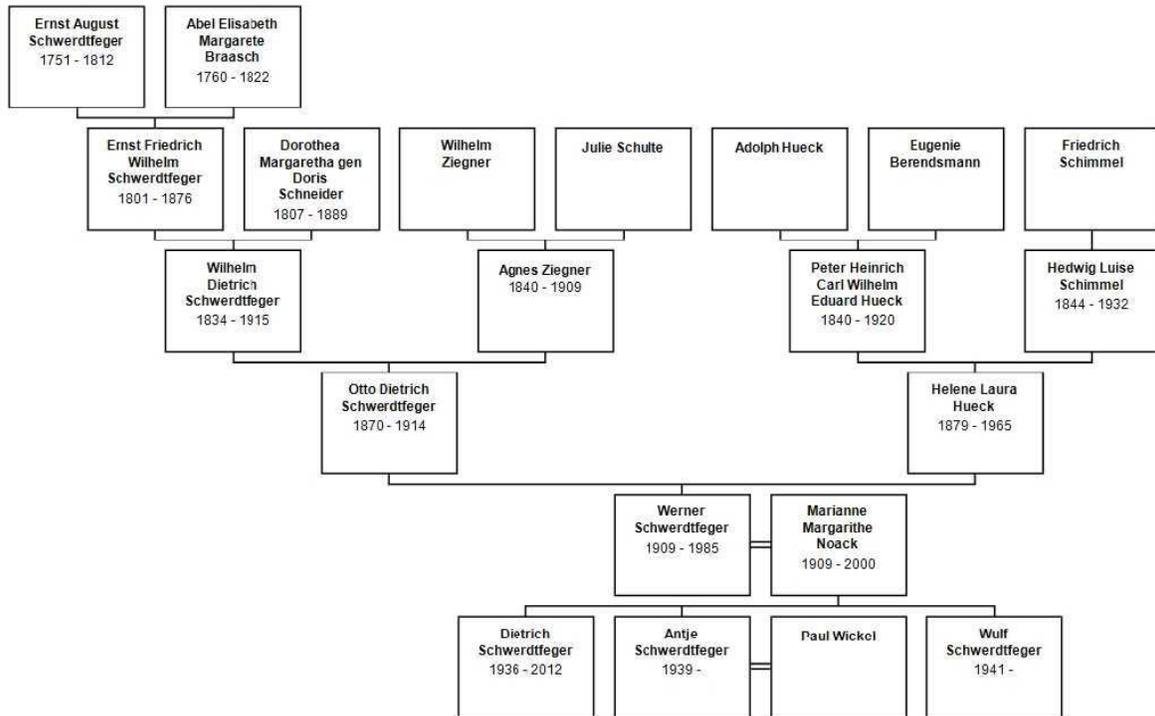
Luftwaffe	German Air Force of the Third Reich.
mb	Millibar, a unit of pressure; 1/1000 th of a bar. One bar is slightly less than the current average atmospheric pressure at sea level.
Meteorologische Beobachter	Meteorological Observer - usually abbreviated as <i>Met. B.</i> The <i>Met. B.</i> was the flight meteorologist on <i>Wekusta</i> aircrews. <i>Also trained as a navigator and aerial gunner.</i>
Meteorologische Zeitschrift ^k	“Meteorological Journal”; a prestigious German technical journal on meteorology.
Ministerialrat	<i>Luftwaffe</i> civil service official rank corresponding to a <i>Luftwaffe Oberst</i> or USAAF Colonel. Full Colonel.
Mulberry Harbors	Temporary floating portable harbors developed by the United Kingdom during the Second World War to facilitate the rapid offloading of cargo onto beaches during the Allied invasion of Normandy in June 1944. After the Allies successfully held beachheads following D-Day, two prefabricated harbors were taken in sections across the English Channel from Britain with the invading army and assembled off Omaha Beach (Mulberry "A") and Gold Beach (Mulberry "B"). These were destroyed in a violent and unforecast storm two weeks after D-Day.
Oberbefehlshaber der Luftwaffe ⁿ	Commander-in-Chief of the <i>Luftwaffe</i> .
Ob.d.L.	<i>Oberbefehlshaber der Luftwaffe</i> ; Commander-in-Chief of the <i>Luftwaffe</i> .
Oberkommando der Luftwaffe ⁿ	Headquarters of the <i>Luftwaffe</i> at Potsdam Germany; abbreviated as OKL. Codename was <i>Kurfurst</i> .
OKL	<i>Oberkommando der Luftwaffe</i> ; Headquarters of the <i>Luftwaffe</i> .
Oberleutnant	<i>Luftwaffe</i> officer rank equivalent to a USAAF First Lieutenant.
Oberregierungsrat	<i>Luftwaffe</i> civil service rank equivalent to a <i>Luftwaffe Oberstleutnant</i> or USAAF Lieutenant Colonel.
ORR	Abbreviation for Oberregierungsrat .
Panzer	German tank.
RAF	Royal Air Force.
Regierungsrat	<i>Luftwaffe</i> civil servant rank equivalent to a Major in the <i>Luftwaffe</i> or in the USAAF.

Reichswetterdienst ^p	Reich Weather Service; civilian weather service of the Third Reich.
Ritterkreuz ^f	“Knight’s Cross of the Iron Cross”; there were five sequential grades of the <i>Ritterkreuz</i> . The top grade, Knight’s Cross with Golden Oak Leaves, Swords, and Diamonds, was awarded only to Hans Ulrich Rudel, <i>Luftwaffe</i> fighter and ground attack pilot on the Eastern Front.
RN	Royal Navy.
sagezahn-flugprofil	“sawtooth flight profile”; the standard <i>wekusta</i> mission profile with ascents at selected points to collect vertical sounding data.
sitzkrieg	“sitting war”; term applied by the Allies to the “phony war” period from the start of the war until the invasion of France on May 10, 1940. A time when combat operations were rare.
Staffelkapitan	Squadron Commander.
“Swimming tanks”	<p>American Sherman M4 tanks equipped with propellers, rudders, and collapsible curtains that extended above the top of the tank and provided flotation. These tanks were referred to as “DDs” or “Duplex Drive” tanks with the capability to either power the tank’s treads or the propellers if the tank was in water.</p> <p>Most of the American DD tanks did not make it to shore on D-Day, especially those intended for and desperately needed at Omaha Beach; launched too far from shore, they sank quickly, drowning their crews in rough seas.</p>
USAAF	US Army Air Forces, predecessor to the US Air Force.
Unteroffizier	<i>Luftwaffe</i> enlisted rank equivalent to a Corporal in the USAAF.
volkisch	Populist or nationalist, and typically racist.
Waffenfarbe	Literally “corps colors.” Different branches in the <i>Wehrmacht</i> had specific colors associated with them much as in the US Army, artillery is associated with scarlet, infantry with pale blue, armor and cavalry with yellow, etc. In the <i>Luftwaffe</i> , the <i>waffenfarbe</i> for flying troops was yellow gold. For meteorologists, as <i>wehrmachtbeamte</i> , including flight meteorologists, it was dark green.
Wehrmacht	German Armed Forces of the Third Reich. Contrary to common usage, the term does <i>not</i> mean German Army. <i>Wehrmacht Heer</i> was the complete name for the German Army; <i>Wehrmacht Luftwaffe</i> for the German Air Force; and <i>Wehrmacht Marine</i> for the German Navy.
Wekusta	Abbreviation for <i>Wettererkundungsstaffel</i> .

Westa	Abbreviation for <i>Wettererkundungsstaffel</i> .
Wetterflieger	Weather flier.
Wettererkundungsstaffel	Weather Reconnaissance Squadron (<i>Staffel</i> = Squadron) in the <i>Luftwaffe</i> . Frequently abbreviated as <i>Wekusta</i> or <i>Westa</i> .
Wetterflugstellen	German meteorological flight stations at airfields where vertical atmospheric “soundings” by airplane were taken before the advent of radiosonde networks. Several European countries operated such flight activities, as did the US, both before and during World War II.
Wetterfrosche	“Weather frogs”; <i>Luftwaffe</i> slang for meteorologists.
Wolfsschanze †	“Wolf’s Lair”; Hitler’s personal headquarters.
Zenit	“Zenith”; code used for recording weather data on <i>wekusta</i> missions.
ZWG	<i>Zentrale Wetterdienst Gruppe</i> (Central Weather-service Group). Principal weather forecast center for the <i>Luftwaffe</i> and collocated at <i>Kurfurst</i> .

Genealogy of Werner Schwerdtfeger

Ancestry.com was used to develop a short family tree for Werner Schwerdtfeger using initial material from a variety of sources and which subsequently proved very reliable.



Note: This listing and the tree shown above should be regarded as suggestive rather than definitive; it has been confirmed through the second generation maternally and through the fourth generation paternally. Ancestry past Schwerdtfeger's parents has not been confirmed for the maternal line as of this writing; nor has currency of information been confirmed for Werner and Marianne's children due to restrictions in Ancestry.com data.

Generation 1

Werner Schwerdtfeger, son of Otto Dietrich Schwerdtfeger and Helene Laura Hueck, was born on 12 Jul 1909 in Köln, North Rhine-Westphalia, Germany. He died on 18 Jan 1985 in Madison, Dane, Wisconsin, USA. He married **Marianne Margarithe Noack**. She was born on 11 May 1909 in Leipzig, Saxony, Germany. She died in 2000 in Madison, Dane, Wisconsin, USA.

1. Werner Schwerdtfeger and Marianne Margarithe Noack had the following children:

i. DIETRICH SCHWERDTFEGER was born on 16 Jun 1936 in Germany (Königsberg). He died on 28 Aug 2012.

ii. ANTJE SCHWERDTFEGER was born on 30 Jul 1939 in Berlin, Germany. She married PAUL WICKEL.

iii. WULF SCHWERDTFEGER was born on 26 Dec 1941 in Berlin, Germany.

Generation 2

Otto Dietrich Schwerdtfeger, son of Wilhelm Dietrich Schwerdtfeger and Agnes Ziegner, was born on 16 Apr 1870 in Göttingen, Göttingen, Niedersachsen, Germany. He died on 10 Dec 1914 in Lowicz, Lodzkie, Poland. He married **Helene Laura Hueck**.

2.

Helene Laura Hueck, daughter of Peter Heinrich Carl Wilhelm Eduard Hueck and Hedwig Luise Schimmel, was born on 26 Jun 1879 in Germany. She died on 18 Mar 1965.

3.

Helene Laura Hueck and Otto Dietrich Schwerdtfeger had the following children:

i. **Hans Wilhelm Eduard Schwerdtfeger** was born on 09 Dec 1902 in Göttingen, Göttingen, Niedersachsen, Germany. He died in 1990 in Adelaide, South Australia, Australia.

1. ii. **Werner Schwerdtfeger** was born on 12 Jul 1909 in Köln, North Rhine-Westphalia, Germany. He died on 18 Jan 1985 in Madison, Dane, Wisconsin, USA. He married Marianne Margaritha Noack. She was born on 11 May 1909 in Leipzig, Saxony, Germany. She died in 2000 in Madison, Dane, Wisconsin, USA.

Generation 3

Wilhelm Dietrich Schwerdtfeger, son of Ernst Friedrich Wilhelm Schwerdtfeger and Dorothea Margaretha gen Doris Schneider, was born on 11 Nov 1834 in Wetterade, Schleswig-Holstein, Prussia. He died on 09 Sep 1915 in Lubeck, Schleswig-Holstein, Germany. He married **Agnes Ziegner** on 17 Apr 1860 in Sankt Marien Evangelisch, Dortmund, Westfalen, Prussia.

4.

Agnes Ziegner, daughter of Wilhelm Ziegner and Julie Schulte, was born on 01 Aug 1840. She died in 1909.

5.

Agnes Ziegner and Wilhelm Dietrich Schwerdtfeger had the following children:

i. Julian Schwerdtfeger was born in 1867. He died in 1868.

ii. Ernst Friedrich Wilhelm Schwerdtfeger was born in 1869. He died in 1931.

2. iii. **Otto Dietrich Schwerdtfeger** was born on 16 Apr 1870 in Göttingen, Göttingen, Niedersachsen, Germany. He died on 10 Dec 1914 in Lowicz, Lodzkie, Poland. He married Helene Laura Hueck. She was born on 26 Jun 1879 in Germany. She died on 18 Mar 1965.

iv. Julie Louise Dorothea Schwerdtfeger was born in 1873.

v. Heinrich Bertram August Schwerdtfeger was born on 21 Juli 1871 in Reinfeld, Schleswig-Holstein, Deutschland. He died in 1953.

Peter Heinrich Carl Wilhelm Eduard Hueck, son of Adolph Hueck and Eugenie Berendsmann, was born on 11 Feb 1840. He died in 1920. He married **Hedwig Luise Schimmel** on 25 Sep 1870 in Sankt Reinoldi Evangelisch, Dortmund, Westfalen, Prussia.

6.

Hedwig Luise Schimmel, daughter of Friedrich Schimmel, was born on 16 Dec 1844. She died in 1932.

7.

Hedwig Luise Schimmel and Peter Heinrich Carl Wilhelm Eduard Hueck had the following child:

3. i. **Helene Laura Hueck** was born on 26 Jun 1879 in Germany. She died on 18 Mar 1965. She married Otto Dietrich Schwerdtfeger. He was born on 16 Apr 1870 in Göttingen, Göttingen, Niedersachsen, Germany. He died on 10 Dec 1914 in Lowicz, Lodzkie, Poland.

Generation 4

8. **Ernst Friedrich Wilhelm Schwerdtfeger**, son of Ernst August Schwerdtfeger and Abel Elisabeth Margarete Braasch, was born on 12 Feb 1801 in Warder, Schleswig-Holstein, Germany. He died on 14 Sep 1876 in Wetterade, Segeberg, Holstein, Germany. He married **Dorothea Margaretha gen Doris Schneider** on 27 Apr 1827 in Luetjenburg Stadt, Schleswig-Holstein, Prussia. **Dorothea Margaretha gen Doris Schneider** was born on 31 Jul 1807 in Luetjenburg Stadt, Schleswig-Holstein, Prussia. She died on 20 Apr 1889.

9.

Dorothea Margaretha gen Doris Schneider and Ernst Friedrich Wilhelm Schwerdtfeger had the following child:

4. i. **Wilhelm Dietrich Schwerdtfeger** was born on 11 Nov 1834 in Wetterade, Schleswig-Holstein, Prussia. He died on 09 Sep 1915 in Lubeck, Schleswig-Holstein, Germany. He married Agnes Ziegner on 17 Apr 1860 in Sankt Marien Evangelisch, Dortmund, Westfalen, Prussia. She was born on 01 Aug 1840. She died in 1909.

10. **Wilhelm Ziegner**. He married **Julie Schulte**.

11. **Julie Schulte**.

Julie Schulte and Wilhelm Ziegner had the following child:

5. i. **Agnes Ziegner** was born on 01 Aug 1840. She died in 1909. She married Wilhelm Dietrich Schwerdtfeger on 17 Apr 1860 in Sankt Marien Evangelisch, Dortmund, Westfalen, Prussia. He was born on 11 Nov 1834 in Wetterade, Schleswig-Holstein, Prussia. He died on 09 Sep 1915 in Lubeck, Schleswig-Holstein, Germany.

12. **Adolph Hueck**. He married **Eugenie Berendsmann**.

13. **Eugenie Berendsmann**.

Eugenie Berendsmann and Adolph Hueck had the following child:

6. i. **Peter Heinrich Carl Wilhelm Eduard Hueck** was born on 11 Feb 1840. He died in 1920. He married Hedwig Luise Schimmel on 25 Sep 1870 in Sankt Reinoldi Evangelisch, Dortmund, Westfalen, Prussia. She was born on 16 Dec 1844. She died in 1932.

14. **Friedrich Schimmel**.

Friedrich Schimmel had the following child:

7. i. **Hedwig Luise Schimmel** was born on 16 Dec 1844. She died in 1932. She married Peter Heinrich Carl Wilhelm Eduard Hueck on 25 Sep 1870 in Sankt Reinoldi Evangelisch, Dortmund, Westfalen, Prussia. He was born on 11 Feb 1840. He died in 1920.

Chronology – Dr Werner Schwerdtfeger

10 Dec 1902	Older brother Hans Wilhelm Eduard Schwerdtfeger is born in Göttingen, Germany.
11 May 1909	Marianne Margaritha Noack, Werner's future wife, is born in Leipzig, Germany.
12 July 1909	Werner Schwerdtfeger born in Köln, Germany.
10 Dec 1914	Father, Major Otto Dietrich Schwerdtfeger, killed in action near Ludicz, Poland.
--	Attended the <i>Humanitische Gymnasium</i> in Göttingen with a demanding high school curriculum.
1927	Entered university studies at the University of Freiberg (1927-1929)
1929	Entered studies at the University of Leipzig, <i>Institut für Geophysik und Meteorologie</i> under the direction of Professor Ludwig Weickmann.
1931	Received Doctor of <i>rerum naturalium</i> at the age of 22 from the <i>Institut für Geophysik und Meteorologie</i> .
1931	Began employment as a meteorologist with the German government's weather service at Berlin-Tempelhof Aerodrome followed by service in-house with the German equivalent to the US Civil Aeronautics Board (CAB).
1933	Married Marianne Margaritha Noack, whom he met while at the University of Leipzig.
1933-1934	Lettau-Schwerdtfeger Balloon Experiment.
1934	Brother Hans left Germany with his family and eventually settled in Australia.
1935	Took over the aerological station at Königsberg where over subsequent years he completed over 1000 ascents to collect vertical observations in specially-instrumented aircraft.
16 Jun 1936	Son Dietrich born in Königsberg.
1937	Habilitated in Königsberg; lectured in meteorology in Königsberg and Vienna.
1938	Entered <i>Luftwaffe</i> service as a civil servant with the equivalent rank to a Major; became a senior flight meteorologist with the <i>Grossraum Wekusta</i> .
1 Jun 1939	<i>Grossraum Wekusta</i> redesignated <i>Wekusta, Ob.d.L.</i>

The *Wetterflieger* Project – Werner Schwerdtfeger

30 Jul 1939	Daughter Antje born in Berlin.
1 Sep 1939	Germany invades Poland and World War II begins.
11 Nov 1939	Became Chief Meteorological Observer at the <i>Wekusta, Ob.d.L.</i> replacing Dr Walter Kopp. Promoted <i>Oberregierungsrat</i> (Lt Colonel).
10 May 1940	Germany invades France and the Low Countries; Phony War ends.
Jul 1940	<i>Wekusta, Ob.d.L.</i> becomes <i>Wekusta 1, Ob.d.L.</i>
3 Jul 1940	<i>Wekusta 1, Ob.d.L.</i> moves to Oldenburg from Berlin-Gatow.
Jan 1941	<i>Wekusta 1, Ob.d.L.</i> moves to Bad Zwischenahn.
26 Dec 1941	Son Wulf born in Berlin.
19 Jan 1942	Schwerdtfeger awarded the <i>Ehrenpokal</i>.
27 May 1942	Schwerdtfeger awarded the <i>DKG</i>.
Jun/Jul 1942	Inspected all <i>Wekusta</i> for <i>Ob.d.L.</i> ; temporarily assigned to Chef Wetterdienst staff as Deputy Chief for the inspections.
1942/1943	Lectured at the University of Vienna.
Jun 1943	Inspected all <i>Wekusta</i> for <i>Ob.d.L.</i> ; temporarily assigned to Chef Wetterdienst staff as Deputy Chief for the inspections.
Jul 1943	Dr Diesing, Chief of the ZWG, dies unexpectedly.
3 Aug 1943	Schwerdtfeger completes his 250th, and last, combat mission.
15 Aug 1943	Schwerdtfeger transferred to become the <i>Chef</i> (Chief) of the ZWG.
26 Aug 1943	<i>Oblt.</i> Rudolf Schütze killed in the crash of an Arado 232 near Banak, Norway.
Jun 1944	ZWG forecasts for Normandy and the English Channel are issued as routine forecasts.
1 Dec 1944	Schwerdtfeger begins daily contact with <i>Kurfurtz</i> and to <i>Wolfsschanze</i> for the Ardennes Counteroffensive.
15 Dec 1944	Schwerdtfeger issues forecast to <i>Kurfurst</i> and to <i>Wolfsschanze</i> for required weather conditions for the Ardennes Counteroffensive. “Fog and/or persisting low-level cloud deck with poor visibility underneath to be expected in entire region, for 16-18 December, W.S., ORR, ZWG.”

The *Wetterflieger* Project – Werner Schwerdtfeger

Jan 1945	Promoted to <i>Ministerialrat</i> (equivalent to full Colonel in US armed forces).
24 Feb 1945	ZWG begins move from <i>Kurfurst</i> by train.
2 Mar 1945	ZWG arrives at Neubiberg.
Apr 1945	ZWG moves to a hideout near Sonderdilching.
8 May 1945	Germany surrenders.
9 May 1945	ZWG disbanded.
Aug 1945	Schwerdtfeger freed and moves to southern Bavaria to take charge of civilian weather services.
1947	Schwerdtfeger taught at the University of Vienna.
1948	Schwerdtfeger and family moved to Argentina.
1948-1957	Scientific advisor to the <i>Argentino Servicio Meteorologica Nacional</i> and teaches at the <i>Escuelo Superior de Meteorologica de la Nacion</i> . Buenos Aires.
1957-1961	Scientific advisor to the Argentine Hydrographic Office (<i>Oficina Hidrográfica Argentina</i>) and taught at the local university in Buenos Aires.
1950	Published the diary of his friend Rudolf Schütze: <u>Weather pilots in the Arctic, War experiences of the pilot Rudolf Schütze</u> ; German; publisher 'El Buen Libro'; Buenos Aires; 1950; 190 pp.
1957/1958	During the International Geophysical Year, visiting professor at the University of Melbourne in Australia.
1962	Appointed professor at the University of Wisconsin in Madison.
1979	Appointed a Fellow of the American Meteorological Society.
1980	Retired as Professor Emeritus.
1982	With Franz Selinger, published <u>Wetterflieger in der Arktis</u> based on the diary of Rudolf Schütze.
1983	The Schwerdtfeger Academic Award is established at the University of Wisconsin in Madison.
17 Jan 1985	Died in Madison, Wisconsin following a massive stroke the day before.

Primary References and Bibliography

This is both a list of references used in developing this biography as well as recommended publications related to the *Wekusta* and the *Luftwaffe*. Minor references are not listed unless they were of especial significance.

Extreme caution is recommended regarding Web sources since much material on the wekusta and in particular Schwerdtfeger's wekusta service contains numerous and significant errors. For example, he is listed as serving in *Wekusta* 5 at Vaernes and Banak Norway in several accounts when he actually served in the lead *Wekusta* near Berlin throughout his time as a *Met. B.* Some sources credit him with 400 or 500 combat missions when his own writing and that of Heinz Lettau credit him with 250^{17,20}. There are other errors too numerous to relate.

Internet sources referenced below have been thoroughly vetted against other source material and deemed trustworthy. Web pages and publications by Kington and by Selinger or both^{10,12,24,25} together were primary sources for *wekusta* history and for details of Schwerdtfeger's career as a flight meteorologist before and during the war. Extensive use was made of Nicholson's interview of Heinz Lettau¹⁷ throughout this biography.

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Notes

a ***Austausch Theory.***¹⁴

The determination of the virtual or eddy viscosity of air in the lowest levels of the atmosphere was a dominant theme for research during the first two decades of the 20th century. This led to turbulence parameterization via *Austausch* or K theory (K becoming the standard notation for the empirical coefficient of eddy viscosity). By the late 1920s, the *Austausch* coefficients had been indirectly estimated in a variety of synoptic situations.

Stimulated by Prandtl's theoretical and experimental work on turbulent boundary layers and Wilhelm Schmidt's work on *Austausch* theory, Heinz Lettau and Werner Schwerdtfeger planned and carried out a bold experiment to study atmospheric turbulence using the manned free balloon as their platform. The idea was to become a "parcel" in the circulation and to make measurements of turbulent structure in the lowest several kilometers of the atmosphere.

b ***Beamte.***

Luftwaffe Beamte, or military officials, were civil servants that served in the *Luftwaffe* in technical, administrative, legal, and other positions. They were not civilian employees, as they were uniformed, often serving with advanced units on air bases in enemy territory. Yet the personnel structure of the military officials was not military - with officers, non-commissioned officers, and airmen - but rather the same as the ordinary civil service, with four typically different career levels.

Although they wore insignia denoting their equivalent rank, they did not have military ranks, but civil service grades, and were not paid by military pay scales, but instead according to their civil service grade. Most officials were *Wehrmachtbeamte*, but there were also four special groups of military officials: the air engineers, the air navigators, the aircraft pilots, and the flying safety officials. *Luftwaffe* meteorologists were *Beamte*, subject to military control and discipline, and with command authority. Met. B. ranks (and equivalent US Army rank):

Ministerialdirigent (General officer);
Ministerialrat (Colonel);
Oberregierungsrat (Lieutenant Colonel);
Regierungsrat (Major);
Regierungsassessor (Captain).

c **Collmberg.** <https://en.wikipedia.org/wiki/Collmberg> .

Doctor Richard Savage recalls that Schwerdtfeger had mentioned a mandatory period of data collection at the observatory as something as a hardship at a primitive facility. The Collmberg observatory was under construction from 1927-1932, so it wasn't finished during Schwerdtfeger's time at the *Institut* and it's quite likely that facilities there were very limited. Weickmann was the first director of the observatory.

A mechanically-coupled horizontal pendulum for measurements of inclinations of the Earth's surface was constructed there by Heinz Lettau in 1936-37. Seismic observations have been recorded there since 1932 and helped investigate claims of a German nuclear

test on 2 October 1944. Collmberg has a long history and a medieval fort there has been dated to between 900 to 930 CE. It is the highest elevation, 312.8 m (1026.3 ft), in the Nordsachsen district and in the Northwest Saxon Basin and is near the small village of Collm.

d *Humanitische Gymnasium.*

The Humanistic Gymnasium derives its name from the educational ideas of neo-humanist educational reformers during the course of Prussian educational reforms. Similar reform concepts were developed in Bavaria and Austria. Latin and Greek dominated as the "*humaniora*"; mathematics received special emphasis, and "historical" subjects, French, physics, and natural history were principal subjects as well. In public opinion in the late 19th century and long after, graduates of the humanistic high school were regarded as an intellectual elite.

Gymnasium in the German education system is the most advanced of the three types of German secondary schools, the others being *Realschule* and *Hauptschule*. *Gymnasium* strongly emphasized academic learning, comparable to the British grammar school system or with prep schools in the United States.

Primary school ended with the fourth grade, and pupils left German basic secondary schools (*Volksschule/Hauptschule* or *Realschule*) at the end of the ninth or tenth grade. *Gymnasium* grade levels were from the fifth through thirteenth years of secondary or "high" school.

e *Institut für Geophysik und Meteorologie.*^{4a}

The development of aviation around 1900 brought the physicist Otto Wiener and the astronomer Heinrich Bruns to push for the creation of a geophysical institute at the University of Leipzig. Founded on January 1, 1913, it was the first institute for atmospheric physics in Germany, with Vilhelm Bjerknes as its director. He later stated: "From the beginning of the foundation of the institute, I aimed for the solution of one single problem: the weather forecast." Instead of earlier statistical approaches, he wanted to solve the forecast problem with theoretical thermodynamics and hydrodynamics.

Because of the war, in 1917 Bjerknes resigned as head of the Institute and moved to Bergen, Norway. His studies begun in Leipzig were finished in Norway with the development of polar front theory. Bjerknes named Robert Wenger (1886-1922), one of his former co-workers, as his successor. Unfortunately, Wenger died young in 1922. In 1923, Ludwig Weickmann (1882-1961) became director of the institute and began the start of two decades often referred as the zenith of the institute.

The institute maintained a geophysical observatory at Collm. Built during economically difficult times, it was finally completed and commissioned in 1932. The observatory incorporated a seismological station, a geomagnetic station mainly dedicated to investigate the physics of the solid earth, and a weather observatory.

The institute building was destroyed during a bombing raid on December 4, 1943. In June 1945, shortly before the Russian army occupied Leipzig, Weickmann and most of the other scientists moved into the American-occupied zone. After World War II, the geophysical institute in Leipzig was reinstated and led provisionally by Walter Hesse (1915-1979). Beginning in 1950 the institute was housed in a new building at the university.

f Iron Cross.

The Iron Cross, *Eisernes Kreuz*, abbreviated *EK*, is a former military decoration of the Kingdom of Prussia, later in the German Empire (1871–1918), and still later in Nazi Germany (1933–1945). Adolf Hitler restored the Iron Cross in 1939 as a German military decoration (rather than Prussian), and continued the tradition of issuing it in various classes. The Iron Cross of World War II was divided into three main series of decorations with an intermediate category, the Knight's Cross (*Ritterkreuz*), instituted between the lowest, the Iron Cross, and the highest, the Grand Cross.

The Knight's Cross replaced the Prussian *Pour le Mérite* or "Blue Max". Hitler did not care for the *Pour le Mérite* as it was a Prussian order that could be awarded only to officers. Hitler also created the War Merit Cross as a replacement for the non-combatant version of the Iron Cross. The only recipient of the Grand Cross during the Second World War was *Reichsmarschall*, or "Reich Marshal of the Greater German Reich," Hermann Göring, who was awarded the decoration on 19 July 1940.

The "Cross awards" of World War II, Sep 1939 to April 1945:

Iron Cross Second Class; *Eisernes Kreuz 2*.

Iron Cross First Class; *Eisernes Kreuz 1*. 300,000 awarded to all services.

German Cross in Gold; *Deutsches Kreuz in Gold*. 26,000 awarded to all services.

Knight's Cross; *Ritterkreuz*. 7313 awarded to all services.

Knight's Cross with Oak Leaves; *Ritterkreuz mit Eichenlaub*. 883 awarded.

Knight's Cross with Oak Leaves and Swords; *Ritterkreuz mit Eichenlaub und Schwertern*. 160 awarded.

Knight's Cross with Oak Leaves, Swords, and Diamonds; *Ritterkreuz mit Eichenlaub, Schwertern, und Brillianten*. 27 awarded.

Knight's Cross with Golden Oak Leaves, Swords, and Diamonds; *Ritterkreuz mit Goldenem Eichenlaub, Schwertern, und Brillianten*. 1 awarded to *Luftwaffe Oberst* Hans Ulrich Rudel, the most decorated German serviceman of the war.

Grand Cross of the Iron Cross; *Grosskreuz des Eisernen Kreuz*. 1 awarded to *Reichsmarschall* Göring.

g Julius von Hann (1839-1921). https://en.wikipedia.org/wiki/Julius_von_Hann .

Austrian climatologist regarded by many as the father of modern meteorology. He was educated at the gymnasium of Kremsmünster and then studied mathematics, chemistry and physics at the University of Vienna, then geology and paleontology under Eduard Suess and physical geography under Friedrich Simony. From 1865 to 1868, he was master at the *Oberrealschule* at Linz, and in 1865 was invited by Karl Jelinek to become the first editor of the *Zeitschrift für Meteorologie*.^k

In 1877, he succeeded Jelinek as the director of the *Meteorologische Zentralanstalt* (Central Institute for Meteorology and Earth Magnetism) and was appointed professor of meteorology at the University of Vienna. In 1897, he retired as director and became professor of meteorology at the University of Graz, but returned to Vienna to fill the chair

of professor of cosmic physics in 1900, where he remained until 1910. In 1912, he was made a foreign knight of the Prussian *Ordre Pour le Mérite*.

h *Lehrbuch der Meteorologie* (“Textbook of Meteorology”).

Written by Julius von Hann⁸ and Reinhard Suring⁹; Schwerdtfeger probably read the 1926 Fourth Edition. Textbook used by generations of meteorology students in several editions.

i **Lettau Bluff.** https://en.wikipedia.org/wiki/Lettau_Bluff .

A rock and ice bluff that forms the central part of the western edge of Beaufort Island, and rises 200 meters (660 ft) above the Ross Sea off Antarctica. It was named after Professor Heinz H. Lettau of the University of Wisconsin, an authority on Antarctic meteorology who was active in the planning and development of the meteorological program and equipment for the Plateau Station, 1966–68. With Paul C. Dalrymple and Sarah H. Wollaston, he co-authored an analysis of the 1958 meteorological data from South Pole Station.

j **Ludwig Friedrich Weickmann (1882-1961).**

Mentor to both Schwerdtfeger and Lettau. Emeritus professor of geophysics, Universities of Munich and Berlin, and retired president of the German Weather Service at Bad Kissingen (U. S. Zone) Germany, 1948-1951. He served in the German armed forces in both world wars.

After graduating from the Humanistic Gymnasium in Ulm, Weickmann studied mathematics, physics and astronomy at the Ludwig-Maximilians-University in Munich, completed an internship with Wilhelm Conrad Röntgen, and completed his teacher's certificate in 1906. Beginning in 1905, Weickmann worked as an assistant at the Royal Meteorological Central Station in Munich. He earned his doctorate in 1911 under Aurel Voss at the University of Munich with a mathematics topic on the "theory of surfaces," and then took on a teaching assignment as a private lecturer in Weihenstephan. He later studied under a Carnegie Foundation scholarship at the Geophysical Institute, Bergen, Norway, under Prof. Bjerknes.

Weickmann served with the Bavarian airship battalion from the beginning of the First World War (1914) until September 1915 on the Western Front. In October 1915 he traveled with the head of the military weather service to Constantinople where he served from 1915 to 1918 as head of the Turkish weather service. Weickmann used scientific findings gained there in 1922 at the University of Munich for his *habilitation* dissertation on the topic of "Air pressure and winds in the eastern Mediterranean area".

In 1923 Weickmann joined the Directorate of the "Geophysical Institute" at the University of Leipzig as successor to Robert Wenger (1886-1922). The following two decades are often referred to as the heyday of the institute. Weickmann's extraordinary talent for science organization and his outstanding personality as a university teacher were key factors in that success. In public, Weickmann became well known by participating in sensational research trips, particularly the polar flight of the airship LZ-127 (*Graf Zeppelin*) in 1931 where he served as the director for meteorology. This expedition, with its extensive research program, still holds a prominent place in international Arctic research.

In his extensive list of publications on meteorology and climatology are several pertaining to the voyages of the *Graf Zeppelin*.

Outside of his institute and in addition to his teaching, Weickmann took over a number of other positions. He served for some time as Dean of the Philosophical Faculty and Vice Rector of the University of Leipzig. In the "German Geophysical Society" he held the Deputy Chair for eleven years, and in the "German Meteorological Society" was involved in the advisory board. Weickmann was president of the Reich Ministry for Weather Service in Berlin for two years.

After the occupation of Norway, Weickmann was assigned in April 1940 for some time as the Chief Meteorologist to Luftflotte 5 in Oslo, but maintained a presence in Leipzig until the end of the war.

In October 1945, Weickmann was brought to Berlin by the American Military Government as a consultant for building a new German weather service. In 1946, Weickmann became the first president of the new German Weather Service (*Deutscher Wetterdienst* or *DWD*) based in Bad Kissingen, and held this office until 1952 when he retired. He died in Bad Kissingen in November 1961.

k ***Meteorologische Zeitschrift*** (Meteorological Journal).

This scientific journal was established in 1866 by the *Österreichische Gesellschaft für Meteorologie* (Austrian Meteorological Society) and is one of the oldest journals in meteorology. In 1884 a similar journal was established by the *Deutsche Meteorologische Gesellschaft* (German Meteorological Society). The two journals merged in 1886 and existed until 1944. After being published separately (under different titles) in East and West Germany after 1945, the journal was reestablished in 1992 as a joint publication of the Austrian, Swiss, and German Meteorological Societies.

m **Mount Schwerdtfeger.** https://en.wikipedia.org/wiki/Mount_Schwerdtfeger .

A mountain in the Royal Society Range, Antarctica; it is named after Doctor Werner Schwerdtfeger, senior meteorological researcher, University of Wisconsin–Madison, a driving force in the study of Antarctic meteorology. His specialty was the study of the barrier winds east of the Antarctic Peninsula.

The Royal Society Range (78°10'S 162°40'E) is a majestic mountain range in Victoria Land, Antarctica. With its summit at 4,025 meters (13,205 ft), Mount Lister forms the highest point in this range. Mount Lister is located along the western shore of McMurdo Sound between the Koettlitz, Skelton and Ferrar glaciers. A notable local terrain feature is Allison Glacier, which descends from the west slopes of the Royal Society Range into Skelton Glacier. https://en.wikipedia.org/wiki/Royal_Society_Range .

n ***Oberbefehlshaber der Luftwaffe.***

The *Luftwaffe* was originally organized in a large and diverse structure led by *Reichminister* and supreme commander of the *Luftwaffe* (***Oberbefehlshaber der Luftwaffe***) Hermann Göring. Göring, through the Reich Air Ministry (*Reichsluftfahrtministerium* or *RLM*), controlled all aspects of aviation in Germany including civilian and military aviation. This organization dated from the peacetime period prior to German involvement in the Spanish Civil War.

In early 1937, Göring announced the reorganization of the Reich Air Ministry into military and civilian branches. The military branch was to be led by the *Oberkommando der Luftwaffe* (Supreme H.Q. of Air Force). A chief (*chef*) would lead the general staff. However, the separation of military from civil aviation was incomplete and fragmented. Some parts of the military branch were left under the control of Air Inspector *Generalfeldmarschall* Erhard Milch. These were the Central Branch, General Air Office, and all the inspectorates.

The reason for this reorganized structure was primarily to undermine Milch, who was getting favorable attention from the Nazi Party. However, later during the year and early in the next, Göring again changed the organizational structure by removing three offices from both Milch's and the General Staff's control. He brought under his own direct control the Personnel Office - under *Generalmajor* Robert Ritter von Greim, Air Defense - under *General der Flakartillerie* Günther Rüdell, and the Technical Office - under *Generalmajor* Ernst Udet.

To prepare for the European war, the *Luftwaffe* needed a high command equivalent to that of the Army (*Oberkommando des Heeres* or *OKH*) or Navy (*Oberkommando der Marine* or *OKM*). On 5 February 1935, Air Force Command (*Oberkommando der Luftwaffe* or *OKL*) was created. Then in 1939, the *Luftwaffe* was again reorganized.

The credit for the formation of a true *Oberkommando der Luftwaffe* goes to *General der Flieger* Günther Korten, Commander of Air Fleet 1 (*Luftflotte 1*) and his Chief of Operations *General der Flieger* Karl Koller. They both campaigned to carve a command out of Goring's all encompassing Reich Air Ministry.

The intent was to put the *Luftwaffe* on a true wartime footing by grouping all the essential military parts of the *RLM* into a single command. It included these branches: General Staff; Operational Staff; all the Weapons Inspectorates; Quartermasters Branch; and the Signals Service. Other areas such as training, administration, civil defense and technical design remained under *RLM*'s control. The new organization proved to be more efficient and lasted until the end of the war.

OKL like *OKH* or *OKM* reported to Supreme High Command of the Armed Forces (*Oberkommando der Wehrmacht* or *OKW*). The *OKW* was answerable to Hitler for the operational command of the three branches of the armed forces. *OKL* was divided into a forward echelon and a rear echelon. The forward echelon moved with the theater of operations while the rear echelon remained almost exclusively at *Kurfurst*.

OKL was also the operational branch of the *Luftwaffe*. It was divided operationally into air fleets at a high level. Initially it was divided into four air fleets (*Luftflotten*) that were formed geographically and were numbered consecutively. Three more *Luftflotten* were added later on as German territorial expansion grew. Each *Luftflotte* was a self-contained entity. The leader of each was in charge of overall air operations and support activities in the *Luftflotte* area. Typically, however, a fighter leader (*Jagdfliegerführer*) was in charge of all the fighter operations and reported to the *Luftflotte* Leader.

p ***Reichswetterdienst.***

The *Reichsamt für Wetterdienst* (*RfW*), unofficially the "*Reichswetterdienst*" (*Reichs* Weather Service), was founded in Berlin in 1934 and was under the authority and control of the Reich Aviation Ministry (*Reichsluftfahrtministerium* or *RLM*). The first head of the

RfW was Dr Ludwig Weickmann, who served for two years. The *Reichswetterdienst* primarily carried out weather observation and auxiliary tasks for aviation. Most of the weather observing stations were located at airports.

q Reinhard Suring (1866-1950). https://en.wikipedia.org/wiki/Reinhard_Suring

German meteorologist famous for taking part in numerous scientific high-altitude balloon ascents between 1893 and 1921. *Setting an unintentional world record at the time*, on July 31, 1901 he and meteorologist Arthur Berson reached 10,800 meters (about 35,430 feet) in an open-gondola balloon, collecting data useful to the discovery of the stratosphere in 1902 by Assman and de Bort. In 1932, after over 23 years, he retired as director of the Potsdam Meteorological Observatory. *He supported Schwerdtfeger and Lettau in their balloon experiments.*

r Uniforms of *Luftwaffe* Meteorologists.

Luftwaffe Beamte officials wore the same basic service uniform as *Luftwaffe* officers except for the color of the edge of their shoulder straps (epaulets) and collar tabs. Regular *Luftwaffe* officer shoulder straps and collar tabs had a yellow gold color (*waffenfarbe* or “corps color”). *Beamte* officials had different *waffenfarbe* depending on their specialties; *the color for meteorologists was green*. Decorations and badges were the same as for *Luftwaffe* “regular” officers.

Werner Schwerdtfeger’s uniform would have included green shoulder strap edges and green collar tabs on the tunic, an observer’s badge beneath the left pocket, a reconnaissance clasp over the left pocket, an Iron Cross First Class on the left pocket, and the German Cross in Gold on his right pocket. His flight uniform would have had the rank emblem appropriate to an equivalent officer’s rank on the sleeve.

Recently offered at auction, this is the wartime uniform tunic of a *Luftwaffe* meteorologist Regierungsrat (Major); there are no flying badges and note that the *waffenfarbe* is green and the ribbon for the Iron Cross Second Class is in the buttonhole beneath the lapel:



s *Wekusta and Wetterflugstelle.* (Adapted from Kington and Selinger, *WEKUSTA, Luftwaffe Meteorological Reconnaissance Units & Operations 1938-1945*)¹²

Wettererkundungsstaffeln, abbreviated as *Westa* or *Wekusta*, were *Luftwaffe* weather reconnaissance squadrons created as an innovative and partial solution to the loss of weather data expected at the start of World War II. *Wekusta* collected weather data from

denied areas using specially-instrumented aircraft manned with a trained meteorologist as part of the crew. A surprising characteristic of *wekusta* aircrew was the highly-educated quality of their flight meteorologists, the *Met. B.* Almost half held doctorates or were senior executive officers of the German Weather Service, the *Reichswetterdienst*. Many were well-known university professors.

Beginning with the lead *staffel*, the *Grossraum Wekusta*, in early 1938, five *wekusta* were ready for operations at the start of the war:

- The *Grossraum Wekusta* (Area Weather Reconnaissance Squadron) based at Berlin-Gatow, later redesignated *Wekusta, Ob.d.L.* and then in July 1940 *Wekusta 1, Ob.d.L.*, developed weather reconnaissance equipment and operational procedures, evaluated aircraft for weather reconnaissance service, trained aircrews including flight meteorologists, and flew operational missions. The *Grossraum Wekusta* was the world's first dedicated weather reconnaissance squadron and the lead *wekusta* throughout the war.
- *Wekusta 1* assigned to *Luftflotte 1* and based at Leipzig-Brandis;
- *Wekusta 26* assigned to *Luftflotte 2* and based at Wesendorf;
- *Wekusta 51* assigned to *Luftflotte 3* and based at Neuberg-Langediebach;
- and *Wekusta 76* assigned to *Luftflotte 4* and based at Zeltweg.

These *staffeln* were equipped with modified twin-engine bombers for operational missions, at the start of the war mostly Dornier Do 17 Z and Heinkel He 111 J-1 twin-engine bomber/reconnaissance aircraft. Older types such as the Focke Wulf Fw 58 *Weihe* (Kite), the Junkers Ju W 34, and the Junkers Ju 52 trimotor transport, were used for training and liaison flights. Other aircraft types were added as the war progressed and the need for longer range and better performance grew. The predominant types were the He 111 in later, higher-performance versions, and the Junkers Ju 88 fast twin-engined bomber.

At the height of the war, the *wekusta* included about eleven *staffeln*; the number varied based on operational demand as the occupied areas increased or diminished. At peak, *wekusta* included several hundred aircraft and over 1000 flight crews. The *staffeln* included:

- *Wekusta 1, OKL* (formerly *Grossraum Wekusta*, then *Wekusta, Ob.d.L.*, and then *Wekusta 1, Ob.d.L.*);
- *Wekusta 2, OKL* (formerly *Wekusta 2, Ob.d.L.*);
- *Wekusta 1* assigned to *Luftflotte 1*;
- *Wekusta 3* assigned to *Luftflotte 5*;
- *Wekusta 5* assigned to *Luftflotte 5*;
- *Wekusta 6* assigned to *Luftflotte 5*;
- *Wekusta 7* formed in 1944 and assigned to *Luftflotte Reich*;
- *Wekusta 26* assigned to *Luftflotte 2*;
- *Wekusta 27* assigned to *Fliegerkorps X* (Eastern Mediterranean)
- *Wekusta 51* assigned to *Luftflotte 3*;
- and *Wekusta 76* assigned to *Luftflotte 4*.

Wetterflugstelle -- The development and growth of the *wekusta* was significantly enhanced by the existence and operations of eight prewar *wetterflugstellen* or weather flight stations, abbreviated as *WeFlugSt*. Beginning in 1920, these were pioneering activities at local airfields by university departments and state weather services and then

later by the *Reichswetterdienst*. Using small two-seat airplanes equipped with weather instruments and with some airplanes built specifically for the task (ranging from single-engine open-cockpit biplanes to more modern twin-engine cabin airplanes), the *WeFlugSt* made daily ascents (soundings) collecting weather data through the lower atmosphere to about 500 mb (approximately 5500 m or 18,000 ft).

The daily ascents led in 1935 to the first upper air weather maps at the 500 mb level. In February 1937, *WeFlugSt* data led to the discovery of the Jetstream from repeated measurements of winds near 150 knots (initially interpreted as navigation errors since winds were determined based on aircraft “drift” or the angle between aircraft heading and the aircraft track). During World War II, the *wetterflugstellen* network was greatly expanded, at one point including stations at: Armavir; Belgrade; Bucharest; Darmstadt; Hamburg; Königsberg; Munich; Berlin; Breslau; Köln; Frankfort; Kharkov; Kiev; Madrid; Munster; Nickolayev; Pardubice; Paris; Rechlin; Riga; Saschtschinskaja; Trondheim; Vienna; and Warsaw.

t ***Weltanschauung.***

This expression has often been used to refer to the "wide worldview" or "wide world perception" of a people, family, or person. The *Weltanschauung* of a people originates from the unique world experience of a people, which they experience over several millennia. The language of a people reflects the *Weltanschauung* of that people in the form of its syntactic structures and untranslatable connotations and its denotations.

Weltanschauung, first used by Kant and later popularized by Hegel, was always used in German and later in English to refer more to philosophies, ideologies and cultural or religious perspectives, than to linguistic communities and their understanding of reality.

u ***Wolfsschanze.***

“Wolf’s Lair.” Adolf Hitler’s first Eastern Front military headquarters in World War II. *Wolfsschanze* is derived from "Wolf", a self-adopted nickname of Hitler. He began using the nickname in the early 1930s and it was often how he was addressed by those in his intimate circle.

"Wolf" was used in several titles of Hitler’s headquarters throughout occupied Europe, such as *Wolfsschlucht* (“Wolf’s canyon or gorge”) I and II in Belgium and France and *Werwolf* (“Werewolf”) in the Ukraine. Sometimes used as a synonym for Hitler’s headquarters wherever it was located later in the war. Although the standard translation in English is "Wolf’s Lair," a *schanze* in German denotes a schanze, redoubt or temporary fieldwork.