



The Unrealized History of the Military’s Utilization of Weather as a Weapon, the “Real” Father of Weaponized Weather and the Secret Hurricane Modification Program Nobody Has Ever Heard Of.

By David Reade

Article Disclaimer: This article seeks to disclose the unrealized history of the weaponization of weather (1961-72) which is currently misunderstood and not correctly represented within the Universal Record. The information contained in these pages does not address any perceived weather waponization efforts that may have been developed since 1972, when the designed checks and balances of a modern democracy evaluated the issue raised at the time, conducted public hearings and subsequently recommended a halt to any and all militarized weather modification practices from continuing. Any suggestions to continued weaponized weather operations by the US Military, under ultra-secured programs, are not addressed here.

Cover Photo: *a tropical cloud near the Philippines, cloud seeded with Silver iodide by the US Navy during Operation GROMET II drought relief efforts (circa 1969) - photo by Dr. Edwin X Berry.*

One of the really annoying things to see in the “*Universal Record*” (a term for lack of a better one) that comprises current and archival newspapers, magazines, books and internet webpages, is the incorrect information that is a result of superficial research and a general lack of understanding of the source information – coupled with inherent biases of the originators of said information and or the misconstruing of reference information available to the public.

Such is the case with the universal record's view (*here to be referred to as simply the "public record" or by its individual components*) of Weather Modification, the understanding of cloud seeding, Chemtrails and the past or present concepts of weaponized weather. There are many books, magazine articles and internet webpages devoted to all or some of these subjects that try to demonstrate connections between these elements (*in a historical connotation*) in an effort to present "*smoking gun*" evidence in support of a long-term malevolent weather modification program (*concepts*) perpetrated by the US Government upon its citizens, if not the rest of the world.

However, a true understanding of these elements and how they actually are related (*or not*) to the weaponization of weather, needs to be reviewed for those people wishing to connect the dots and fully understand what weaponized weather really is, as it relates to cloud seeding and other elements that are seemingly related.

First, an understanding of terms is required to fully define exactly what these elements are when used in these smoking gun discussions or declarations of evidence to the perceived malevolent weather modification programs.

"*Cloud Seeding*" is a technological process or technique, that can be utilized in weather modification projects or programs, by which to induce rainfall from certain types of clouds (*not all*) to provide drought relief or in some cases to alleviate or reduce damaging effects of hailstorms. As most know, the cloud seeding process, utilizing various cloud seeding compounds or materials, have been used in past experiments to reduce the damaging and dangerous effects of severe convective storms; tropical cyclones and tornado-producing thunderstorms. Thus, cloud seeding is a tool and in itself is not weather modification – just a component of it.

"*Weather Modification*" is the manipulation, altering or controlling of weather towards a specific result. Weather modification can be accomplished via the utilization of various types of technologies and or processes, one of which is cloud seeding. Weather Modification is not inherently malevolent and the majority of weather modification projects have benevolent goals and outcomes. Again, not all weather modification projects or programs are evil in intent.

Cloud seeding projects and programs, by virtue of their processes are for the most part beneficial to society. The agricultural and ranching industries as well as local, county, state and federal municipalities often look toward cloud seeding to charge water utilities reservoirs through increased precipitation, or snowpack enhancement (*that also supports increased water flow to electrical generating plants*). Cloud seeding has also been investigated to prevent or reduce lightning strikes causing forest fires and has been used towards the proposed mitigation of hurricanes and severe convective storms, reducing damages and ultimately saving lives.

However, as we have seen particularly in the past, there have been those instances where cloud seeding, in concert with certain weather modification schemes, have been utilized in efforts to create weapons of war - that have been viewed with sinister intent.

If you were to inquire about weather as a weapon in the public record (*on the internet*) you would be presented with countless references regarding Project Cirrus, Project Stormfury and Project Popeye that purport to be elements (*evidence*) of the US Government's efforts to weaponize weather. Most of these references and some of those projects cited in the public record "*are not*" examples of the US Military's efforts towards weaponization of weather and only one (*Popeye*) technically became an intended instance of weaponized weather in Southeast Asia. Thus, these programs require a quick review.

Project CIRRUS (1947-52)

Project CIRRUS was a long-running cloud seeding effort conducted by the General Electric Company, under contract to the US Military, specifically the Office of Naval Research (ONR) via the Naval Research Laboratory (NRL) and the US Army Signal Corps. This contract essentially enabled General Electric to conduct a study of cloud dynamics associated with the cloud seeding processes and techniques. The project was dubbed “CIRRUS”, because of the goal of the project to transform super-cooled water droplets into ice crystals, the basis of Cirrus clouds. The major objective of the project’s flight operations was to conduct the first basic exploratory flights to test and determine any potential economic or military significance of the cloud seeding process. Ultimately, the project was established to verify the cloud seeding process to see if it could really affect clouds into producing precipitation.



The first cloud ever seeded by General Electric as part of Project CIRRUS in April 1947.

Project CIRRUS cloud seeding experiments eventually included the seeding of Cirrus clouds, super-cooled Stratus clouds, cumulus clouds and that one (*now famous*) hurricane, with dry ice and Silver iodide.

The majority of the seeding efforts were focused in the Albuquerque and Socorro areas of New Mexico beginning in the fall of 1947, although there were several individual cloud seeding flights conducted over California, the Ohio River basin and off the coast of New Jersey. The first official cloud seeding experiment of the project was conducted in early April 1947 into some Stratus clouds with dry ice to achieve any possible results.

As it would turn out, one of Project CIRRUS’s first cloud seeding experiments would be the seeding of a mature Atlantic hurricane, “Hurricane King” on 13 October 1947, off the northeastern coast of Florida.

Note: *most internet references regarding Project CIRRUS wrongly infer that the project was a program to specifically conduct hurricane modification. Project CIRRUS was in fact an experimental cloud seeding project to explore the parameters of the interaction of the cloud seeding process on various types of clouds to verify the process and develop a specified technique for seeding clouds. The subsequent October 1947 hurricane seeding experiment was the first and last hurricane the project would seed. It was conducted just to see if the cloud seeding process would have any effects on tropical cyclones. Although the storm made an abrupt left-hand turn towards Savannah (Ga.) within a few short hours of the seeding event, a subsequent study of the storm (conducted in 1957), reviewed the storm’s surrounding synoptic environment at the time, reviewed hurricane reconnaissance reports from flights made before and after the seeding by Navy hurricane reconnaissance aircraft unassociated with the experiment as well as reviewed dozens of ship reports from vessels in the area of the storm around the time of the seeding – to conclude that evidence existed to suggest that the hurricane would have made the turn towards Savannah whether the storm was seeded or not.*



The General Electric Project CIRRUS team in front of one of its B-17 aircraft at MacDill Field (Tampa) Florida on the morning of the H-1 seeding of Hurricane King (13 October 1947)

In 1952, the project's seeding operations were greatly impacted when military aircrews and aircraft were re-directed towards combat operations in support of the build-up of the Korean War. The Project looked towards other support elements including aircraft from the Massachusetts Institute of Technology, supporting cloud physics research for the Air Forces' Cambridge Research Laboratory or AFCRL. Despite several cloud seeding flights, the Korean War held greater focus to the military and the Project CIRRUS cloud seeding operations just stopped in September 1952.



In all, more than 225 research flights were flown during Project CIRRUS, between 28 February 1947 and 30 Sept 1952, with more than 116 missions flown as actual operational cloud seeding flights. Despite generating no conclusive results on the effectiveness of the cloud seeding process, the concept of cloud seeding as explored by Project CIRRUS had far reaching effects, that spawned countless other cloud seeding projects conducted by the US Government as well as commercial concerns throughout the United States and the world.



The Project CIRRUS B-17 #85-560 during H-1 Seeding operation. Although originally denied by the Air Force that any of its aircraft had participated in the seeding of Hurricane King, as part of Project CIRRUS, most of the press (media) at the time believed them at their word and wrongly identified Navy aircraft as having flown the seeding flight into the storm. In fact, it was three USAF aircraft that flew the storm, two specially equipped B-17s flown by a USAF flight test unit, under the control of the US Army Signal Corps, and a new WB-29 assigned to the USAF's 53rd Weather Reconnaissance Squadron - Hurricane Hunters squadron based in Bermuda. The USAF only admitted their role in Project CIRRUS (quietly) in 1953.

View of Project CIRRUS Dry Ice seeding system installed on one of the Project's B-17s.



Unfortunately for all those in the public record that have suggested that Project CIRRUS was the first attempt at the weaponization of weather, they would be wrong. Although the project was sponsored by the US Army Signal Corps and the Office of Naval Research, there was no malevolent intent to make weather a weapon - only a scientific interest to understand the parameters of the cloud seeding process and its effects on modifying weather.

Hurricane King on 13 October 1947, illustrating the area cloud seeded by Project CIRRUS aircraft.

Project Stormfury (1962-83)

Despite public record (*and internet*) references to the contrary, Project Stormfury was never a military effort to control hurricanes as a weapon. Stormfury was a well-planned and control experiment with the objective of conducting experimentation towards changing a hurricane's energy exchange via a strategic aerial cloud seeding process with Silver iodide – in an effort to see if Atlantic hurricanes could be tamed and have their destructive winds reduced sufficiently near landfall. There was no malevolent intent whatsoever.

The whole project was designed with built-in safeguards that would not allow seeding of a storm if it came within 24-hours of any populated area. Seeding of storms were confined to a very narrow area of the ocean, within a 100 miles (160 kms) x 150 miles (241 kms) square box in an isolated area north-northeast of Puerto Rico.



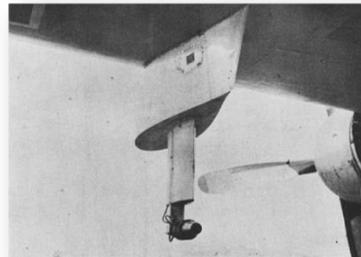
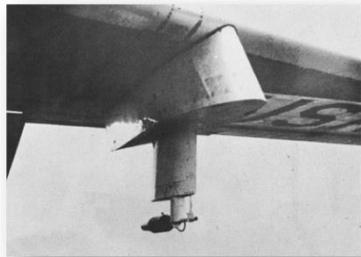
The US Weather Bureau's National Hurricane Research Project B-50 hurricane research aircraft, that was used to seed Hurricane Daisy in August of 1958.

The reduction of a mature hurricane by just one intensity category on the US Hurricane Center's Saffir-Simpson Scale (*a reduction of a category 4 storm to a category 3*) would significantly reduce the level of damages to property and save lives. This was always the goal of the project and that never wavered. The reduction of a hurricane's intensity was formally originated by Dr. Robert H. Simpson of the US Weather Bureau, in the years after Project CIRRUS's seeding of Hurricane King. When he became the (*first*) Director of the US Weather Bureau's "*National Hurricane Research Project*" back in 1956, Simpson incorporated hurricane modification (*or what he would later dubbed "Hurricane Mitigation"*) into the top five goals of the Weather Bureau's hurricane research project.

In fact, Simpson and the hurricane research project had actually carried out a hurricane modification effort in 1957-58. Little known by the general public, this hurricane seeding experiment was conducted by the hurricane research project through the exploitation of the cloud seeding method with Silver iodide. It had been Simpson's own experience and observations, during hurricane research flights he conducted in the early 1950s, that there might be significant quantities of super-cooled liquid suspended within a hurricane's inner core. He thought that this super-cooled liquid could ultimately be artificially influenced by the cloud seeding process to affect change within the storm's dynamic environment and potentially weaken its destructive winds.

Note: *additionally, an associated "micro-cloud physics" project was conducted during the NHRP hurricane seedings of 1957-58 to overcome the failings of the Project CIRRUS hurricane seeding event; where no viable meteorological instruments were on-board the project's aircraft to record any discernable changes of the storm's cloud structures before, during and after the seeding runs.*

Although a number of storms were flown and seeding attempts were made, there was considerable problematics with the (*borrowed*) airborne Silver iodide "*burner*" seeding generator used and the flights were aborted due to the inability of the burner to ignite and stay lit within the slipstream of the aircraft and the torrential rains of the hurricanes' environment. With additional tweaking of the burner, the hurricane research project was finally ready to seed a storm.



With the approach of Hurricane Daisy (*24-29 August 1958*) Simpson and his team flew four seeding mission on the storm over as many days, while the storm was off the east coast of Florida. The one and only successful seeding flight of Daisy, where actual seeding material was released within the storm, was conducted on August 25th – while the storm was centered 220 miles (*354 kms*) east-northeast of West Palm Beach or well east of the Bahamas islands. Another seeding flight was mounted, but aborted after it was determined that the storm's position had move outside a projected safety zone and was forecasted to track too close to land to be seeded.

In the aftermath of the one successful seeding flight on Daisy, other research aircraft flying normal research flight patterns within the storm reported no visible signs of change in the hurricane. Given the problematics of the burner seeding device, against the long-range plans of the hurricane research project's goals towards hurricane modification, the continued use of this seeding device was abandoned. Ultimately, they were just not generating enough Silver iodide smoke to have any effect on the storms. Thus, Simpson threw in the towel on his plans for hurricane modification, thinking that there was no conceivable means to affect the mitigation of a hurricane.

Enter "*Pierre Saint-Amand*" and his talented team from the Naval Ordnance Test Station, China Lake, California.

In the universal public record, there is one internet site that contains a produced documentary-like program entitled "*The Father of Weaponized Weather*" highlighting the comments of a gentleman who has been dubbed The Father of Weaponized Weather. This gentleman discloses that he was a prominent or lead figure in the effort of the US Government to weaponized weather. He suggests that, in a major role, he helped develop and test the processes and techniques to control hurricanes and or the weather – during participation in projects like Popeye and Stormfury.

This person goes on to say that that technology exists today and should be utilized to weaken or steer hurricanes in the post-Hurricane Katrina (2005) era.



Pierre Saint-Amand (circa 1963)

The fact is that the information contained within the content of this video presentation, some of the comments made by this particular individual in this online presentation and on various other internet webpages and in media stories, are not actually correct and that the gentleman has over-stated his importance in the development and testing of the capabilities towards the weaponization of weather. At the least he has embellished his participation in the weather modification programs discussed as well as other background and key elements presented in the video production in question.

The reality is, that the true *Father of Weaponized Weather* is a man named "*Pierre Saint-Amand* !

Pierre Saint-Amand

Despite what various public record references (*books, websites, etc*) suggest, Pierre Saint-Amand pioneered the development of military (*tactical*) weather modification - the weaponization of weather - at China Lake. In fact, he pioneered successful weather modification in general, with dozens of patents (*shared and alone*) and numerous technical papers that demonstrate the processes, techniques, equipment, and capabilities of cloud seeding that were used by the US military and that are still used by commercial cloud-seeding companies today.

Known as a geophysicist, Saint-Amand had a Ph.D in Geophysics and Geology and was a widely known earthquake expert when he joined NOTS China Lake in 1954. In 1960-61, Saint-Amand was assigned to the Astronautical Sciences Division of the NOTS's Research Department (*later the Earth and Planetary Sciences Division of NWC*) with the important task of developing the Navy's weather modification capabilities based initially upon NOTS-developed pyrotechnic silver iodide compounds as well as other cloud seeding solutions and materials.

Subsequently promoted to head the Earth and Planetary Sciences Division, Saint-Amand personally ran or over-saw all of China Lake's numerous weather modification projects, often managing projects on the ground in such places as India, the Philippines, Southeast Asia, the Western Pacific (*Midway and Okinawa*), the Azores, and throughout the United States. He personally lead the China Lake technical contingent to Puerto Rico each year in support of Project Stormfury, conducted most of the pre-brief / cloud seeding training of Navy P-3 Orion flight crews conducting GROMET drought relief cloud seeding operations in the far Western Pacific and Eastern Atlantic oceans. He was the man that pioneered the weaponization of weather beginning in 1961 as well as those in Southeast Asia (*1966-72*).

In the years after the ENMOD Treaty was ratified, Saint-Amand continued to consult on weather modification issues in the US (*North Dakota, South Dakota, Colorado and California*) and with other countries (*Mexico, Canada, Chile, Taiwan, Rhodesia and South Africa*), as well as on earthquake relief and rebuilding projects in Nicaragua. Saint-Amand retired in 1981 after nearly 28 years at China Lake.

He went on to become an institution in the community of Ridgecrest, California, serving as a member (*and past-president*) of the Indian Wells Valley Water District Board, as the driving force behind the Indian Wells Valley Airport, and on the board of the Ridgecrest Regional Hospital.

He died in April 2011 at the age of 91.



As the official story goes, NOTS China Lake was given a project back in 1958-59, to revise or re-develop a new smoke marker for Navy aircrews and jet pilots downed at sea. Although the existing Navy survival smoke marker served well enough on land, it was difficult to see from a long distance during seaborne search and rescue missions. The China Lake chemists and technicians eventually developed a smoke marker in 1960 that produced huge amounts of smoke, given its small size. These smoke markers were made up of a pyrotechnic compound comprised of Silver iodide.

Pierre Saint-Amand was cognisant in various aspects of science and knew the significance of Silver iodide to those involved in cloud seeding. It was in late 1960 / early 1961, that Saint-Amand traveled to the University of Arizona to speak with professor of meteorology and atmospheric scientist; Dr. Louis J. Battan.

Note: Battan conducted research on clouds, their precipitation processes, lightning and their radar relationships. He later (1964) led the development of the 3-cm Doppler weather radar and conducted research to measure the vertical motion in convective clouds and radar detection of (rain drop) particle sizes in thunderstorms.

Having discussed China Lake's invention of a silver iodide based smoke marker compound, now considered a pyrotechnic Silver iodide smoke generator, Battan urgently recommend that Saint-Amand go see Dr. Robert H. Simpson at the US Weather Bureau's hurricane research project. Less than a week later, Saint-Amand visited Simpson at his Weather Bureau office in Washington, DC. During Saint-Amand's presentation of the pyrotechnic Silver iodide compound, he lit a thumbnail size sliver of the compound in Simpson's desk ashtray and completely smoked out the office and part of that floor level in the building.

In the wake of this meeting between Simpson and Saint-Amand, Simpson fired off a request for funding (*grant*) to the National Science Foundation to support an improvised hurricane cloud seeding experiment utilizing China Lake's new pyrotechnic Silver iodide compound. Just a few weeks later, Simpson received notice that his funding request would be approved and immediately phoned Saint-Amand to give him the good news - that Simpson had secured funding to conduct a hurricane seeding experiment with the China Lake invention the next summer, during the 1961 Atlantic Hurricane Season. Although pleased to have received the call from Simpson, Saint-Amand was immediately panicked. Although China Lake had the Silver iodide compound developed, they did not have any means by which to deploy the compound; they had no seeding device. With support of senior management at the NOTS Research Division and the station command, Saint-Amand was placed in charge of the project to quickly design, develop, produce, test and manufacture pyrotechnic seeding devices to encompass the China Lake developed pyrotechnic Silver iodide compound for the Weather Bureau's planned seeding of an Atlantic Hurricane.

The on-base project code name for this program to produce a seeding device was called "*Cyclops*". Thus, the subsequent pyrotechnic seeding devices produced by China Lake came to be called Cyclops – leading to the eventual joint US Navy / US Weather Bureau experiment, to test the seeding of a hurricane, to be also named "*Project Cyclops*".

Project Cyclops

Project Cyclops was an one-off experiment to see if the new NOTS developed Silver iodide compound and smoke generator could be used to modify (*weaken*) a hurricane. The project itself never had any malevolent intent.

Given the (*supposed*) short timeframe, China Lake was able to design, develop, produce, test and manufacture pyrotechnic seeding devices just before the official deployment to Puerto Rico to conduct the hurricane seeding experiment – where a storm had just materialized on the horizon and was a prime candidate for seeding; *Hurricane Esther (10-27 September 1961)*.



Hurricane Esther's eye wall clouds on 8-9 September 1961

The Cyclops (*Silver iodide*) cloud seeding device was a high-capacity pyrotechnic Silver iodide smoke generator that produced high-rates of Silver iodide particles into the atmosphere. Packaged as a bomb-like canister, 8 inches in diameter x 36 inches long and weighing 130 pounds (*60 pounds of which was seeding material*), the Cyclops was the first working Silver iodide cloud seeding device ever produced for that purpose and more importantly was tailor-made for use in the experimental modification of hurricanes.

Although the goal of this experiment was to just test the capabilities of the new Cyclops seeding generator, in a hurricane seeding application, Simpson and the NHRP scientists were additionally eager to utilize this event to test out their new working hurricane modification hypothesis.

During the seeding experiment, Cyclops pyrotechnic generators were dropped into the tops of Esther's eyewall clouds by a Navy A-3 Sky warrior seeding jet from altitudes between 42,800 and 43,600 feet (*13.100 – 13.289 m*).

The Cyclops bomblets released vertical plumes of Silver iodide smoke (*burning down though 22,000 feet / 6706 m*) that eventually flowed downstream via the hurricane's innate circulation. Sixteen Cyclops canisters were dropped into Hurricane Esther over two days, eight on each seeding mission, along a 6 mile (*10 km*) long track across the northern (*right-front quadrant*) edge of the storm's eyewall in 0.81 mile (*1.3 km*) long intervals. The seeding runs occurred near the point of maximum winds, along a course 90 degrees to the right of the storm's track, from a point 4 miles (*6.4 kms*) inward from the wall cloud, outwards 8 miles (*13 kms*) from the center, as the storm was traveling west-northwest.

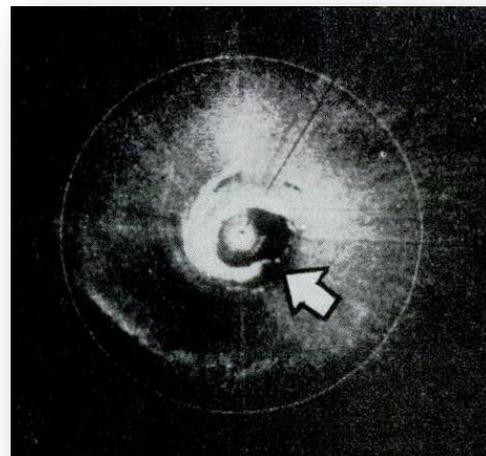
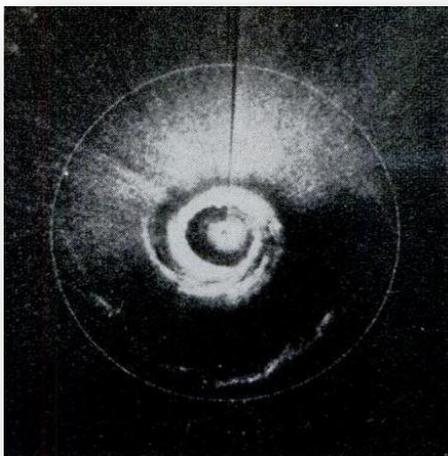
The results of the seeding experiment on the first day, as established by the participating Navy hurricane hunting WV-3 Constellation's APS-20 (*10 cm*) radar that observed the transition of the super-cooled liquid (*water*) into ice in the seeded sector of the storm, were promising. It was here that the

northern (forward) portion of the eyewall disappeared on radar – but not visually. The 10 cm radar showed a reduction in the reflections or reflectivity (echoes) in the area of the storm seeding as well



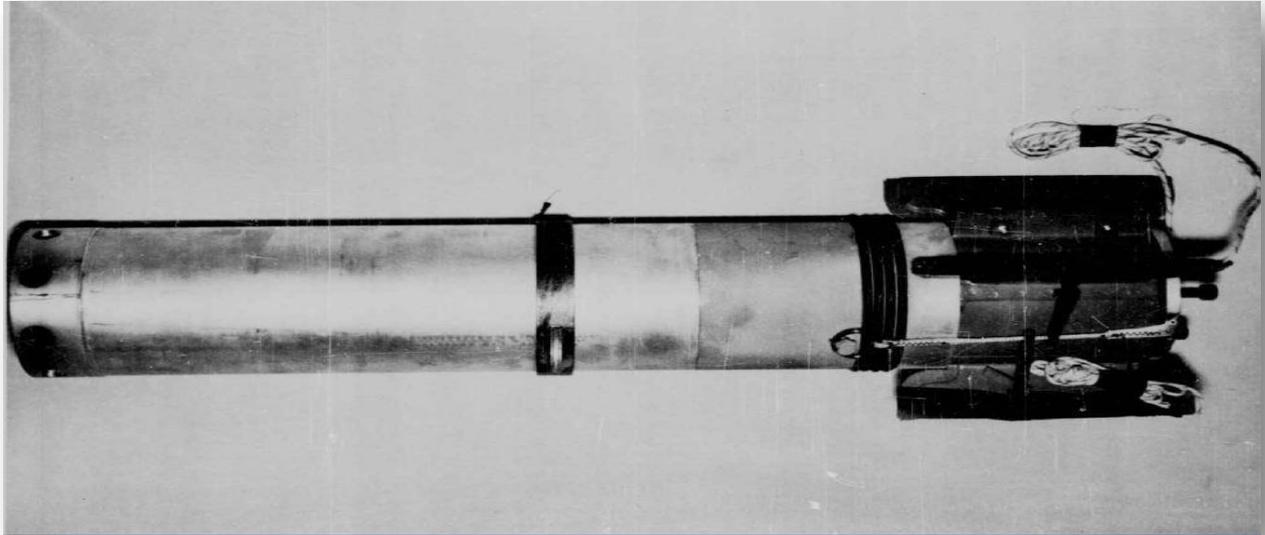
An A3D-2 (A-3B) Skywarrior; like the one used in seeding Hurricane Esther on 8-9 September 1961

as a reduction in the amount of kinetic energy in that region – revealing more than an 180 degree sector hole (gap) in the northeastern wall of the eye. This equates to a collapse of approximately one third of the entire eyewall. However, the Navy Constellation's APS-45 (3 cm) radar did not see any break in the eyewall, nor any significant changes within the central eye region.



Navy aircraft 10 cm radar images of Hurricane Esther before and after seeding operations. Within an 1 ½ hours after the seeding operation, the hole revealed by the 10 cm radar had been replaced and the totality of the eyewall was restored. It was during this 1½ hour period that the eye actually oscillated and changed shape. The eye took on the shape of an inverted (and sideways looking) figure "9", before retuning back to normal.

Later analysis of the seeding data captured established a wind speed drop by approximately 14 percent in the one sector of the storm seeded. Estimates suggested that a large segment of the hurricane, some 400 cubic miles (1667 km³) of super-cooled water vapor (clouds) were converted into ice crystals, over a 40 minute period - comprising about 20,000,000 tons of ice.



The NOTS China Lake developed CYCLOPS Silver iodide smoke generator used to seed Hurricane Esther 1961.

Although the end results of the hurricane modification experiment on Hurricane Esther were mixed, considered inconclusive by some, the test seeding results were encouraging enough for both the Weather Bureau's hurricane research project and the Navy (ONR & NOTS) to pursue a continued effort toward hurricane mitigation.

After the seeding of Esther, Simpson went on to write a report with recommendations to the senior personnel at the US Weather Bureau. In Simpson's report was a proposal for the establishment of a more formal series of hurricane seeding experiments under a new dedicated field project. Once approved, this new effort would be called "Project Stormfury"

Project Stormfury

Subsequently established on 30 July 1962, Project Stormfury became another joint hurricane modification project between the US Department of Commerce, directed through its component agency the US Weather Bureau (later ESSA & NOAA) and the National Hurricane Research Project, with (again) the US Navy, through its Office of Naval Research via the Navy Weather Research Facility as well as NRL. The Navy Weather Research Facility, located in Norfolk, Va., was the Naval weather center designate for all weather modification experiments, with NRL responsible for developing and / or acquiring meteorological instruments and equipment for the Navy's support role in Stormfury.

Initial financial support for the project (for the Weather Bureau) came from the National Science Foundation (NSF) and later from increased funding to the NHRP budget via Congress. The Navy's financial support to the project was through the participation of various US Navy organizations and operational aircraft squadrons; including various Navy Attack jet squadrons, the Navy's VW-4 hurricane reconnaissance squadron and the technical and logistics support of the NOTS – now the Naval Weapons (test) Center at China Lake, California.



Pierre Saint-Amand and Cdr. John F. Barlow (commanding officer of VAH-11) in the weapons bay of Barlow's A-3B Skywarrior that he used to seed Hurricane Beulah on 23-24 August 1963 – during Project Stormfury



A pre- seeding briefing between NOTS and VAH-11

Project Stormfury aircraft circa 1963



Note: Stormfury would ultimately acquire additional cooperative support of the US Air Force's Air Weather Service (AWS) hurricane reconnaissance squadron (the 53rd WRS) as well as other participating air force aircraft organizations.

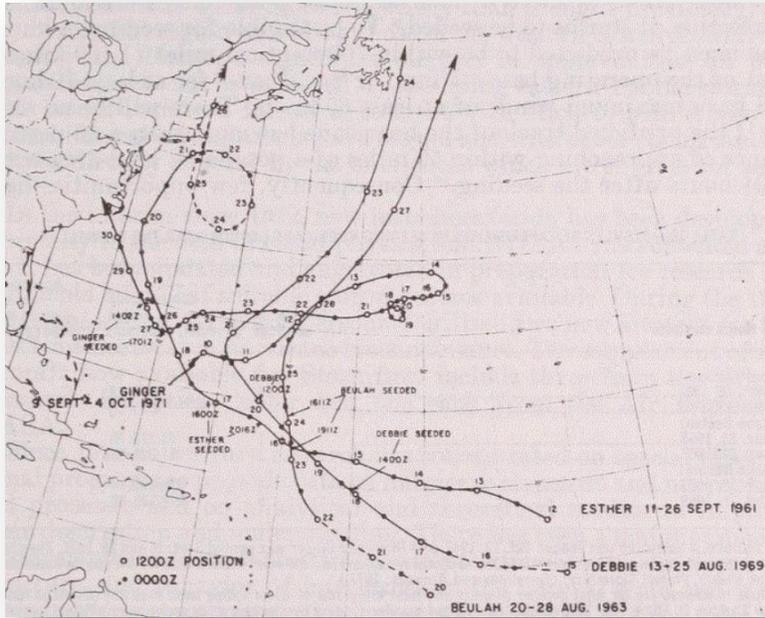
Project Stormfury was the experimental phase of a hurricane modification program to test the so-called Stormfury hypothesis and develop the systems, procedures and processes towards an eventual operational hurricane modification capability. The Goal of the project was to reduce the force of a hurricane's winds by between 10-20 percent, whereby storm damage is directly related to the square of the wind's speed. The scope of the project also included the scientific study of cloud physics, storm structure and cloud dynamics that were critical towards the understanding of the hurricane modification process.

Even though the US military was involved and participated in the program, it was never the intent of US Weather Bureau (*later ESSA and NOAA*) to allow this project to become subverted into a weapon of war by the Military. In fact, it can be said now that the Military, specifically the US Navy, never had any intentions to subvert Project Stormfury. It didn't have to, for some very specific reasons that we will see in the pages ahead. So any public record and / or internet connotations that suggests Project Stormfury was somehow a malevolent military program towards the development of hurricanes as a weapon, are sadly misinformed and have misconstrued the true purpose of the project.



Project Stormfury aircraft gathered at NAS Roosevelt Roads, Puerto Rico (circa 1969)

Unfortunately, Stormfury's slow methodical scientific process, the limitations put on it as to where and when they could seed storms and having only seeded three storms in 12 years (*4 storms if you count Esther 1961*) forced an internal reevaluation of the program in 1974. It was subsequently determined that, given their previous momentum, it would take the seeding of 12 more (*Debbie-like*) storms to achieve the confidence needed to consider taking Stormfury operational. It was further estimated that it would take another 20-25 years to achieve those 12 storms, given the frequency of hurricanes in the Atlantic during the 1960s.



A chart of all hurricanes seeded by the US Weather Bureau during Project Stormfury.

It was at this point that senior (NOAA) Stormfury personnel began formulating plans to move the project to the Western Pacific, where the frequency of tropical cyclones was much greater and encompassed much more wide-open sea lanes where seeding experiments would be less hampered by stringent limitations. Stormfury also start looking for additional partners in the Pacific. Australia was interested; that is to say Australia's scientific community and its Bureau of Meteorology were supportive of teaming up with Stormfury after the devastation wrought by "Cyclone Tracy" (21-26 December 1974) that nearly completely destroyed the Northern Territories city of Darwin.



Actual A-3B Skywarrior Jet from Heavy Attack Squadron 11 that seeded Hurricane Beulah August 1963



The destruction wrought by Cyclone Tracy 25 December 1974 on the City of Darwin

However, the Australian federal government was leery of United States activities in their country at the time (*i.e. the CIA's plan to depose Prime Minister Gough Whitlam of Australia / the 1975 Australian constitutional crisis, as disclosed by Christopher Boyce – aka the Falcon – from the Falcon and the Snowman fame*) and refused to consider partnering up with the US on any weather modification program. Later, the Philippines expressed an interest in co-sponsoring Stormfury, but complaints from China and other nations in the region put a halt on any further consideration.

Note: *China objected to any modification of typhoons in the Western Pacific principally on concerns over potential changes to their normal weather patterns that might occur from what they perceived as fallout from Geoengineering within their synoptic environment. However at the time, within the US itself, debate was underway given the recent disclosures of militarized weather modification conducted in Southeast Asia – that must have weighed into any concerns by the Chinese. In the end, China was just unwilling to lose the beneficial rains that come each year from unmodified tropical cyclones. The Chinese went so far as to stifle the advancement of any tropical cyclone modification experiments in the Western Pacific by proposing limitations to such experiments at the World Meteorological Organization's (WMO) sponsored Regional Typhoon Committee (typhoon modification) Conference in 1974.*

Stormfury suffered another setback in 1975, when the US Navy ceased support to the project with the disestablishment of its only hurricane reconnaissance squadron, VW-4.

However, one of the more significant factors that contributed to the decline of Project Stormfury (*and weather modification in general*) comprised the change in the general public's attitude towards the environment, with the rise of the environmental awareness movement, that championed the protection of the environment that weather modification projects sought to manipulate. The grassroots

environmental movement, which advanced out of the 1960s peace culture, embraced opposition to weather modification and further amplified the negative view that ultimately caused political support for such weather modification projects to wane and available funding to dwindle.

US federal funding for weather modification projects in the US was slowly reduced, just at a time of increased scientific and technical advances as well as the actual growth in recommendations for more government funding. The decline in weather modification projects can be seen in US Government funding statistics (*reports*). Beginning in Fiscal Year 1974, federal funding for weather modification was reduced by 21% and continued a downward slide until there was little or no funding approved at all for weather modification projects; including Stormfury.

Note: *US federally funded weather modification projects, in the mid-1970s, were posted at \$19 million dollars, which dropped to \$12 million in 1985, and then was sharply reduced to such significant low levels, that the amounts were no longer tracked by any of the government agencies. Some estimates suggest that weather control program funding dropped to less than 10% of its peak (\$24M) in 1973. At this time, the Soviet Union, in comparison, was spending more than \$100M on weather modification in 1973 alone.*

Another factor contributing towards the general negative view of weather modification in the US, that added to the downfall of weather modification projects like Stormfury, was the subsequent disclosure of the US Military's secret cloud seeding operations in Southeast Asia, known as; "Operation Popeye" during the Vietnam Conflict. In the wake of this disclosure, weather modification programs began to be viewed with suspicion by US Lawmakers and the public alike. Coupled with US Government reports suggesting that the hurricane modification hypothesis was flawed, calling into question Stormfury's ability to differentiate between effects of their cloud seeding operations and those of the natural eye replacement process in mature hurricane life cycles, further eroded any support. The persistence of these reports (*often repeated in the universal public record*) and all the other factors piled up to spell the demise of Project Stormfury.

In the end, Stormfury was quietly canceled in July 1983, despite the fact that the Stormfury hypothesis was never really fully tested. Three (*or 4*) storms in 22 years is not really a viable test of the Stormfury theory.

Note: *an early October 1998 statement issued by the American Meteorological Society announced; " that there was no sound physical evidence that the hurricane modification process, nor the cloud seeding process used to control tornado producing thunderstorms, decreased the intensity or otherwise lessened the severity of these severe storms".*

Some thirty-two years later, hurricane researchers and scientists still disagree on the science of cloud seeding, hurricane modification and the Stormfury hypothesis. A perceived lack of scientific credibility continues to hamper weather modification projects today and subsequent future hurricane modification and abatement proposals.

Now that the proper context of these previous weather modification projects has been established for the record, it's evident that the history of weaponized weather must be outlined.

The Unrealized History of Weaponized Weather

The history of weaponised weather is, to the general public and within public record, unrealized. Mostly due to a general misconstruing of available information in the public record on the subject and partly through the omission of information relating to weather modification events, where weather was manipulated for militaristic goals and objectives.

Although experiments in modern cloud seeding and weather modification events goes back to the end of the 19th Century, weaponized weather is a product of the Cold War with the former Soviet Union. In the late 1940s and into the early 1950s, papers were written suggesting the utilization of weather (*as a weapon*) to fog up (*cloud-up*) the airfields of enemy forces to deny them flight operations, muddy up passes in the mountains of eastern and western Europe to slow-down or mire enemy tank battalions from advancing very far into Western Europe, and strike at and cause droughts in an enemy's agricultural zone to cause food shortages and hopefully starvation amongst the troops and civilian populace. There were even concepts presented to use weather more as a tactical weapon, with thoughts of utilizing (*gain control of*) severe convective storms to steer thunderstorms over enemy territories, causing wind and flood damages to strategic or tactical resources.

However, none of these concepts or efforts ever actually came to fruition, save three, and then not until their start in the early 1960s. Although public record (*internet and literary*) references like to suggest that the US Military in general had a wide-ranging pathological agenda towards the development of weaponized weather applications, this could not be farther from the truth. In reality, it was only the US Navy that earnestly pursued different opportunities to develop weather as a weapon. Despite what the internet suggests is the reality of the history of weather modification and / or the history of the weaponization of weather, no other US Agency nor Military service; not the US Air Force, not the US Army or other government departments, conducted the types of cloud seeding / weather modification experiments and operations to use weather as a weapon, than the US Navy.

The US Navy early on stated their goals with regards to weather modification as; *to pursue cloud seeding capabilities, equipment (technology) and processes (techniques) to a point by which to successfully manipulate the weather whenever – wherever military requirements dictate.*

The first Navy discussions towards the use of weather modification occurred during WWII, where some stories suggest that ships guns were used to destroy dangerous water spouts at sea. After the war other stories suggest that the Navy experimented with high explosives as a means to disrupt hurricanes. Unfortunately no archival records have ever been found to date to verify this use of explosives on hurricanes.

Later during the mid-1950s there were some suggestions to “nuke” hurricanes. Senior Meteorologist at Sandia National Labs, Jack W. Reed had the important task of predicting the fallout and shock patterns for US atmospheric nuclear bomb tests conducted both in Nevada and in the South Pacific. (*Jack Reed had pioneered tropical cyclone reconnaissance in the immediate post-war (1946), that led to the formation of USAF typhoon reconnaissance operations in the Western Pacific between 1947-87*) Given his background with tropical cyclones and his work studying the effects of nuclear blasts on the earth's atmosphere, Reed seemed eminently qualified when he proposed dropping a nuclear bomb on a tropical cyclone. His plan was not to destroy a storm, just to weaken it and or change its trajectory out of the way of populated areas. Although there have been a number of nuclear bomb tests conducted to prove potential peaceful uses for nuclear technology; no known nuclear bomb test has ever been conducted on a hurricane (*tropical cyclone*) to date. It's interesting to note that Dr. Edward Teller, Father of the H-Bomb, also advocated the use of nuclear bombs to destroy hurricanes.

As stated before, it's believed that a nuclear bomb-test has never been conducted on a tropical cyclone. However an atomic bomb test in the Pacific did once use a typhoon to rainout all the radioactive fallout from a blast cloud into the ocean. During Operation Greenhouse (1951) a bomb tests in the Pacific (*Shot George; the first thermonuclear bomb – type experiment*) was timed with the approach of a typhoon (*believed to have been Typhoon Joan 6-13 May 1951*) where the storm enveloped the blast's radioactive cloud and its torrential rains dumped all the fallout into the ocean before the cloud could get very far.

But in the end, no major practical weather modification applications materialized during or after the WWII.

In the early post war years of the late 1940s and early 1950's, weather modification experiments began during an era of technological advancements in jet aviation, rocketry and the growth of technology as the answer for all things new to offer society. This comprised the Navy's participation and sponsorship of benign cloud seeding projects such as Project CIRRUS.

However, with the inconclusive results from the CIRRUS cloud seeding program, the Navy had no choice but to start all-over again.



An actual image of the thermonuclear bomb George blast during Operation Greenhouse in May 1951

The next opportunity for the Navy commenced where Project CIRRUS left off, under a wide-ranging meteorological program called “*Project AROWA*”

Project AROWA, or the “*Applied Research; Operational Weather Analysis*” department, was a small division within the (*then*) US Navy Bureau of Aeronautics (*the Navy's material-support organization for naval aviation: 1921-59*). Established in October 1950, Project AROWA originally began as a one-off (*stand-alone*) project to provide basic weather research to improve fleet-wide weather forecast issues (*meeting the needs of the fleet updating and developing new forecast techniques, especially for the ships at sea with limited Aerological services*), but quickly became a focal-point department for all Naval meteorological research.

AROWA conducted more than 20 long-running meteorological research projects during its 7-year existence, that comprised such diverse weather elements as work on a revised or newly developed altitude (*pressure*) fuses for Atomic Bombs to upper atmospheric research associated with the Jet Stream. The department, along with ONR, conducted the Navy's first research efforts on hurricanes, studying characteristics, structure and dynamics to improve forecast track predictions, that often included the use of the Navy's Hurricane Hunting aircraft.

However, with regards to this specific weather modification discussion, AROWA became the Navy's focal-point research agency to oversee and conduct cloud seeding experiments in the immediate period following Project CIRRUS.

Under AROWA, one of the more significant cloud seeding projects of its day commenced, one that further tested the previously proposed theory of Artificial Cloud Nucleation (*cloud seeding*) on larger scale cyclogenesis (*on extra-tropical / winter storms*) that developed along the US East Coast each year. The Navy wanted to determine if cloud seeding techniques would be capable of producing large scale weather centers to interact with the violent winter storms (*at an earlier stage in their development*) to reduce their intensities before they've had a chance to fully develop. This cloud seeding experiment was conducted secretly and was not disclosed to the American people at the time. This cloud seeding effort came to be called "*Project Scud*"

Project Scud (1952-54)

Beginning in the winter of 1952, Project Scud employed two different methods of randomized cloud seeding, encompassing 17 ground-based Silver iodide (*smoke*) generators and aerial dispensed dry-ice seeding materials from several US Navy aircraft. The ground-based silver iodide (*burner*) generators were positioned at different cooperating US Coast Guard bases and airfields along the US East Coast – from New York City to Tampa, Florida. The aircraft operations were flown from numerous Navy airfields and bases from Maine to Florida – although aerial cloud seeding sorties took place as far north as over Nova Scotia, Canada with or without the approval of that country's government.

Project Scud was the inspiration of Dr. Jerome Spar from the Meteorological Department (*College of Engineering*) of New York University, under the sponsorship of the Navy's Office of Naval Research and Project AROWA.



US Navy hurricane hunting PB4Y-2 Privateer and PV-2 Neptunes; flown by the Navy Hurricane Hunter's Squadron (VW-4) to conduct the aerial cloud seeding component of Project Scud (1952-54)

Project Scud's flight operations were conducted by aircraft flight elements of the US Navy's hurricane reconnaissance squadron, recently re-designated VW-4 at the time. A three – plane formation (*initially PB4Y-2 Privateers and later PV-2 Neptunes*) seeded vast tracks of the eastern seaboard of the United States. The Navy hurricane hunting aircraft were equipped with dry-ice dispensers mounted in the rear of the aircraft, just forward of the aft hatch, with a drop-chute (*tube*) installed through the body (*fuselage*) of the plane. The motorized dispensing unit had variable speeds and was capable of dispensing up to 150 pounds of seeding material per hour. The dry-ice was pre-crushed and stored in insulated containers housed in the main compartment of the aircraft with back-up containers carried in the weapons bays. Upwards of 13 cases of dry-ice were used per flight, per aircraft.

The aerial component of the project was broken down into separate phases conducted over two years. Phase 1 (January – April 1953) dispensed approximately 3000 pounds of seeding material (1000 pounds per aircraft) at an average drop rate of one pound per mile. Phase 2 (December 1953 – April 1954) of the project increased the amount of dispensed seeding material to 7500 pounds (2500 pounds per aircraft) with an average dispensing rate 5 times that of Phase 1 or 5 pounds per mile. Over the span of the entire program, more than 30 tons of seeding material was dispensed.

Note: the length of each of the tracks varied between 323 and 645 miles (520-1038 kms) with an average length of 522 miles (840 kms).

Besides serving as seeding aircraft for the project, the Navy hurricane hunting aircraft also conducted cloud physics survey flights and weather reconnaissance flights documenting the meteorological environment within the seeding areas before and after the seeding events. VW-4 and other aircraft also conducted photo reconnaissance (*photogramphy*) missions to document changes in the clouds from the seeding experiments. More than 325 color and black & white photos were taken.



The results of Project Scud were disappointing, with meteorological indicators suggesting that changes in the environment failed to show significant or definitive results that could not have occurred as a result of natural variance within the winter storms.

The Navy again failed to gain any significant return on their investments in the science of cloud seeding. But that did not stop them. The next significant cloud seeding project that came along comprised the use of Carbon Black.

Project Blackbody

The Navy conducted another cloud seeding project in 1958, this time testing the feasibility of cloud modification by the release of Carbon Black (*dust*) into clouds.

This experimental cloud seeding effort, called “*Project Blackbody*”, was the brain-child of Dr. Florence W. Van Stratton, at the time the Director of the Technical Requirements Section, of the Technical Readiness Branch, of the Naval Weather Service Division (*under the CNO’s office*) - the only woman meteorologist working in the US Navy’s Weather Service at that time.



Commander Florence Van Stratton: had been one of the first women accepted into the US Navy’s “WAVES” program in 1942 and became one of the first war-time

weather forecasters for the Naval Aerology Service (Bureau), where she became instrumental in advancing the science of tactical naval meteorology during WWII. A graduate of New York University (in 1933) and the Massachusetts Institute of Technology with a Ph.D. (in 1942), Van Stratton became a Navy Aerological Engineer (or Atmospheric Physicist) in the post war years until 1962 when she retired from Naval Service as Commander - but continued to consult to the Navy on atmospheric physics as a civilian until 1973. Career-wise, Van Stratton was instrumental in the development of the rocketsonde, a vertically launch rocket with all the components of a radiosonde weather balloon, to collect weather data in the upper atmosphere. She also developed the constant-altitude weather balloon and the Navy’s Oceanographic Meteorological Automatic Device (NOMAD), an open-sea floating weather station. NOMADS were often placed in the path of hurricanes and captured important storm data relevant to on-going hurricane research during the 1970s.

Program Managed by Van Stratton, Project Blackbody was sponsored by her department and ONR (through the Naval Research Laboratories) and focused on utilizing (ultra-fine) Carbon Black powder (or soot – one of the blackest substances known) to heat up the temperatures in isolated clouds, altering the heat balance within the clouds, to dissipate them or “cloud carboning” them, a term developed by Van Stratton.



A Hurricane Hunting Constellation like the ones used by VW-4 during Project Blackbody (1958)

The project began in July 1958 and again comprised the use of the US Navy hurricane hunter squadron's (VW-4) aircraft as seeding planes. Where conventional cloud seeding material like dry ice targeted super-cooled clouds, seeding with carbon black was used on any kind of clouds at any temperature. The Navy Constellations were modified with a cloud seeding chute, fitted through a hatch in the aircraft's floor. The carbon black was dropped into the chute and out into the slip-stream underneath the aircraft. While one squadron Constellation was a designate seeding plane, another acted as a scouting and monitoring aircraft.

Note: other observation aircraft participated in the Project Blackbody experiments including AJ-2P Savage Photo-Reconnaissance / Surveillance aircraft from Heavy Photographic Squadron 62 (VAP-62) that were used to photographically capture seeding results on still and motion picture film. VAP-62 would later support Project Stormfury, providing photographic surveillance and cloud seeding capabilities to the project between 1964-66.

Seeding flights were flown from NAS Jacksonville into isolated clouds off the coasts of northern Florida and southern Georgia. The carbon black would be dispensed into the cloud tops at altitudes between 4800-12,000 feet (1463 - 3658 m). The clouds were seeded with between 1 ½ - 6 pounds (.68 – 2.72 kgs) of carbon black dropped as carbon dust mixed with a little water - at the time costing about \$3.00 dollars. The carbon black particles ranging between 10-100 microns in size

During one seeding sortie, several seeded clouds split length-wise, turned a dark misty grey and then just faded away to nothing within 8 minutes.

Another component of the project comprised the seeding of clear-air at existing cloud levels to create clouds. On cloudless days, a trail of carbon black was petered out behind the seeding aircraft for more than 1 mile (1.61 kms) with a number of small clouds seen to have formed along the seeding track. Then, the experiment would disperse carbon black into these same clouds again and watch as they just disappeared.

However, one of the failings of the project, was no adequate cloud physics equipment to record what was causing the clouds to form and or disappear physically. Although they had film and stills to document what happened, there were no physical measurements to detail any of the interactions with in the environment that caused the clouds to form or dissipate.

Later in 1958 and 1959, the US Air Force's Geophysical Research Directorate (USAF – GRD) conducted similar tests with carbon black that saw even less success than the Navy and also suffered from a lack of knowledge regarding the radiative properties of carbon black. Recent statistical studies have established that to have any effects on clouds with carbon black requires significantly more quantities of material to achieve results. The early Navy and USAF experiments utilized too little amounts to garner lasting successes.

Meanwhile back at China Lake, the weapons test facility had been supporting ongoing Navy weather modification projects since 1949, when they sought to reduce warm fogs hampering flight operations at some Naval Airfields in California and elsewhere in the United States. China Lake was testing different ways of dispersing cloud seeding materials to develop a capability to clear the fogged-in airfields.

But at a much higher level within the Navy, at the Bureau of Ordnance (*later the Navy Weapons Bureau*), the interest in cloud seeding came to the fore and funding was made available (*through ONR*) to continued research in the hopes of a breakthrough in weather modification that would provide the edge they were looking for towards the development of a weather weapon by which to surprise the Soviets in the advent of a sudden melting of the cold war in to that of a hot one.

Enter RADM. William F. "Red" Raborn.

Admiral William F. Raborn, having had a notable World War II career, became the first Director of Special Projects at the Bureau of Weapons in November 1955. Raborn was personally selected by Chief-of-Naval-Operations (CNO) Admiral Arleigh Burke (*who supported Adm. Hyman Rickover in developing the US Navy's nuclear-powered submarine force*) to be the program lead on the project to develop the Navy's A-1 Polaris (*sub-launched*) Ballistic Missile System to arm Rickover's Nuclear



An actual image of a VW-4 Constellation dropping carbon black into clouds off the coast of North Florida during Project Blackbody (circa July 1958)

Submarine fleet. Delivering the Polaris Missile system three years ahead of schedule, Raborn was promoted to Deputy Chief of Naval Operations (*D-CNO*) in 1962, later retiring from the Navy in 1965 – to become the 7th Director of Central Intelligence Agency.

While still at the Special Projects Office, Bureau of Weapons, Raborn became aware of the weather modifications efforts being made at China Lake, and became interested in the development of the NOTS's pyrotechnic Silver iodide seeding compound and its potential development towards a weather weapon. He ordered NOTS to develop the compound further, specifically towards weather modification applications.

Note: *although not generally known, China Lake had a secret development role in the production of the Navy's Polaris SLBM system. It was under this effort that Raborn visited China Lake a number of times in the mid-to-late 1950s and early 1960s.*

It was for Raborn that China Lake actually developed the "Cyclops" seeding generator that would revolutionise cloud seeding capabilities and

techniques towards the development of weather as a weapon – not specifically for the Weather Bureau's hurricane mitigation program as previously acknowledged.

Even as Raborn moved on to the Deputy CNO position, he collaborated with China Lake in the further development of the center's cloud seeding capabilities. In fact in early 1963, Raborn wrote a crucial magazine article (*"New Horizons of Naval Research and Development" published in the US Naval Institute's "Proceedings" Magazine - January 1963 issue*) that spoke about *"..... the capability to change the direction of destructive storms and guide them towards the enemy has already been experimented on"* Raborn also went on to say; *".... that we have taken our first steps towards developing an environmental warfare capability"*

The interesting thing about these statements is, that if he was referring to having already conducted experiments before January of 1963, this would have been well before Project Stormfury had ever taken to the air or conducted it's first (*true*) hurricane seeding experiment in Hurricane Beulah in August 1963.

Was he talking about; Hurricane Esther ?? Project Cyclops and the seeding of Esther never had as its goal to re-direct the course of hurricanes and guide them to potential enemies. As we will see, weaponized hurricane modification began much earlier than most people realize and was funded indirectly by Raborn's Office of Special Projects, Bureau of Weapons.

The Naval Ordnance Test Station (*NOTS*), later the Naval Weapons Center (*NWC*), China Lake, would go on to pioneer the art and science of weather modification, developing various cloud seeding concepts and techniques as well as producing a number of pyrotechnic devices and seeding material compounds. The significance of China Lake's development of its pyrotechnical form of Silver iodide cannot be overstated enough and was a major breakthrough in modern cloud seeding technology. It was Pierre Saint-Amand that elaborated the point distinctly; when he explained that prior to China Lake's development of its Silver iodide compound, cloud seeders were not utilizing real Silver iodide.



RADM. William F. "Red" Raborn

As established by Vonnegut, (*pure*) Silver iodide catalyzes super-cooled water, within convective storms, to freeze into ice. Silver iodide must not dissolve, before the super-cooled liquid has a chance to freeze. Silver iodide is relatively insoluble and has a particular structure similar to ice crystals.

However, when early cloud seeders utilized acetone burners to produce Silver iodide smoke, it wasn't pure Silver iodide. Instead, they were producing various complex compounds of silver and Alkali iodides, with different physical properties, trying to catalyze the growth of ice crystals. It's very possible that this is the reason that early cloud seeding and hurricane seeding experiments presented little success. It wasn't until China Lake developed its pyrotechnic form of "*pure*" silver iodide generated smoke that cloud seeding and weather modification in general was advanced.

China Lake would subsequently support cloud seeding projects around the world, that spanned the scope of weather modification including severe storms (*tornado and hurricane*) modification experiments, fog suppression, and rainmaking (*drought relief*) operations, as well as the subsequent highly-publicized military cloud seeding operations in Southeast Asia (SEA) known as "*Project & Operation Popeye*".

China Lake Seeding Projects

By 1967, the (*now*) Naval Weapons Center, China Lake weather modification investigations and experimentations had been focused along several areas of interest; 1) Warm and Cold Fog / Warm and Cold Cumulus Cloud seeding; 2) Cold Clouds precipitation enhancement / drought relief; seeding 3) the control of Tropical Cyclones – through the "*Mitigation*" (*defined as to reduce severity or lessen the force or intensity*) of hurricanes or the "*Amelioration*" (*defined as to make better or more bearable / tolerable*) of severe storms. But as we will see, China Lake also conducted a series of projects to secretly manipulate the weather into weapons of war.

Note: "*mitigation*" was the word originally coined by Dr. Robert Simpson when he established Project Stormfury in 1962. However, Pierre Saint-Amand consistently used the word "*ameliorate*" when describing their participation in Project Stormfury. Seemingly there is some subtle difference in the meaning of these two words between the two scientists. Or perhaps it is in the eye of the beholder and to Saint-Amand, "*ameliorate*" relates to his view of hurricane control in general.

One of China Lake's long-term investigations, under various projects, was its development and subsequent ability to dissipate warm and cold fogs as well as produce precipitation from warm and cold cumulus clouds to clear-up airfield to relieve halted aircraft operations.

With regards to severe convective storms (*hurricanes and tornados*), China Lake supported the US Weather Bureau's research of severe storms associated with tornado-producing thunderstorms in the US mid-west. Run much like Project Stormfury (*actually overseen by Bob Simpson*) the US Weather Bureau conducted tornado / thunderstorm research from the early 1960s through the 1980s, with many research aspects of those programs continuing to this day.

Supercell storms associated with tornado production comprise severe turbulence, gusty surface winds, hail and lightning. Much research conducted in the 1960s (*1964-68*) included a number of cloud seeding experiments to specifically investigate the possibilities of weakening these severe storms to prevent the formation of tornados, hail stones, lightning and torrential rains causing flooding. In these efforts, China Lake developed airborne silver iodide seeding generators, different seeding materials and seeding techniques as well as subsequent cloud seeding rockets. China Lake additionally contributed an aircraft for seeding and monitoring purposes during the tornado research events. This was the same A-3B that China Lake used for Stormfury hurricane seeding experiments between 1964-66. This aircraft later crashed on its way to a seasonal tornado research deployment, in Ohio, killing the crew of four.

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Although not generally known, China Lake was key in helping the USAF (AWS) to study cold and warm fogs, through the USAF's "Cold" series of weather modification projects, to develop counter-measure seeding methods to dissipate those fogs and clouds hampering USAF aircraft operations around the world. These included projects like *Cold Cowl* (1967 -1973); that comprised the fog (and supercooled cloud strata) clearing at Elmendorf AFB (Alaska) affecting normal aircraft operations from that air field. The cloud seeding operations included the use of dry ice dispersed (via China Lake developed dry-ice crusher and dispensing systems) mounted onboard WC-130Es from the AWS's 54th Weather Reconnaissance Squadron. Another similar effort included Project *Cold Crystal* (1968 – 1974) that comprised Cold Cowl - like dry ice seeding operations, but were conducted in Germany (at Hanh, Britzburg and Spangdahlm airbases) flown by elements of the AWS's 53rd WRS. The dry ice was dispersed at low altitudes over fog banks, that blanked airfields and turned the super-cooled water droplets that made up the fog into ice that fell as light snow, clearing up the visibility to resume normal airfield flight operations. Although these and numerous other "Cold" projects were run by the US Air Force AWS, China Lake was an integral component of these experiments and developed many of the seeding systems and techniques used by the AWS aircraft.



Under a long-running series of experiments known as "Project Foggy Cloud" (1968-1972; in some cases as late as 1977), China Lake studied warm fogs which comprised different techniques (not just cloud seeding methods) to determine the best method to disperse or suppress warm fogs. Over the years, various techniques were tested including both conventional and hygroscopic cloud seeding (with various seeding material – such as glycerine), warm helicopter rotor down washes as well as the spreading of water-borne monomolecular films.

Note: the water-borne monomolecular film application was part of a sub-project to Foggy Cloud known as the "Panama Canal Warm Fog Dispersal Program" that sought to utilize monomolecular films, spread over the Panama Canal's surface to block the formation of fogs that hampered ship movements through the canal / loch system.

USAF cloud seeding WC-130 Hercules dry ice seeding system used to reduce fog like at Elmendorf AFB (Alaska)



One of Saint-Amand's politically successful weather modification projects was called (*Operation*) "GROMET", where cold cumulus clouds were seeded to produce precipitation specifically for drought relief. GROMET is a term derived from the words "*agronomy*" and "*meteorology*". Agronomy is defined as the science of soil management and crop production, combined with meteorology, as it relates to cloud seeding, is the genesis of the project name established by China Lake.

Utilized by the US State Department (*initially under the Johnson Administration*) GROMET exported US scientific (*technical*) expertise as a means of diplomatic goodwill to advance US Policies in developing countries. It was conducted in a series of events that occurred between 1967-1972.

Operation GROMET I (1967)

The first GROMET project (*later known as GROMET I*), saw China Lake and a small group of (*private*) civilian contractors travel to India to relieve severe drought conditions and associated crop failure (*famine*) at the request of the Indian Government.

Actually begun in December 1966, the cloud seeding operations didn't start until January 1967, when a large USAF C-141 Starlifter transported especially equipped aircraft to an airfield outside New Delhi with several small disassembled Cessna airplanes stowed in its cargo hold. The cloud seeding project was carried out over Bihar Province and eastern areas of Uttar Pradesh Province, during a three month period. The goal was to enhance monsoon-like rainfall, in between India's normal spring and fall monsoon periods, to produce significant rainfall to provide potable drinking water and save agricultural food crops – to stave off famine.



All operations were conducted by China Lake and its contractors who flew in fake commercially marked aircraft with all personnel dressed in civilian clothes as not to draw attention. As a pre-emptive measure, a cover story was released to the local press that these flights were associated with a (*contracted*) "*Agro-Meteorological Survey*" program to study the cloud physics and rain producing mechanisms - related to the current drought conditions. (*a story that was based in reality, as the China Lake aircraft were conducting support to drought relief*) The Indian Government especially did not want it known that the US Government or Military was involved in their weather modification Project.

The project was established on a classified basis by agreement between the US State Department and the Indian Government. India additionally stipulated, as part of the deal, for the US not offer the same weather modification capabilities to (*the then*) West Pakistan. If discovered, it would lead to diplomatic problems between all three governments, so the project was kept secret.

Note: *apparently some Indian Government officials "leaked" information to the Indian press on the seeding project, to the ruling party's embarrassment.*



Due to the project being established under the cooperation of the US State department, the CIA and NWC China Lake, through the authority of the Indian Government, and because of classified nature of this project, the true level of success remains to be seen. What is known, is that more than 100 individual cumulus clouds were seeded by the China Lake aircraft, over 90 days, with no significant rainfall experienced during this period, to reverse the drought in India. Apparently there was a lack of suitable clouds to seed, limitations in seeding areas outside of those areas designated (*whereby seeded clouds would drift over Pakistan*) and the continuing political sensitivity of the seeding activities, complicated a successful outcome.

In the end, the eventual arrival of the seasonal Monsoon rains, which occurred in greater amounts than normal in 1967, ended the drought. And with more modern agriculture methods, including the use of fertilizers and improved plant seeds, generated an over-abundance of crops that alleviated the looming famine.

NWC China Lake Operation GROMET cloud seeding operations conducted in India in 1967



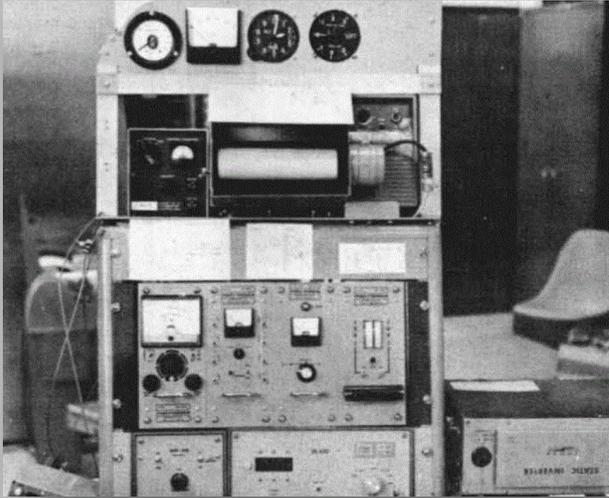
GROMET II (1969-71)

In 1969, a severe drought affecting the whole Philippines archipelago prompted the Philippine government to request help from the US. As with the previous cloud seeding operation, China Lake was notified and asked to participate. This cloud seeding project came to be known as Operation GROMET II.

Like its predecessor, GROMET II was organized and directed by Pierre Saint-Amand, with support of China Lake personnel and those NWC contractors hired by Saint-Amand. The actual airborne cloud seeding flights were flown by flight crews and aircraft of the 54th Weather Reconnaissance Squadrons (WRS) out of Guam – under authorization of the Commander-in-Chief, (C in C) Pacific.

GROMET cloud seeding flights were flown on 54th WRS WC-130E, operating out of the local USAF airfield at Clark AFB, near Manila, equipped with the same Silver iodide flare dispensing units used by the squadron in its support of Operation Popeye in Southeast Asia.

Given that the GROMET cloud seeding missions differed somewhat from Popeye seeding flights, the USAF Hercules were required to have a portable cloud physics sensor system installed on-board. This comprised the portable “Mini-Labs” system specially developed for China Lake weather modification projects.



Unlike Project Popeye, GROMET (*the Philippines*) required precise data gathering to measure any changes before, during and after the seeding runs. Given that they were utilizing standardised USAF AWS weather reconnaissance WC-130Es and not equipped with cloud physics instruments, the seeding C-130s were provisioned with portable (*tabletop*) “Mini-Lab” meteorological instrument system (*actually known as the #11-15 WSI Airborne Met System*) that was originally designed for other China Lake cloud seeding projects and produced for them by Weather Science Inc.

The Minilab consisted of a series of flight-level meteorological sensor systems, display and control console and micro-cloud physics (*ice nucleus counter instrument*) combined with an integrated data (*magnetic tape*) recorder and strip chart recorders. The portable met system was connected to a cluster of sensor heads mounted to the outside bulkhead of the fuselage.

Note: given that the 54th AWS aircrews were not familiar with the use of the WSI Mini-Lab met system, nor the micro-cloud physics instruments, China Lake established a training component to teach the AWS crews in the function and operation of the Mini-Lab systems package at Clark Field. Both China Lake and NWC contracted personnel conducted the Mini-Lab classes for the Philippine Air Force and USAF aircrews.



During this project, more than 76 cloud seeding missions were flown between 29 April and 30 June, 1969 over the whole of the Philippine archipelago. The type of cloud seeding conducted comprised a recently developed method called "*Pin-Point Seeding*" where they were able to target specific reservoirs that would be filled up by artificially induced rainfall. On one mission over Cebu Island, more than 12 inches (304.8 mm) of rain was produced to fill up a depleted reservoir.

Most of the flights flown were deemed successful, although the effectiveness of the operation is still in doubt.

One significant difference between GROMET I and II, was that the Philippine project comprised an additional technical transfer component, that encompassed teaching Philippine government personnel (*Philippine military and weather bureau personnel*) how to conduct cloud seeding on their own. This encompassed technical training into the fundamentals of cloud seeding science (*theory*), practical cloud seeding techniques and processes and the use and maintenance of cloud seeding equipment – to support the subsequent establishment of an organic cloud seeding capability within the Philippine Military.



Recent PAF cloud seeding capable aircraft; a NA-Rockwell OV-10 Bronco and Cessna LC-210 Centurion.

For over a 2-year period, after the initial seeding flights in 1969, China Lake and contracted personnel supported the Philippine government to conduct its own GROMET– like cloud seeding operations. China Lake, for the US Government, further gave the Philippines support towards the acquisition of its own light aircraft and equipment for conducting cloud seeding operations - a capability that is apparently still maintained to this day by the Philippine Military.

It's evident that the technological transfer of a cloud seeding capability by the US (*via NWC China Lake*) in 1969 during Operation GROMET II, allowed the Philippine Government to arbitrarily engage in a typhoon mitigation flight in 1976.

Philippine Typhoon Seeding (1976)

By 1976, the Philippine Air Force maintained two cloud seeding capable C-47 transport aircraft. It was at this time that a long-rumored and long suspected, cloud seeding operation was undertaken in the Philippines into a typhoon off the southeast coast of Luzon in May 1976.

Typhoon Olga (12-27 May 1976) had tracked through the northern Philippines Island group and subsequently (*or uncharacteristically*) stalled near eastern Luzon for 4-days. With winds of 115 mph (185 km/h) and heavy

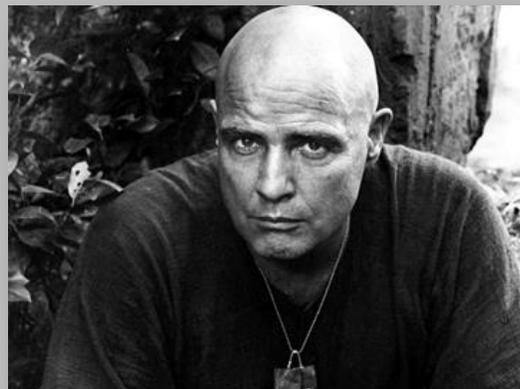
torrential rains that dumped more than 50 inches (1270 mm) of rain, with wide-spread devastation and severe flooding occurring. After the storm had passed, there were more than 200 fatalities.

Rumors persisted almost immediately, within the Western Pacific weather services, that a cloud seeding operation was carried out on Typhoon Olga by non-US Forces. It was suggested that seeding of the storm continued for at least 24 hours before the typhoon approached the eastern coast of Luzon on the 21st, shortly before the storm stalled for several days and its heaviest rains flooded most of the country.



Philippine Air Force C-47 conducted experimental typhoon modification flights into Typhoon Olga in May 1976

Note: for two months prior to the Typhoon Olga, the movie "Apocalypse Now" had been filming in several areas of the Philippines. When Olga struck, most of the principle movie sets (at Iba near Subic Bay) were destroyed and other movie sets were buried in waist-deep mudslides. Production was shut-down because of the storm and due to the subsequent damage would not resume for another two months. All new replacement sets had to be built, at a cost of more than \$1.32M, this time on higher ground else-where in the country - causing further delays to an already troublesome production.



Since the over-throw of the Marcos Government in February 1986, there has been no hard evidence to prove the suspected cloud seeding of Typhoon Olga, except local newspaper accounts that do indicate Marcos having order cloud seeding flights during the storm and US government documents indicating that he was looking to establish a typhoon modification project; designated the *TYMOD* project at the time.

Philippine newspaper reports in May 1976, suggest that due to on-going \$15M government flood control project in Manila, that was still under construction and vulnerable to unexpected flooding, Marcos ordered cloud seeding to be conducted over mountain areas away from the city to ease the severe flooding that was forecasted during Typhoon Olga. Philippine Air Force C-47s were reported to have dispersed a sodium chloride (*salt*) and Ammonium Nitrate solution into clouds associated with Olga over mountainous areas to the northeast of the city. It was hoped that the seeding would dump excess precipitation further away from the Manila, and its population of 7.5 million people, to prevent excess flooding. Despite this effort, more than 16 inches of rain fell on Manila over two days and flooded the streets.



Philippines flooding; much like the flooding in Manila during Typhoon Olga in May 1976.

This supposed explanation of countering the storm's heavy rains, by dumping the rainfall up into the mountains by cloud seeding, is flawed. Seeding storm clouds in this way would have actually induced destructive flooding in Manila from heavy runoff rushing down the mountain sides. For the storm to have stalled where it did for days, further lends credence to the rumors that the PAF aircraft actually seeded the storm offshore before it ever made landfall.

Whether it actually happened this way or not, it is clear from US documents that the Philippine government had taken a keen interest in the mitigation of typhoons and was working on the establishment of a typhoon research project that encompassed developing typhoon seeding capabilities.

If running and over-seeing Operation Popeye, Operation GROMET II, as well as several additional cloud seeding projects back in the United States weren't enough, Pierre Saint-Amand personally ran another GROMET project, also beginning in 1969. Unofficially known as Operation GROMET III, this project comprised a series of drought relief efforts towards US Military island bases and facilities throughout the Western Pacific, including Midway and Okinawa as well as Diego Garcia in the Indian Ocean.

GROMET III Midway (1969)

The first cloud seeding effort to be under-taken under this new effort, labeled “*GROMET III – Midway*”, was a drought relief operation on the island of Midway.

In the months leading up to this seeding project, Midway had been suffering from a critical shortage of fresh water. The island’s only freshwater supply was solely dependent on rainfall to replenish the station’s reserves. During the first half of 1969, the area around Midway Island experienced lower than normal rainfall (*35% lower than normal precipitation for that year*) that reduced the station’s fresh water supplies to critical levels. One of the proposed options to alleviate the problem included cloud seeding, with NWC China Lake called in to consult.

Note: *Midway Atoll, located near the northwestern end of the Hawaiian Island chain, is approximately “mid-way” between Asia and North America and is 1/3 the distance between Tokyo and Hawaii – making it a strategic trans-Pacific stop-over and refueling base for transiting military aircraft. Although more known for its “Battle of Midway” fame, the island figured prominently in the world-wide Cold War of the 20th century and was a regional center for anti-submarine warfare (ASW) operations and was an operational deployment site for Navy P-3 Orion patrol aircraft on the frontlines of the ASW war against the former Soviet Union.*



US Navy P-3 Orions from VP-4, VP-17 and VP-22 flew cloud seeding flights for Midway

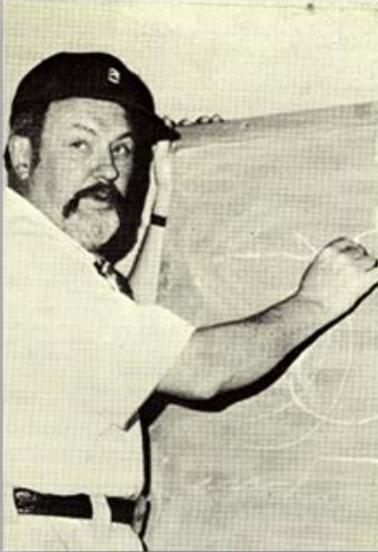
The subsequent cloud seeding project was conducted in July 1969 and encompassed Navy aircraft flying cloud seeding flights in and around the island. Both cloud physics observations and seeding flights were flown by Navy P-3A Orions from Patrol Wing 2 (*NAS Barbers Point, Hawaii*). Various Navy Patrol Squadrons based at NAS Barbers Point participated in the cloud seeding project, including individual flight elements from VP-4, VP-17 and VP-22 (*5 different crews*) conducted the seeding flights. Two different pyrotechnic seeding methods were used including the utilization of modified hand-held AN-M-8 (*pyrotechnic*) verey pistols, shooting pyrotechnical seeding material cartridges as well as the P-3A’s own M-112 Photoflash ejector configured with pyrotechnical seeding cartridges.

The Midway cloud seeding project further encompassed an additional associated seeding experiment utilizing Carbon Black. The carbon black seeding flights occurred in the late afternoons and early evenings as a means to actually produce clouds that could then be selected the next morning for cloud seeding to produce precipitation. Carbon Black seeding experiments were first conducted by the US Navy in 1958.

Although 15 daytime cloud seeding flights were conducted between 7 – 18 July 1969, as well as a number of night-time carbon black seeding flights, there was no appreciative rainfall generated during the project – due to unusual dry conditions in the upper atmosphere. Unfortunately the clouds needed to enact a successful result were too far away from the island to be of any benefit. In the end, the Navy brought in a tug-towed freshwater barge, with 250,000 gallons of fresh water, to replenish Midway Island’s water supply in the short-term.

However, these distant clouds were subsequently utilized for training as part of an adjunct component of this project, that included the technical transfer of the cloud seeding process to Midway Island personnel. NWC technical representatives trained station personnel in the procedures of conducting cloud seeding missions in future, for when atmospheric conditions were more acceptable. NWC also evaluated and equipped the

station's amphibious Grumman HU-16D Albatross aircraft with a rudimental seeding capability. There was even a proposal made by the China Lake team to provide an expanded cloud seeding capability incorporated into the station's HU-16D Albatross, comprising a more comprehensive pyrotechnic system based upon a hydrosopic seeding capability, from China Lake's "Salty Dog" series of cloud seeding systems. There is some evidence to suggest that the station aircraft was so equipped and was used to seed clouds to recharge Midway's freshwater resources over the long term.



Pierre Saint-Amand on Midway during GROMET III – Midway cloud seeding project (circa 1969)



The Midway station HU-16D Albatross seaplane configured as a cloud seeding aircraft as part of GROMET III – Midway cloud seeding project (circa 1969)

GROMET III – Okinawa (1971)

Another situation whereby drought relief was export with China Lake's cloud seeding technology, occurred in July 1971, in a project to provide drought relieve to Okinawa and among some of the smaller islands of the Ryukyus

Group stretching southwest from mainland Japan. It was then that the Okinawan Government contacted the US Navy's C in C Pacific Fleet to request drought relief. Given its knowledge of the China Lake GROMET cloud seeding operations (*and those being conducted in Southeast Asia*) the Pacific C in C requested support from NWC China Lake.

Notionally known as Project GROMET III – Okinawa, this project was established to support a drought relief effort towards a protracted severe drought in Okinawa. The drought, said to have been the worst in 50 –years, saw dried up reservoirs, failed crops and water rationing among the Okinawa populace as well as the US military installations on the island. At NAF Naha, water was rationed with the base water distribution system only turned on for 12 hours every two days.

In actuality, regional clouds were producing rainfall at the time. However, with increases in air temperatures and humidity prevalent in the months preceding the drought caused the normal rainfall to evaporate before reaching the ground.

With lack of airborne resources to support this project, Saint-Amand again looked towards the use of a US Navy P-3 Orion equipped Anti-Submarine Warfare (ASW) Patrol Squadron to conduct the cloud seeding flights. Flight crews from Patrol Squadron 40 (VP-40), deployed to NAS Naha (*Okinawa*), were personally trained by Pierre Saint Amand on how to locate and target clouds at sea, whose trajectory would carry them over Okinawa and how to seed them to generate the most precipitation.



P-3 Orions belonging to VP-40 were used on cloud seed / drought relief flights in Okinawa 1971

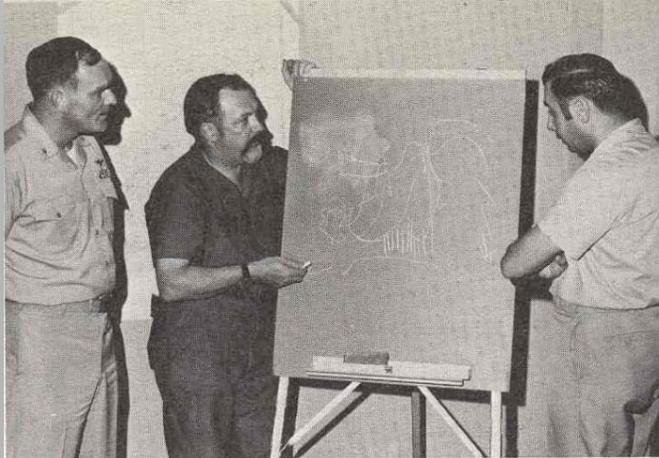
Note: *this was not the first time US forces provided drought relief / cloud seeding in the Japan. In the early 1950s, a group of Japanese researchers chartered (CIA owned) Civil Air Transport aircraft to carry out cloud seeding operations over Osaka, Japan with Silver iodide. Later in 1958, USAF C-130 Hercules, from the 315th Air Division, conducted hygroscopic cloud seeding (with a 40% solution of Calcium Chloride) sprayed through hoses running out the back of the open aft cargo ramp doors, to induce rainfall.*

VP-40 was provided with special (2" x 7") Silver iodide flares that were capable of being dispensed from the Navy P-3B Orion's updated Mod - 9A Lambert photo-flash flare ejector(s) mounted on the aft section of the aircraft - on both sides of the tail section under the horizontal stabilizers. The Mod-9A ejector was originally developed to dispense photo-plash flares for night time airborne photography and in some cases for the deployment of anti-missile, radar-evading Chaff and or anti - infrared (*hot*) flares. Each ejector unit housed 24 flare cartridges.



For this cloud seeding project, the ejector units had to actually be reinstalled in three of the Squadron's P-3B aircraft. They had previously been removed after an incident where another VP Squadron's P-3 aircraft was lost due to an on-board fire from a malfunctioning photo-flash flare ejector.

Pierre Saint Amand personally traveled to Okinawa, with two China Lake personnel to teach the VP-40 crews in the art of cloud seeding. Saint Amand taught the navy crews how to identify the right clouds to seed and how to approach the clouds to release Silver iodide flares – optimally around 17,000 – 18,000 feet (5182 – 5486m). The rainmaking crews learned how to conduct “cloud hunting” flights to locate and target prospective clouds out over the sea, who's trajectory would carry them over Okinawa. Then, just when the targeted clouds have reached their maximum heights, the P-3s would penetrate them. Although buffeted by turbulence inside the clouds, the crew would wait for that moment of updrafts to pop off several flares, that would carry the seeding material upwards into the clouds, while the flares continued burned as they fell down through the clouds for between 6000 and 8000 feet (1829 – 2438 m).



Saint-Amand in Okinawa during cloud seeding operations (1971)

During the training process, Saint-Amand often flew along on trial seeding flights, in the cockpit of the P-3, hanging off the back of the flight engineer's seat, directing the pilots in the procedures to corral clouds and seed them. In one case, targeted clouds for cloud seeding were located southwest of Naha, near the island of Miyakojima.

After having gathered a number of clouds together, they were pin-point seeded to fill a particular reservoir in the area. The subsequent rainfall produced was more than sufficient, having filled up the reservoir and caused a little bit of localized flooding.

Overall, the cloud seeding project in Okinawa was considered a successful one and was credited in breaking the drought.

Saint Amand actually demonstrated another little-known process to the “Rainron 40” rainmaking crews, that comprised how to herd clouds like cattle into large groups or clusters which would then be seeded to produce rainfall. By seeding the outer edges of a cloud, changes the thermodynamics of the cloud and causes an artificial area of low pressure to form on the side seeded.

It is therefore possible, with repeated seeding of the cloud's edge, to literary drag a cloud in the direction of the side of the cloud seeded.

Thus, once grouped over a specific area, the aircraft could then penetrate the cloud tops and seed them with several cartridges of silver iodide to dump rainfall over a targeted area.



Those VP-40 crews actually involved in the cloud seeding flights dubbed themselves the “Rain-makers of VP-40 or Rainron 40” and later developed a flight suit patch to commemorate their participation.

GROMET III - Diego Garcia (1971-72)

Diego Garcia is a lone coral atoll island that sits just south of the equator in the central Indian Ocean, some 1,113 miles (1,790 kms) south-southwest of the southern tip of India or approximately 1,865 miles (3000 kms) northeast of Madagascar. Although the island, part of the Chagos Archipelago, was once owned by the self-governing colony of Mauritius, it was acquired by the United Kingdom in 1965 (creating the *British Indian Ocean Territory* or *BIOT*). The island was subsequently leased to the United States for 50 years beginning in 1971 - for defense purposes, under a UK /US mutual defense strategy agreement that currently runs through 2016, with an optional 20-year extension to 2036.

Note: between 1968-1973, the British Government expelled the island's inhabitants, upwards of 2000 people, to Mauritius and the Seychelles, to make way for the subsequent US Military takeover of the island. To this day, the original exiled inhabitants and their families have tried to return to their homeland – claiming illegal forcible expulsion.



Diego Garcia, one of the most littlest known strategic bases in the US Military

Beginning in 1971, the US Navy began a decade-long construction effort to build multi-faceted naval facilities on the island, including a modern airfield and naval port facilities. The Island eventually became home to the “*US Naval Support Facility (NSF) Diego Garcia*” with facilities comprising a large naval ship and submarine support base, a military air base, communications, intelligence and space-tracking facilities as well as deep water anchorages for pre-positioned Military Sealift Command ships in the island's natural lagoon. Thus, making Diego Garcia one of the most (*littlest known*) strategic bases in the US Military.

This island base became a critical element for the US's involvement in the 1991 Persian Gulf War with Iraq and during Operation Desert Fox, as a refuelling base for allied aircraft and the operating base for forward deployed USAF B-52 aircraft - which launched more than a 100 long-range cruise missiles at Iraq. The island served as an operating base for US B-2, B-1B and B-52 aircraft conducting strikes on Afghanistan in 2001.

Today, the Diego Garcia Island bases remain active. Some military experts say that the Island's strategic importance will figure prominently should the US and her allies ever take up arms against Iran in future.

Fresh water on the island exists within a precarious balance that is replenished by rainfall, of which the island receives up to 102 inches (2590.1 mm) per year. Fresh ground water sits as a lens on top of saltwater within underground aquifers. If you draw off too much fresh water, faster than the rainfall can replenishment, an imbalance occurs and the existing fresh water is plagued by saltwater intrusion. Only increased rainfall can reduced the amount of intrusion. Thus, during droughts, this situation reduces the amount of freshwater available.



This was the case in 1971-72 on Diego Garcia.

In an operation very similar to GROMET III (*Midway*), tactical aircraft (*for China Lake*) conducted cloud seeding operations in the synoptic environment around the island to produce sufficient rainfall to maintain the equilibrium of the island's fresh water supply.

Then again like Midway, US Navy station personnel were trained in the art and science of cloud seeding to support and maintain the fresh water supply in the future. Provisions were made for various station aircraft to be equipped with the capabilities to conduct cloud seeding as requirements warranted.

Later in 1972, China Lake was again asked to support another instance of international drought relief, this time in Portugal's the Azores.

GROMET IV - the Azores

Between 1971 and 1972, the normal winter storms that produce needed rains to fill-up reservoirs in the Azores, did not occur or were uncharacteristically below normal, causing widespread drought conditions. In retrospect, it was discovered that changes in the regional weather patterns causing the heat of summer to rise up over the land (*the islands*) and create a temperature barrier that prevented moister-laden clouds from drifting over the islands to deposit precipitation. US Government and Portuguese officials agreed to conduct a cloud seeding project in the Azores to alleviate the problem - with the US Navy directed to provide the support.

Given that the Navy's VW-4 hurricane hunting squadron had recently acquired WP-3A Orions, with inherent cloud seeding capabilities via China Lakes updated silver iodide cloud seeding system, Saint-Amand asked VW-4 to participate and conduct the cloud seeding flights. The squadron's aircraft operated out of Portuguese Air Force Base No. 4 at Lajes (*Base Aérea das Lajes*) on Terceira Island in the Azores.

Between 9 July - 3 August 1972, VW-4 flew cloud seeding flights to relieve the severe drought in the region. The squadron rotated two crews and several WP-3A aircraft through Lajes field from their home base in Jacksonville, Florida.



The WP-3A utilized the NWC China Lake designed SUU-53/A photo-flash ejector seeding pods, installed upon the aircraft's wing (*weapons*) hard-points. Saint-Amand personally led the initial flight operations and conducted the crew briefs before the missions. He also accompanied them on several of the seeding flights to guide them on the types of clouds to choose and how to seed them.



The Azores cloud Seeding Project (1972): Cdr. Paul Cutchen, executive officer of VW-4's Hurricane Hunters squadron, explains the function of the squadron's WP-3A cloud seeding capability to Portuguese officials at Lajes AFB, the Azores, during the first phase of drought relief efforts in the Azores in 1972. Pierre Saint-Amand from NWC China Lake is on the left along with other USAF base weather personnel and other Naval representatives of NWC.

Eight cloud seeding missions were flown by VW-4's WP-3A with 188 pyrotechnic flares dispensed. However after a two to three week effort, significant rainfall did not materialize to reverse the drought conditions. With the VW-4 aircraft already committed to another cloud seeding project back in the US, the WP-3A departed the Azores with the situation unresolved.

Not generally known until now, was that there were actually two cloud seeding events in support of the Azores drought relief.



GROMET IV – the Azores (Redux)

Unfortunately, the Azores drought persisted through August into September (1972). VW-4 had other operational commitments elsewhere and could not continue with the seeding flights. To advance the seeding operation another 30 days, Saint-Amand established a second phase of the project and much like the cloud seeding project in Okinawa, this second group of cloud seeding flights were flown by the deployed Navy Patrol Squadron assigned to Lajes, flying anti-submarine patrol missions in the eastern north Atlantic.



The Squadron, Patrol Squadron 44 (VP-44), utilized their P-3A aircraft's standard Mod-9A Lambert photo-flash flare ejectors, mounted on both sides of the aircraft's tail section, under the horizontal stabilizers, as the cloud seeding device – once suitably armed with Silver iodide (*pyrotechnic*) seeding flares.

Also like in Okinawa, Pierre Saint-Amand was initially on-hand to personally teach VP-44's rainmaking crews in the art and science of cloud seeding. However, one of the USAF's weather officers, Lt. Col. Dave Carlson, assigned to Lajes base weather station, was selected to direct the seeding flights and assisted the VP Squadron in locating candidate clouds and pin-pointing the moment of an updraft within the cloud tops to pop-off the Silver-iodide flares. In fact, it was information provided by Lt. Col. Carlson that established that there were two phases of the cloud seeding effort in the Azores and provided details of their operations.

In the end, after the second series of cloud seeding flights, the drought continued unabated with a significant amount of negative press surround the seeding flights that ultimately brought the project to an end.



Storm rolling in over Terceira (circa 1972)

Note: a subsequent rare "tornado" formed over Corvo Island (the Azores), 300 miles to the west of the seeding area. The local press attributed the appearance of this rare tornado to the seeding project and political and public opinion back in Portugal echoed the rising international opposition to weather modification at the time.

Thus, the seeding operations were discontinued and the drought continued for several more months.

Although not generally known, NWC China Lake (*Pierre Saint-Amand*) responded to numerous drought relief requests from all over the world and actually entertained (*or participated in*) rain-making projects from Canada, Mexico, Chile, Taiwan, Rhodesia and South Africa over the years.



Between 1961-74, China Lake had been involved in more than 25 different cloud seeding-based weather modification experiments and operations, many ongoing simultaneously at any-given time. Most of these cloud seeding projects, with names such as Project Cyclops (1961), Project Stormfury (1962-1975), Project Hailswath (1966-67) Cloud Puff Project (1968), Project (Operation) GROMET (1967-74), Thunderbird (1967-69), Santa Barbara Pyrotechnic Cloud Seeding Project(s) (1961-63, 1967-71 & 1974), CENSARE Central Sierra Research [cloud seeding] Project (1969-72), Project Gulf Q (1969-72), the Great Lakes [seeding] Project (1970-74), Texas Cloud Seeding Project (1970-72), Cold Rain (1971), Project FACE (1973) and Foggy Cloud Projects (1968-74) to name but a few, were comprised mostly of benign (*overt*) fairly public experiments.



Note: in 1965-66 China Lake developed a (ground-launched) silver iodide cloud seeding rocket for the delivery of cloud seeding material in applications of severe weather, where it was too dangerous for seeding aircraft to venture. However some China Lake archival materials suggest that the rockets were developed for tactical uses, such as in denied areas where seeding another country's territory covertly could be conducted from the safety of a friendly neighboring country.

These tornado research seeding operations, were supported by the US Navy (*Bureau of Weapons via ONR*) and were a component of activities conducted as part of the Navy's desire to exploit weather as a weapon.

Weather as a Weapon

Weather has always been of interest to the military and became of greater interest to them with the beginning of manned flight. But as the Cold War era began and soon heated up, perceived threats from the Soviet Union had the Military scrambling for new weapons. Weather control had been suggested as a potential new Cold War weapon and needed to be explored in greater detail. As a proposed new weapon, weather modification seemingly had the potential to release large amounts of energy to destroy an enemy force, deny his use of the battlefield, while causing costly economic hardships at home, or in some cases, improve the battlefield weather conditions (*tactically*) towards the advancement of one's own forces.

Proposed military applications for cloud seeding / weather control methods comprised the release of violent weather against an enemy's territory, disrupt agricultural areas of other nations for strategic purposes, hinder a nation's commerce, influence weather (*heavy rain or snow*) to hinder enemy troop movements, render incapable its ability to logistically resupply itself or control weather precipitation as a means to deliver biological and or radiological agents.

Despite the perceived threat posed by Soviet climate change and cloud seeding experiments, it was the US that has the distinction of being the first nation in the world to have implemented weather modification as a weapon in active conflicts.



The Ho Chi Minh Trail was actually a complex network of jungle roads, routes, trails and footpaths that wound its way down from North Vietnam, through central Laos into South Vietnam and Cambodia.

One weather modification application that became a tactical weapon, came during the Vietnam Conflict, when clandestine cloud seeding aircraft flew over remote and steamy jungles of Southeast Asia to cause a near-steady state of monsoon rainfall in an effort to flood out key stretches of the infamous "*Ho Chi Minh*" trail system - and stem the flow of logistical material transport and personnel along the trail network by Viet Cong guerrillas (VC) and North Vietnamese Army (NVA) units.

To reduce the "*trafficability*" along main resupply and infiltration routes from the north to the south, a multi-service effort comprising elements of the US Navy, US Air Force and DoD was established to soften road surfaces, saturate the soil to encourage landslides and cause wide-spread flooding to wash out roads and river crossings.

DoD estimates, in 1966, suggested between 58,000 and 90,000 NVA troops (*at least 5 full regiments*) infiltrated into South Vietnam via routes that makeup the Ho Chi Minh trail system.

At the time, US intelligence reports further established that North Vietnamese forces were building drivable sections of road along the trail network from North Vietnam through to Laos and Cambodia. Thus, the interdiction of enemy movements along the trail was paramount and the employment of cloud seeding began.

Project Popeye (1966)

On 7 September 1966, a secret weather modification project was initiated as an experimental pilot program to test the feasibility of extending the rainy monsoon season in Southeast Asia, in an effort to hamper or impede North Vietnamese traffic along the Ho Chi Minh trail network, by muddying up the trail system and making key vehicle route sections impassable. This project, utilizing cloud seeding technology developed by NWC China Lake, was to extend the regional monsoon season and increase normal rainfall to soften (*muddy*) road surfaces, create landslides along the roadways, washout river crossing and generally maintained soften soil conditions beyond the normal rainy season.

Note: *although most internet references (stories) suggest that the first actual application of cloud seeding as a weapon in Southeast Asia was conducted by the CIA in 1963, via its proprietary air service "Air America" utilizing a Beechcraft Model 18 Twin Beech configured for Silver iodide cloud seeding, this is actually not the case. The CIA cloud seeding scheme was proposed as a means to hamper and suppress anti-Diem Government demonstrations by Buddhists Monks in the city of Hue and elsewhere in South Vietnam. However, according to Air America archival documents (kept at the University of Texas – Dallas, McDermott Library, Special Collections Dept, "CAT/Air America Collection") there is no actual evidence that this proposed cloud seeding event ever took place. Even if it had, it might have only warranted a footnote as the first "political" application of weather modification.*

The first actual tactical application of weather modification as weapon seems to have been made by the French during the siege of Diem Bien Phu in 1954. With more than one hundred tons of supplies per day streaming into French Indochina (from southern China), supporting the communist Viet Minh insurgency and the siege of the French fortress at Diem Bien Phu, the French military turned to one of its chief meteorologists for help. Col. Robert Genty, suggested a cloud seeding concept to increase precipitation to hasten an early onset of seasonal monsoons and muddy up the Viet Minh's supply routes by which to stem the flow of supplies and support an ultimate breakup of the siege at Diem Bien Phu. Genty eventually conducted a number of cloud seeding test flights with Silver Iodide, mixed with activated charcoal, dropped by parachutes into cumulus clouds from a modified French Air Force Sub-Quest SO-30P Bretagne cargo – transport aircraft with significant results. The artificial rain making (test) project's first seeding flight created a torrential downpour as well as a hailstorm within minutes of the seeding operation over an area 25 miles across, near Diem Bien Phu - that lasted 2 hours. However, before this cloud seeding concept could be implemented operationally by Genty, the Communist insurgents overran Diem Bien Phu and forced the surrender of the French colonial forces, which ultimately led to the complete withdrawal of French control over Indochina. It was later acknowledge, by General Giap commanding the Communist insurgents, that heavy rains associated with normal monsoon season did severely disrupt his army's supply lines with several of the truck routes turned to quagmires and supply trucks sunk up to their bumpers in deep mud.

The original goal of the experimental project (*Project Popeye*) was to extend the existing monsoon season by 30 to 45 days to muddy up sections of the trail system and if possible, increase the annual monsoon rainfall averages by upwards of 20-30%.

Although the public record (*internet*) would have you think that Project Popeye experimental cloud seeding flights were conducted solely from the Royal Thai Air Force Base, Udorn, (*Thailand*),



A French Air Force Sub-Quest SO-30P Bretagne cargo – transport aircraft; like the one used by Genty to conduct the first tactical cloud seeding experiments in Southeast Asia in 1954.

the reality is that they were conducted primarily from Da Nang, with additional air support from Pleiku Vietnam and from “Ubon” in Thailand - under the technical and supervisory control of personnel from NWC China Lake. NWC China Lake provided all the various technical cloud seeding personnel, training, direction, supervisory and leadership for the project as well as conducted all of the scientific analysis and design, manufacture (*fabrication*) of the seeding dispensers, canisters and seeding agents.

The air operations comprised the utilization of several in-country airborne assets from the US Air Force and US Marine Corps to seed clouds over Laos. The USAF provided two Troop Carrying (*tactical airlift*) C-130A transport aircraft, flown by individual flight crew elements of the 54th Weather Reconnaissance Squadron (*based in Guam*), while the US Marine Corp’s VMFA-115 squadron (*out of Da Nang*) furnished three F-4B Phantom jets flown by select flight crew elements of the Squadron.



Actual C-130 cloud seeding operations during Project Popeye (1966)

It was the F-4Bs that served as the primary seeding aircraft, providing a high-altitude cloud seeding capabilities as well as post - seeding flight (*assessment*) observations. For the project, the F-4B were equipped with a modified version of the A-6 photoflash Silver iodide seeding flare system known as “Wimpy” – in keeping with the Popeye cartoon theme. Developed by China Lake, the Wimpy was based upon a 40mm aluminum photoflash – type cartridges once used in Project Stormfury. The cartridges were incorporated into a specially-designed aerodynamic launcher system developed specifically for high-speed jets.

One of the USAF C-130As was utilized as the command, reconnaissance and monitoring (*control*) aircraft during the seeding missions and served as a back-up seeding aircraft when needed. A second Hercules aircraft, flown from Ubon, scouted for the clouds to be seeded and also provided a secondary seeding capability when required. This aircraft often served as a test aircraft for the seeding devices under evaluation.

VMFA-115 squadron provided three select flight crews (3 pilots and 3 RIOs) along with three squadron F-4B Phantom jets to conduct the cloud seeding flights and assess the reaction of the clouds to the cloud seeding runs. Most flights were flown in the early afternoon from Da Nang and took about 4.5 to 5 hours in duration.



A US Marine Corp's VMFA-115 squadron F-4B Phantom Jet used in cloud seeding experiments in Southeast Asia in 1966.

Not generally known, two additional Douglas A-1E Skyraider ground-attack aircraft, from the USAF's 1st Air Commando Squadron, based in Pleiku, supported the experimental project with low-level observation and (*ground*) precipitation assessment reconnaissance, during their normal tactical missions along the Ho Chi Minh trail network.

Upwards of six experimental pyrotechnic Silver iodide smoke generators and seeding devices were tested and evaluated during this seeding experiment. Besides the small hand-fired (*AN/M-8 Verey Pistol*) flare called "*Sweetpea*", the Hercules aircraft were also equipped with a specially modified rocket –motor version of the ALECTO seeding device called "*BLUTO*" as well as a seeding smoke generator dubbed the "*Grumper*". (*the Grumper comprised a Silver iodide smoke generator based upon a modified JATO rocket housing filled with pyrotechnic Silver iodide seeding compound*) Several Grumpers were fitted to the standardized JATO rocket assist racks mounted on the starboard and portside air deflector doors of the project's C-130A Hercules – and utilizing the aircraft's existing JATO rocket fire-control panel in the cockpit to ignite the seeding generators.

Additionally, modified versions of the Cyclops II and a standardized ALECTO flare ejector system (*dubbed "Goon Girl"*) were also tested during the experiment. But the two units were deemed too hazardous for operations over Laos and not suitable for the experiment. They were subsequently only used for aircrew practice out over the open ocean areas off the coast of Vietnam.

With the project's cloud seeding flights principally conducted over an area of the Se Kong River watershed (*Valley*) east of the Bolovens Plateau, in the panhandle region of Laos, beginning in mid-September 1966, the cloud seeding experiment targeted cold cumulus clouds at about 14,000 -19,000 feet (4267 – 5791 m) and seed them with Silver iodide smoke. One of the first experimental seeding flights saw seeded clouds drift over the border into Vietnam and dump heavy rains over a wide area. A US Special Forces A-camp, located in the heart of VC territory along the border, recorded approximately 9-inches of rain over a 4-hour period.

Under this pilot seeding project, China Lake conducted 56 experimental seeding flights, where 48 of the missions were deemed successful equating to an 85.7% success rate of seeded clouds producing significant rainfall.



Douglas A-1E Skyraiders from the 1st Air Commando Squadron



Pierre Saint-Amand on the ground in Vietnam, examining the "Grumper" cloud seeding device - during Project Popeye (1966).

Project Popeye completed its experimental operations in early November 1966, with enough positive results that recommendations were forwarded back to Washington for the initiation of an operational phase of cloud seeding in Southeast Asia.



Street fighting
associated with the
Tet Offensive

Although Project Popeye had the in-country support of regional commanders, including the US Ambassador to Laos (*William H. Sullivan*), the C in C Pacific and of course the Navy headquarters, the project was not approved right away – a delay occurred. Apparently there were some reservations and concerns about the program in Washington – over at the White House and with the Secretary of Defense. However, these reservations all melted away with the events of 21 February 1967; “*the Tet Offensive*”. The Tet Offensive, a counter-offensive strike by NVA agents and VC insurgents (*infiltrated into South Vietnam via routes and trails that made up the Ho Chi Minh Trail system*) specifically targeted US and South Vietnamese command and control centers throughout the south. The North Vietnamese further sought to incite an uprising among the South Vietnamese people to topple the US - backed Saigon Government and cast out the Americans invaders. No action taken by the enemy so apply demonstrated the need to disrupt the infiltration routes along the Ho Chi Minh Trail system. With the gloves off now, Operation Popeye was subsequently approved and China Lake made plans to return to Vietnam.

Operation Popeye (1967-72)

The operational phase of US weather modification in Southeast Asia, “*Operation Popeye*”, commenced in March 1967. The seeding flights were flown just before the onset of Southwest Monsoon season (*between April and September*) with an objective of increasing the normal amounts of rainfall during the monsoon season and then to extend the seasonal conditions further through October or about 30-45 more days. Special attention was paid to increasing rainfall to washout river crossings, saturate the soil causing landslides and to make the trails and routes muddy and impassible.

The Operation Popeye cloud seeding missions were primarily flown out of the RTAFB Udorn, Thailand, by revolving flight crew elements of the 54th WRS and (now) USAF RF-4C Phantom jets, flown by flight crew elements of the Air Force's 14th Tactical Reconnaissance Squadron. The USAF 14th TRS provided a two jet detachment to fly project missions. The RF-4C Phantom jets were equipped with several wing and fuselage mounted Silver iodide flare dispensers (52 flares per unit) fitted on each aircraft. These RF-4Cs normally seeded clouds at 19,000 feet (5791 m). The RF-4C additionally conducted routine photo-reconnaissance missions in conjunction with the seeding missions.



A 14th Tactical Reconnaissance Squadron RF-4C Phantom landing at RTAFB Udorn (circa 1968)

Under Operation Popeye, the 54th WRS flew three specially configured WC-130A Hercules, that were subsequently converted into weather reconnaissance configured aircraft (by the Warner Robins Air Materiel Area or "WRAMA" at Robins AFB, Warner Robins, Georgia.) that were further equipped with China Lake developed Silver iodide flares ejectors, based on an early version of the SUU-53/A silver iodide seeder dispenser.

The early Silver iodide smoke generator (flare) dispensers comprised a photoflash dispenser rack mounted to the existing aircraft's JATO rocket assist mounts on both sides of the aircraft, on the air deflector doors.

The Silver iodide seeding flares burned for 36 seconds as they dropped down some 3,000 feet (914 m). These were the same pyrotechnics seeding cartridges and seeding agents subsequently utilized in Project Stormfury hurricane seeding flights.



Operation Popeye WC-130A with cloud seeding devices – early versions of the SUU-53/A system (circa 1969)

Note: there is some confusion over the C-130s used in Project Popeye (1966) and the WC-130A used in Operation Popeye (1967-72). The internet suggests the Hercules aircraft utilized in Project and Operation Popeye were to have been Hercules aircraft #s 56-519, 56-522 and 56-537 that were assigned to the 54th WRS. However this is not the case. USAF archival records now indicate that the initial two C-130A transport aircraft used in Project Popeye (1966) were not among the three aircraft used in Operation Popeye (1967-72) and were never assigned to the 54th WRS in Project Popeye. The Project Popeye's C-130A were more likely aircraft #s 56-520 and 56-518 or 56-523 and were assigned to the 315th Air Division / Group out of Okinawa. Hercules aircraft #s 56-519, 56-522 and 56-537 were flown as part of Operation Popeye, first as standard troop carrier C-130As and then later as WC-130A. But it wasn't until after (July 1967 - #519, April 1967 - #522 & June 1967 - #537) when the aircraft were re-configured as WC-130A, that they became directly assigned to the 54th WRS. These Hercules aircraft were later phased out of Operation Popeye between September 1968 and June 1969, when 54th squadron based WC-130E aircraft began participating in Operation Popeye.

Under Operation Popeye, the Hercules aircraft were the primary seeding aircraft, flying two seeding sorties per day, with the third WC-130A acting as a cloud scouting plane. This scout plane would go out and reconnoitre clouds in the target area to seed and report back to the base for the other seeding aircraft to launch. The WC-130 would then direct the seeding aircraft to the cloud's position (*coordinates*) and provide the flight levels for the freezing layers by which to commence their seeding runs.



Operation Popeye C-130A / WC-130A # 56-522

The operational Popeye missions were conducted over Laos, Cambodia and parts of South Vietnam. Although some public record references suggest seeding flights were flown over North Vietnam, this is not exactly the case. In actuality, US DoD and Congressional (*Popeye*) records show that seeding flights into areas of North Vietnam only occurred for a few short weeks in 1967 and a 5-6 week period between September and early November 1968. Other than these very short periods in 1967-68, there are no other archival records or evidence that indicates Popeye ever flew over North Vietnam again. The Popeye missions were focused specifically on those key areas along the Viet Cong resupply and infiltration routes, as part of a much wider US military counter – insurgence, trail interdiction program.

Also in the public record (*the internet*), there are numerous references that directly state that the US Air Force conducted the Popeye programs in Southeast Asia, presumably based upon the fact that aircraft from USAF squadrons (*the 54th WRS and 14th TRS*) were used as seeding aircraft in execution of the operations and given that there are multiple internet websites referring to the 54th WRS's "*Motorpool*" flights – which was that squadron's cover name for the Popeye missions. However these volumes' assumptions would be incorrect, for it was the US Navy, not the US Air Force, that conceived and directed the Popeye cloud seeding operations in Southeast Asia.



One of two Operation Popeye RF-4Cs belonging to the 14th TRS

Popeye was ultimately sanctioned by the office of the “Special Assistant for Counter – insurgency and Special Activities or SACSA” (an office within the Pentagon positioned under the Joint Chief of Staff) responsible for covert operations in Southeast Asia and elsewhere in the world - that Washington insiders at the time knew to be effectively the CIA. The authorization for the Southeast Asian cloud seeding scheme flowed down from SACSA through the Navy CNO, to C-in-C Pacific, with dotted lines to National Security Advisers in the White House, on to MACV, who provided all logistical support authorizations for the program in-country. The day-to-day functional control of the seeding flight operations and technical support to the cloud seeding missions, in country, was commanded by NWC China Lake personnel and personally by Pierre Saint-Amand.



China Lake personnel running Popeye operations, in Da Nang (circa 1966-67); Pierre Saint-Amand second from left. The US Naval Officer is Cdr. Frances R. “Knobby” Walsh Jr., China Lake’s technical program officer for Popeye in-country at the time.

Note: *it’s interesting to note, that as a civil-service civilian, Saint-Amand should not have been permitted to command these Popeye operations. And yet, he did. In actuality, there was a US Naval Officer (from NWC China Lake) who was the actual program / project manager of the Popeye operations. This officer was the Navy’s uniform lead on the ground and was actually in operational control of the project. However, this officer deferred his lead elements of command and control of the program over to his boss at China Lake; Pierre Saint-Amand during the duration of their time in Southeast Asia. It’s also interesting to note that it was during this time (1967-1969) that Saint-Amand was often known as “the Admiral”, an unofficial title conferred on to him to demonstrate who was actually in command of Popeye and to provide the equalization of importance (rank) when dealing with regional commanders over any logistical support issues and with regards to authorizations.*

Broader Applications

During the original Project Popeye experiment in 1966, Saint-Amand looked around the region (*or more likely the war itself*) and envisioned broader applications for China Lake's weaponized weather capabilities. Given that Saint-Amand was always tweaking Popeye operations in the field, developing better seeding materials and seeding equipment to achieve greater efficiency, some of those improvements and or ideas became broader applications of the tactical weather modification effort that seemingly gained the interest of regional commanders.

In fact, this concept of broader applications probably came to Saint-Amand from a seemingly competing project that arose in the wake of the Tet Offensive, that also sought to interdict traffic along the Ho Chi Minh trail network.

Commando Lava (1966-67)

Identified by as "*Commando Lava*", in declassified Vietnam War CHECO reports (*Contemporary Historical Evaluations of Combat Operations report in SEA*), this experiment involved the test use of chemical soil destabilizing compounds (*referred to as "Emulsifiers"*) to make sections of the Ho Chi Minh Trail system impassible from mudslides and the creation of deep mud through chemical destabilization of the soil. This project involved the aerial dispersing of a chemical compound (*trisodium nitrilotriacetic acid and sodium triphosphate, commonly found in most detergents and cleaning products*) to break down the molecular structure and or cohesion of the soil. The emulsifying agents when dispersed and combined with rainfall, destabilizes the soil, breaking down the chemical bonds that binds the soil together. The soil loses all consistency and creates a particularly soft and loose deep mud that is very sticky.

It was for this project, not Operation Popeye, that inspired the now famous phrase; "*Make Mud, Not War*", which was coined by US Ambassador William H. Sullivan (*Ambassador to Laos 1964–1969*) in a State Department dispatch back to Washington in 1967.

Commando Lava was another Geophysical operation of the DoD (SACSA), which like Project Popeye, utilized flight aircrew elements from active USAF squadrons in the regions. In the case of Commando Lava, aircrews of the 41st Troop Carrier Squadron (*a component of the 315th Air Division / Troop Carrier Group*) home based in Naha, Okinawa, were forward deployed to Ubon, Thailand and Cam Rahn Bay, South Vietnam, to fly the Commando Lava missions.

These mission flights encompassed the aerial spreading of the emulsifiers along various sections of the Ho Chi Minh trail network in the Laotian Panhandle and along the trail's associated infiltration routes, to literally soap up the ground and make the trails, paths and tracks slippery to foot traffic and cause the soil to break down under the weight of trucks and other vehicles.

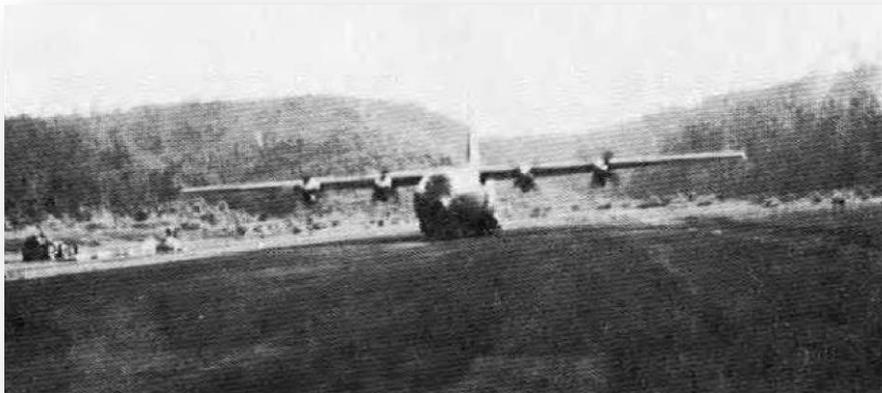
Conducted during daylight hours, at low altitude, test flights primarily targeted hillside roads and trails in southern Laos, to destabilize the soil, create mudslides and the deep loose mud. The first test flight was met with great success; the compound was dispensed along a hillside road, below the crest of a ridge-line.



C-130As from the 315th Air Division / Troop Carrier Group participated in Commando Lava 1966

Later, with heavy rains, the whole road washed away and slid down the hill. The second test flight was less than successful. Although dispensed adequately, the follow-up rainfall never occurred and failed to achieve any results. The third test flight was aborted when one of the C-130As took heavy ground fire in the seeding area and later crash landed at Chu Lai.

Although area commanders wanted to go fully operational with the emulsifying project and expand its applications throughout the whole Ho Chi Minh Trail network and the infiltration routes (*and possibly combine Commando Lava with Project Popeye to maintain a better control of when and where the rain would occur to activate the emulsifying agent and muddy up the roads and trails*) there was a problem. Apparently there was no mechanical dispensing system for the spreading of the emulsifying material. During the early test flights, the compound was hand-shoveled out the back of an opened cargo door-ramp of the C-130A Hercules. Additionally, the aircraft had to fly at very low altitude to disperse the material. As previously mentioned, at least one aircraft came under ground fire over the seeding area. It was said that the Commanding Officer of the 41st TCS refused to fly anymore missions after one of his aircraft was effectively shot down.



Commando Lava Hercules on takeoff for mission along the Ho Chi Minh trail

Although this would seemingly have spelled the end of the project, a second version of the program got underway in July 1967. Called "*Commando Lava II*", this effort continued the dispensing of emulsifying compounds over different areas of Ho Chi Minh trail system and its associated infiltration routes, through the utilization of UC-123 Providers from another unit, previously involved in "*Ranch Hand*" defoliant flights.

Although the first Commando Lava sorties did cause mudslides that are said to have wiped out two roads that were components of the greater Ho Chi Minh trail system (*in Laos*), they failed to cause widespread destabilization of the soil along other parts of the trail system. It's been suggested that the Communists caught onto the Commando Lava scheme and literally sent out sweepers to sweep up the chemical compound off the roads and trails before it had a chance to rain. Other intelligence reports suggest the VC sweepers would lay camouflage bamboo mats down on the roads and trails to catch the "*soap*" dropped by US aircraft, protecting the trails from destabilization.

Note: *although this project is mentioned here as an example of another US counter-insurgency (Geophysical) warfare application applied against the enemy's trail network, and was a potential inspiration to Saint-Amand and his concept of broader applications of cloud seeding, this project was not a cloud seeding / weather modification project itself, despite the aerial delivery of the compound. It was more of a "chemical" counter-insurgent weapon*

application, where chemicals were used to achieve a tactical result – much like Ranch Hand operations – which was also not a weather modification application as some internet references would have you think. Ranch Hand forest defoliant spraying in Vietnam, part of a much wider anti-insurgency deforestation program called “Trail Dust”, has actually been openly classified as Environmental Warfare or “ecocide” in scholarly historical reviews.

The first broader application of Saint-Amand’s tactical weather modification capabilities in Southeast Asia encompassed a little known side-project that included the use of cloud seeding techniques towards warm fog clearing.

Khe Sanh Fog Clearing

In 1968 the long-troubled US Marine Corps combat base (*outpost*) at Khe Sanh, located in Quang Tri Province just south of the Vietnamese Demilitarized Zone (*DMZ*), had its logistical supply line under near constant attack by enemy forces. The base’s lifeline was the almost daily air support and logistics supply it received from transport aircraft, made possible by a short runway build next to the base. Unfortunately, persistent and ground-hugging fog would roll in over the hills and settle down over the base, making it difficult to get re-supplied and unable to see the enemy sneaking up on the Marines’ positions.



The US Marine base at Khe Sanh during the 11-weeks siege by Communist Forces in early 1968

Khe Sanh Fog was a protracted event during the monsoon season that was actually comprised of four different types of fog, drizzle and light rain, that caused a widespread overcast (*low ceiling*) down to the ground that prevented resupply aircraft from landing on the airstrip – which provided an opportunity for the North Vietnamese to over-run the camp during an 11-week siege in early 1968.



Para-drop in a Khe Sanh fog



Digging foxholes in the Khe Sanh fog



On patrol in a Khe Sanh fog

It was at this point that Saint-Amand was approached to devise a way to disperse the warm fog and make it dissipate – in support of the US's Operation Niagara effort to break the siege. Utilizing hygroscopic compounds (*of salts and water*) Saint-Amand secured the use of several USAF Ranch Hand (*Agent-Orange defoliant*) spray-equipped UC-123 Providers, based in Da Nang, to fly fog-clearing missions over Khe Sanh. More than 15 fog clearing sorties were flown over the base, before it was determined that the seeding solution was not that effective.



USAF UC-123 Provider aircraft were used by a Saint-Amand's cloud seeding effort to dissipate fog over Khe Sanh US Marine Base under siege in early 1968.

It's been said that Saint-Amand (*and his China Lake team*) then came up with a modified Silver iodide compound (*flare cartridge*) that could be fired from a hand-held AN/M-8 (*pyrotechnic*) "verey pistol" (*flare gun*). Capable of streaking upwards of 1500 feet, into the low-lining fog and clouds, the verey pistol technique could be utilized by the Khe Sahn troops themselves on the ground to dissipate the fog.



Another little known (*potential*) broader weather modification application in Southeast Asia, comprised the development of a new seeding compound that apparently contained caustic elements.

SEA Acidic Rain

Believed to have been conceived in 1968 during casual discussions with regional commanders highlighting problematics with North Vietnamese targeting radar systems, guiding surface-to-air missiles (SAMs) into US B-52 bomber formations, a solution materialized based around a modified cloud seeding technique. The scheme was based upon a new cloud seeding material that not only caused seeded clouds to dump their precipitation, but also create something akin to a caustic "Acidic Rain".

The subsequent weather modification plan of this so-called acidic rain seeding concept was for a caustic rain to fall over North Vietnamese controlled areas and corrode and / or rust metal it came in contact with. The hope was that the caustic rain would foul the mechanical and electrical components of the SAM targeting radars as well as other mechanical air defence systems to make them fail during US B-52 bomb strikes.



A Vietnam War B-52 bomb strike on North Vietnam

Although first presented by Seymour Hersh in his series of "Rainmakers of SEA" articles in the New York Times in early July 1972 (*based upon information provided by unnamed DoD sources*), and a random mention of the proposed effort in a CHECO report on weather modification in SEA, there are no archival records found to date that sheds any light on the details of this cloud seeding operation or details as to the effectiveness of the corrosive cloud seeding process on enemy air defenses, if indeed it was conducted at all during the Vietnam conflict. Again, more archival research is required in this area.

B-52 Cloud Seeders

Another Saint-Amand broader application of tactical weather modification in SEA (*or elsewhere*) comprises the apparent use of USAF B-52 as cloud seeding aircraft. This is confirmed somewhat by Dr. Edwin X Berry (*PhD*), an American Atmospheric Physicist that was one of Pierre Saint-Amand's contracted specialists involved in NWC China Lake weather modification projects, including Operation GROMET II and Operation Popeye, in 1969. It's clear from information on Berry's website and from conversations directly with him, that Saint-Amand had Berry train USAF B-52 Pilots (*based nearby at Clark Field*) in the art and science of cloud seeding – during Operation GROMET cloud seeding operations in the Philippines in 1969.

Berry additionally reports that later, he saw Silver iodide cloud seeding dispensers mounted to the airframes of B-52 Bombers at Clark Field. The seeding devices were mounted aft of the wings, between the aircraft's wings and the tail sections of the B-52.

Note: *It clear from Dr. Berry's website that he is somewhat in the dark about this aspect of his participation in other (broader) applications of weather modification in SEA for Saint-Amand. It is his understanding that the B-52 cloud seeding aircraft were just part of Operation Popeye. However, none of the current archival documents available to date (those from the DoD, Congressional or Navy / China Lake archival sources) mentions cloud seeding by B-52s associated with Operation Popeye. In fact there is currently no archival information or references to date that suggest any cloud seeding operations by B-52 Aircraft. Dr. Berry's website and his comments are the only current source that identifies USAF B-52s having been used as cloud seeding aircraft and directly links Pierre Saint-Amand (China Lake) to other weather modification efforts in SEA via B-52 Bombers.*



It's been suggested that USAF B-52 were equipped with Silver iodide seeding devices, like these, in 1969 for unspecified weather modification missions in Southeast Asia and or other operations in the Far East.

As the Vietnam conflict continued, senior regional commanders aware of Operation Popeye requested additional weather modification support. DoD historical references suggest that operational commanders directing the air war in SEA, were hampered by foul weather (*low ceilings, rain and fog as well as*

overcast stratus clouds) obscuring bombing targets and interfering with tactical support aircraft supporting allied ARVN ground troops engaged in battles with North Vietnamese army troops. This situation came to ahead in March 1972 during the Easter / North Vietnamese offensive in Quang Tri Province. The poor weather conditions favored the enemy's advances, due to the inability of US Tac Air assets to support the ARVN ground troops.

Thus, weather modification was proposed and requested to break up the poor weather conditions to advance US tactical operations to counter the enemy's offensive. Unfortunately neither the China Lake control group nor the 54th WRS assets were in-country at the time and subsequent technical

information provided suggested a limited effectiveness on the weather conditions being experienced in the region by the cloud seeding capabilities available. Thus, no cloud seeding flights were conducted to lift the siege at Quang Tri. However, it's been suggested in other CHECO reports that cloud clearing and precipitation reducing cloud seeding operations were conducted to benefit US tactical air missions at various times during the war between 1966 and the end of Popeye in 1972.



a B-52 landing at the RTNB U-Tapao Thailand (circa 1972)

Note: *there are other unsubstantiated reports of possible US cloud seeding operations against North Korea, during this period of Operation Popeye (1967-72). With Cold War tensions heighten (between US and the USSR, China and North Korea) in the wake of the USS Pueblo incident (January 1968), it seems evident that cloud seeding operations may have been employed to harass the North Koreans and may have necessitated the possible employment of B-52 cloud seeding aircraft or other tactical aircraft.*

Although seemingly viewed as just extended adjuncts of Operation Popeye, these broader applications of Saint-Amends' would have been complex enough to have acquired their own project names. But none can be immediately discerned, requiring additional archival research in this area.

A moment about Codenames: it's interesting to note, that when Operation Popeye was disclosed by Jack Anderson in the Washington Post in March 1971, he actually never mentioned the codename of the Southeast Asian weather modification project as being Popeye. Instead he used the codename "*Intermediary -Compatriot*". The actual name "*Project Popeye*" was not used for more than a year, when it first appeared in a series of New York Times articles, beginning in early July 1972, on the weather modification project in Southeast Asia by reporter Seymour Hersh. It's been suggested on internet webpages and elsewhere in the public record, that the original name of the Southeast Asia cloud seeding project was called "*Popeye*" initially and later, having been compromised on a couple of occasions, changed its code name to "*intermediate*" and or "*compatriot*" or both. However this is not actually the case.

After review of US State Department, Congressional, DoD and US Navy (*China Lake*) archival records, it seems evident now that all of the various agencies and services that directly supported or had overview of the project initially utilized their own codenames for this project. The Military Advisory Command –Vietnam (MACV) used the codename “*Flat Tire*” for Project Popeye (1966). The 54th WRS used the codename “*Motorpool*” for discussions (*and scheduling*) of the cloud seeding flights within the squadron. The codename “*Intermediary -Compatriot*” apparently stems from a memo from White House Special Assistant for National Security Affairs, *Walt W. Rostow*, to Defense Secretary, Robert McNamara in early 1967. (*also in a memo to McNamara from CM Wheeler at the State Department May 1967*) However, Ambassador Sullivan in Laos used the Project Popeye codename in all his cables to Washington on the subject of the SEA weather modification effort during the same 1966-67 timeframe.

Ultimately it was China Lake’s codenames, *Project Popeye and Operation Popeye*, that stood the test of time and were never compromised. The reason that the Operation Popeye did not come to a screaming halt in March of 1971 with the publishing of Jack Anderson’s article, is that “*Intermediary-Compatriot*” was not the name of the project at that time or if at all. However, once Seymour Hersh published his first article on 3 July 1972 using the project codename “*Popeye*”, all cloud seeding flights in Southeast Asia, suddenly ceased on 5 July 1972.

Popeye: Typhoon Seeding

Between 1970-71, it’s been suspected that the Navy (*i.e Pierre Saint-Amand*) took tactical weather modification operations one step further and may have additionally seeded storm clouds, associated with tropical cyclones affecting Vietnam, in order to create an even more destructive outcome. Although anecdotal and based largely upon unsubstantiated “*hear-say*” evidence, the question whether cloud seeding operations were conducted on tropical convective storms during Operation Popeye remains unanswered.

This concept initially evolved from Congressional investigators for Senator Pell, who suspected that particular tropical storms (*i.e. remnants of Western Pacific typhoons*) affecting Vietnam were potentially cloud seeded by Operation Popeye to ultimately caused catastrophic flooding and damages throughout the North and South of the country. Despite DoD witness testimony before Congress, that no Popeye seeding flights were ever conducted during tropical storms (*as stated in the transcripts of the subsequent Congressional hearings on the Popeye operations 1972-74*), comments by others claiming to have been associated with Operation Popeye, suggest that storm(s) were seeded and caused the types of damage that resisted conventional bombing. Apparently Senator Pell himself firmly believed that Popeye had seeded a storm or storms which ultimately killed tens of thousands of people in North Vietnam in August 1971.

If this did occur, the seeding of clouds within the circulation of a storm, with the express interest of increasing rainfall over strategic areas of North Vietnam, was meant to inflict severe damage on the enemy – aimed to specifically washout railways and bridges, flooding urban highways and roads as well as cripple the electrical generating capability of North Vietnam.

Senator Claiborne Pell of Rhode Island (left - seated) during congressional hearings with other aides and committee members.





The facts of the matter are that unusual torrential rains did occur in August 1971 and contributed to severe flooding, that wrought significant destruction on to North Vietnam that had not been seen there since before WWII. Known generally as the severe flooding of August 1971, unusually heavy and prolonged (*widespread*) torrential rainfall, flooded three different river systems in the north that breached 1000 year-old dykes surrounding the heavily populated city of Hanoi. More than 618,000 acres (*250,095 hectares*) were flooded, wiping out the annual rice crop of North Vietnam (*for that year*), and killing approximately 100,000 people – leaving another 300,000 homeless and ultimately affecting more than 2.7m people.

It's been said that the Nixon Administration had been reluctant to bomb these same dykes and / or attack the food (*rice*) supplies of North Vietnam, because of the bad press that it would have generated towards his administration.

Note: according to US Military archival documents and public record references, Popeye seeding operations often had disastrous effects on US combat operations, including the November 1970 "Son Tay Raid" - a US Special Forces assault on a small enemy compound 23 miles west of Hanoi, believed to have housed approximately 61 American POWs. Unfortunately when the assault force reached the POW camp it was empty – no POWs. It's been suggested that severe rainfall (flooding) from presumed Popeye cloud seeding operation on the remnants of a typhoon, caused the North Vietnamese to move the POWs sometime before the raid. The Popeye cloud seeding operations were so secret, even in-country, that the Raid's military planners were not informed or were unaware of the potential effects of artificially induced flooding would have on the rescue mission.

Again anecdotal and not rooted in proven fact, persistent rumors of typhoon(s) seeded by an unspecified US Military organization echoed through the hallways of the Western Pacific weather services, during this time period (1970-71). In one alleged Popeye storm seeding mission, it's been claimed that one key strategic bridge in North Vietnam was washed away, having previously resisted repeated bombings.

Given that the 54th WRS was a typhoon reconnaissance squadron, coupled with Saint-Amand's vast experience in seeding hurricanes in the Atlantic, all the elements were in place to have had conduct weather modification operations of available tropical cyclones to further cause damage to the enemy. It's all very plausible, but no archival evidence exists to verify that it ever occurred – at least not to date and will require further archival research.



In the end, Operation Popeye conducted approximately 2602 cloud seeding sorties, expending approximately 47,409 canisters of Silver iodide seeding material over Laos, Cambodia and South Vietnam, at a cost of \$21.6 million dollars, between 1967-72.



Photos of the Operation Popeye aircraft after their 500th cloud seeding mission on 31 July 1968.

Although the results of these secret weather modification operations were played down, once the project was made public in 1972, to a total rainfall increase of 10% over normal precipitation, it's believed that the actual total was much higher or as much as a 30% increase in precipitation along different areas of the trail network.



The program's further goal of extending the seasonal monsoon conditions to 30 days or more was also achieved, with upwards of 37 days extended to the season. Peak for the cloud seeding project occurred in 1969-1970, coinciding with record annual rainfall of more than 48 inches of rain in the month of July 1969 alone.



This photo of the Viet Cong moving along a section of the Ho Chi Minh Trail was taken by a SOG MACV guerrilla monitoring enemy movements along the trail system under a project called Roadwatch

Note: these rainfall estimates were collected as part of an ongoing Defense Intelligence information gathering project associated with tracking the increases and decreases of enemy movements along the Ho Chi Minh Trail network and infiltration routes. Known as "Project Roadwatch", special indigenous reconnaissance teams and Special Forces guerrilla units were employed to specifically surveil the trail system. USAF Air Weather Service personnel trained Roadwatch guerrillas in basic weather observations and reporting. The guerrillas were also taught how to collect rainfall measurements along areas of the trail system in support of Operation Popeye. These estimates were also backed-up by electronic intelligence sensor data collected as part of a monitoring component of another anti-infiltration project known as "Igloo White" with regards to the levels of trafficability throughout the years.

Although a number of road sections, trails and dikes were completely washed away and much flooding was produced (*destroying 10 % of the total North Vietnamese Rice crop during Popeye's 5-year run*) it would seemingly have been considered a technical success. However, there is no statistical evidence that Popeye had any appreciable effects on the movements of the enemy's logistical supplies or troop infiltrations into the south along the Ho Chi Minh trail system. The Vietnamese were seemingly very adept at approaching a situation and overcoming any or all obstacles. It would seem logical to assume that NVA and VC had conceived of techniques by which to move supplies and personnel along the trail system during the rainy monsoon season (*based upon Project Roadwatch trafficability reports and statistics*). It would have been easy for them to have just continue those procedures if the monsoon conditions persisted beyond their normal period – or develop new ones to overcome increased rainfall and flooding along the trail system. In this view, Popeye was a futile attempt to use weather as weapon, when the weapon was useless in the kind of environment that was the Vietnam Conflict.



As indicated by this image, the Viet Cong were able to overcome the problematics of flooded trails with bicycles replacing trucks.

Ultimately Popeye came to an end on 5 July 1972, when the last cloud seeding missions were flown. The end was actually precipitated by the subsequent public disclosure of Popeye operations in a series of New York Times newspaper articles written by Seymour Hersh beginning on 3 July 1972.

The first actual disclosure of the Popeye weather modification seeding operations occurred in 1970, through the unauthorized release of the so-called "*Pentagon Papers*" by Daniel Ellsberg.

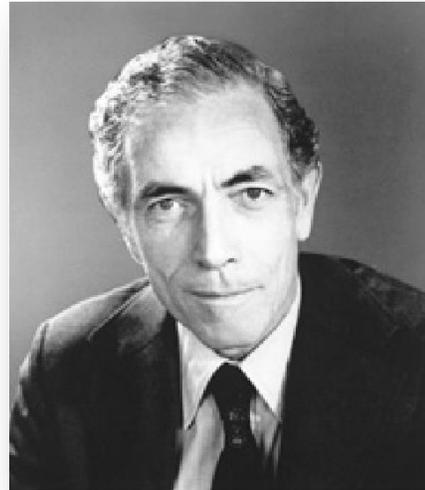
The Pentagon Papers, actually a DoD historical analysis of the US involvement in the Vietnam War, illustrated the Government's misleading of the US Public with regards to its handling of the Vietnam conflict.

Among its many pages were references to the weather modification operations in Southeast Asia, that comprised Project Popeye (1966) and the first year of Operation Popeye (1967), but were missed for some months amongst all the other pertinent information regarding the US Military's management of the war.

As a result of all the newspaper articles (*written by Anderson, Hersh and later Victor Cohn from the Washington Post Service*) detailing the clandestine cloud seeding operations, Senator Claybone Pell (*Rhode Island - D*) began a Congressional investigation and subsequent hearings on the weather modification program in Southeast Asia. Although public opinion in the wake of the disclosures centred on the moral implications of this type of warfare, Pell and others saw the weaponization of the weather

as opening a door on a new and dangerous form of warfare – much like atomic weapons were viewed after Hiroshima. The Popeye seeding operations had created a negative environment, within the US and elsewhere around the world, towards the artificial interference of Mother Nature and the climate.

The US Congressional efforts to bring the *(then)* secret weather modification operations in Southeast Asia out into the open, essentially established the guidelines towards the future development of environmental modification (*ENMOD*), as a weapon of war, and ultimately lead to an international treaty banning ENMOD operations.



Senator Claiborne Pell (Rhode Island - D)

Pell's investigations, in pursuit of the truth, resulted in the subsequent official DoD disclosures of the classified weather modification program and led to Pell's Senate Resolution 281 (*later reintroduced as SR-71*) to prevent any more US weaponized weather modification programs in the future. The resolution passed in the senate by a vote of 82-10 in 1974. This resolution would eventually lead to an international treaty banning all forms of environmental (*geophysical*) weather modification or warfare. Later in 1974, the Nixon Administration signed international agreements, limiting environmental (*weather*) modification towards geophysical warfare – save only those scientific investigations for peaceful purpose.

In 1977, the US Government ratified the international "*Environmental Modification Treaty*" or *ENMOD Treaty* that had as its main tenant; "*.....that each party to this convention undertakes not to engage in military or any other hostile use of environmental modification techniques having wide-spread, long-lasting or severe effects as means of destruction, damage or injury to any other party*". Many will tell you that this agreement (*treaty*) is riddled with loop-holes and allows for those who will, to violate the main tenant of this agreement and conduct continued weather modification projects towards weapons of war.

Weaponized Weather

As previously suggested the ultimate goal of the US Navy's Weapons Bureau and China Lake was the successful transition of cloud seeding technologies, developed and pioneered at China Lake, into viable weapons by which to combat the enemies of the United States in the perceived environment of the Cold War.

It was the primary motivating factor in everything that Pierre Saint-Amand did at China Lake. Although seemingly developing and refining seeding devices and new and more effective seeding compounds for projects like *Stormfury*, *GROMET* or *Foggy Cloud*, China Lake was ultimately developing and refining these tools by which to improve their capabilities to use weather as a weapon of war.

With regards to the specific China Lake weather modification projects that were blatantly the weaponization of weather, the most infamous of these was Popeye. Although Popeye was the best known of China Lake's practical applications of weaponized weather, it was not the first. The first actually materialized out of China Lake back in 1961 with the development of the Cyclops (*Cyclops I*) Silver iodide seeding generator. Although promoted by China Lake as having been developed for the US Weather Bureau's hurricane mitigation program, Project Stormfury, it actually wasn't. You see; China Lake's original application of weaponized weather encompassed a secret hurricane seeding program that ran parallel to Project Stormfury and nobody knew it !

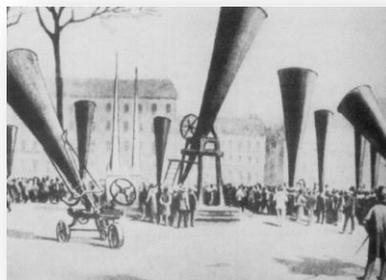
Interest in controlling hurricanes is a much older concept than most people would think. In the 1800s, British naval fleets were said to have employed cannon fire, broadsides, to disrupt dangerous waterspouts that threatened their vessels. There was even a patent issued for the control and or destruction of tornados by high explosives during this same era.



In 1924, a US Senator suggested that the US Navy use Battleships to fire shells into hurricanes to disrupt them and or break them up.

Another proposal was submitted to the Weather Bureau in 1928, proposing to blow hurricanes up with explosives in the areas of the West Indies. This proposal was based upon the hail cannon concept, only larger. These proposed "*Hurricane Cannons*" were to have been 100 feet high, capable of shooting more than one ton of gunpowder smoke upwards for several thousands of feet into the atmosphere of approaching hurricanes.

With a battery of 20 to 30 anti-storm cannons, spread out across southern Florida and the Bahamas, it was proposed that they could produce enough black smoke to effect changes within hurricanes to weaken them and or cause them to shift position altogether.



Several proposed severe weather counter-measures concepts, particularly those associated with Hurricane Control

In 1945-46, discussions of an explosive method of hurricane control was conducted on the floor of the US House of Representatives, in Washington, during debate over a bill to include funding for an investigation of the destructive power of thunderstorms – in response to a number of passenger plane crashes during thunderstorms. Representative Butler B. Hare (*South Carolina - D*) lobbied for the inclusion of a “*hurricane provision*” to be added to the Congressional language of the bill. He spoke for an additional study of hurricanes and the means by which to destroy them before they’ve had a chance to begin.

Hare outlined a plan encompassing the establishment of aerial patrols in the Caribbean to detect and observe developing storms and a squadron of bombers based nearby to intercept the hurricanes and bomb them (*break them up*) before they assume dangerous proportions. The bill passed without the provisions for hurricane research and the concept of an explosive control of hurricanes.

Yet there are published references to suggest that around this same timeframe, the US Navy did conducted extensive experiments into the use of bombs (*high-explosives*) to break up hurricanes at sea - but with negative results. Currently there have been no archival documents found to confirm this information.

Note: *present day meteorologists categorically proclaim that there isn’t enough TNT or explosives in the world to have even the slightest effect on hurricanes.*

In the immediate days after the Atomic bombings of Japan, in August 1945, Weather Bureau meteorologists and forecasters were inundated with inquires, requests and proposals from the public, as to whether the new “*Atom Bomb*” could be used to destroy hurricanes. In fact, the Mayor of Miami (*Herbert A. Fink*), a vocal advocate for hurricane control, actually wrote to the President of the United States requesting that any leftover atomic bombs should be used to bust hurricanes off the coast of Florida. (*despite the fact that after the atomic bombings of Japan, there weren’t any actual atomic bombs leftover in the US inventory*) At that time, it was unknown what an atomic bomb would do to hurricanes. Would it destroy them, make them worse or have no effect at all (?)



Proposed Atomic Bombs towards Hurricane Control

The question of “*the bomb*” and hurricanes continued to haunt the Weather Bureau for many years, until 1961, when the Chief of the Weather Bureau (*Dr. Francis Reichelderfer*) announced that the Weather Bureau would conduct a study into the feasibility of controlling hurricanes by conventional explosives and or by nuclear bombs.

Although he stressed that the use of any atomic or nuclear device requires a national policy decision to test a bomb in the atmosphere, Reichelderfer suggested that the theoretical study could eventually encompassed the practical use of conventional explosives to be tested on hurricanes within 2-3 years. Initial speculation suggested that bombs could be deployed into various areas of storms to weaken or divert them.

The study was to encompass laboratory experiments (*rudimentary computer models*) with possible field experiments in actual hurricanes with conventional explosives. The study looked at the possibility of attacking hurricanes during one of their four stages of development, from their formative stage through rapid intensification, maturity and dissipation. However, it was established as part of the goals of the study, that no atomic or nuclear bombs could be used in hurricanes without steadfast assurances that the bomb would not intensify a storm and only weaken it.

Subsequently, the Department of Commerce (*via the Weather Bureau*) announced, in 1963, that it would no longer be pursuing the atomic / nuclear bomb process as a means to control hurricanes. It was the conclusion of the study that the use of nuclear bombs on hurricanes would not likely affect changes to dissipate or weaken hurricanes. The Weather Bureau went on to state that instead of a nuclear solution to control hurricanes, they would continue to pursue hurricane cloud seeding efforts towards weakening them – through Project Stormfury.

Back when Pierre Saint-Amand sought out the US Weather Bureau in late 1960 / early 1961 with the China Lake developed pyrotechnic seeding compound (*that subsequently generated the Cyclops hurricane seeding experiment*) he (*that's to say China Lake*) had already developed the Cyclops seeding device, despite the official story presented by him in his post – Cyclops seeding experiment report. The Cyclops was actually developed to be used in the Navy's own (*secret*) hurricane seeding project under authorization from the office of Naval Ordnance / the Navy's Weapons Bureau.

China Lake's Secret Hurricane Seeding Program (1961-65) (1966-69) (1969-72)

The goal of the Navy's secret hurricane seeding program (*aka; hurricane control program*) unlike the Weather Bureau's goal of mitigation, was to exploit the raw natural power of hurricanes and harness them into a controllable force, a weapon that could be steered and intensified at will. There was even some suggestion (*later*) within some NWC archival records that they wanted to actually create hurricanes from embryotic tropical depressions and then intensify and or steer them as weapons of war.

Although the official story suggested that it wasn't until Bob Simpson had gotten the NSF money, to conduct the Cyclops hurricane seeding experiment, that sent Saint-Amand into a panic to develop the subsequent Cyclops seeding generator, it's now quite apparent that the Cyclops device was already under development or already developed at this time. In fact, by the time the Weather Bureau and all the other participants traveled to Puerto Rico to conduct the Cyclops seeding experiment on Hurricane Esther, Pierre Saint-Amand and his team from China Lake had already conducted their first ever experimental seeding operation on a hurricane – secretly !

The fact is that in early 1961, Admiral Raborn's Weapons Bureau (*through the bureau's Meteorological Management Division*), ONR, NRL, the Navy Weather Research Facility and NOTS China Lake came together to establish Project ACE (1961-68), under the direction of Pierre Saint-Amand.

Note: *the Navy Weather Research Facility was created from components of Project AROWA and research elements previously housed under the Navy's Fleet Weather Central (HQ) in Norfolk, Virginia. This research weather facility absorbed the responsibilities of and became the Navy's focal-point agency for all things cloud seeding and or weather modification.*

The “*Atmospheric Control Experiment*” (or *ACE*) was a Research, Test, Development & Evaluation (*RTD&E*) project to develop the hardware, materials, procedures and techniques (*technologies*) specifically needed to develop weather modification capabilities that could be used to establish tactical, strategic and in some cases political applications of weather as a weapon. *ACE* also comprised the development of associated activities, such as atmospheric physics, cloud physics and research concepts that would aid in the establishment of weather control capabilities.

It's seemingly apparent, that *ACE* was an over-arching program towards the development of weaponized weather projects and the first just happened to be the exploitation of hurricanes as a weapon.

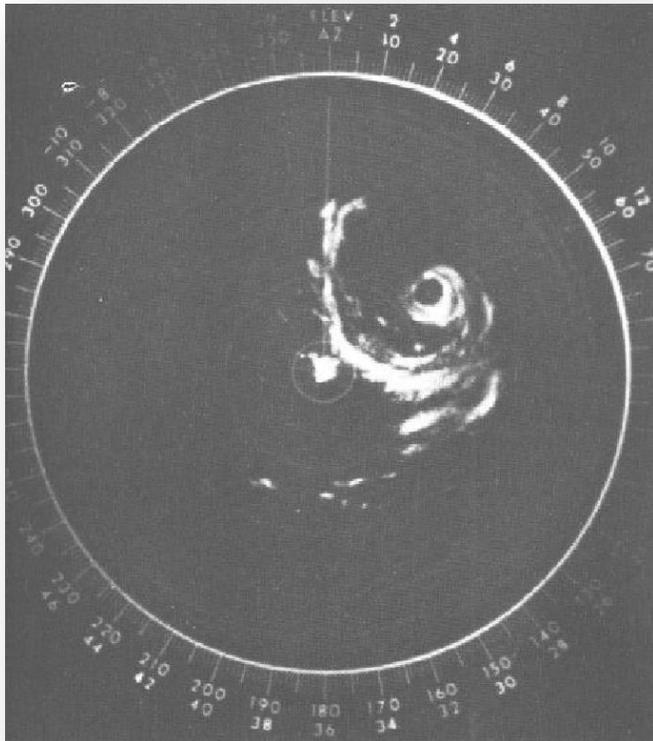
The Navy's secret cloud seeding operations into Atlantic hurricanes were initially carried out between 1961 and 1965, within the open ocean areas of southwestern North Atlantic, the Western Caribbean Sea and the Gulf of Mexico, with little or no restrictions on the China Lake personnel involved in conducting the seeding flights. Unlike the subsequent public Stormfury hurricane seeding operations conducted out of Puerto Rico, in a small seeding box 100 miles (161 kms) x 150 miles (241 kms) square, to the north, northeast of Puerto Rico, the secret Navy hurricane seeding flights were primarily flown from NAS Sanford (*Florida*) and from a forward deployed airfield at NAS Boca Chica in Key West, initially by Navy A-3B Skywarrior jet equipped Navy Heavy Attack Squadrons.

Although it was normal for any China Lake project to be assigned an internal code name, this project didn't seem to have received one - on the surface. Ultimately Saint-Amand cleverly gave it one, “*Project Stormfury*”! Given that China Lake already had a Project Stormfury, the Weather Bureau's hurricane mitigation project, that they were participating in and supporting with their seeding compounds and seeding devices, what better name to call the secret project on the base. It was a secret project hiding in plain sight with a ready-made public cover. Even the China Lake base newspaper (“*the Rocketeer*”) got into the act reporting any and all elements of the secret hurricane seeding project that may have popped up as part of the Weather Bureau's Project Stormfury. And it worked !

Note: *it must be said that there is some miscellaneous evidence in NAWC China Lake archival materials, which have survived the classified censors, suggesting that the planned name for the secret hurricane control project may have been intended to be “Project Cyclops”. But the Weather Bureau jumped the gun and suggested calling its joint USWB / Navy hurricane experimental seeding project Cyclops after the name of the then developed seeding device, “the Cyclops” and China Lake just couldn't say no.*

With few restrictions and the lack of liability derived by its classified status, China Lake had seeded 8 - 12 hurricanes between 1961 and 1963, even before Project Stormfury had ever seeded its first storm, Hurricane Beulah (20-28 August 1963) – or its second storm, if you count Hurricane Esther under Project Cyclops. By the time Stormfury had seeded Hurricane Debbie (14-25 August 1969), the Navy had secretly seeded dozens of other storms. Some of the storms that were seeded by this secret hurricane control program potentially consisted of Hurricanes; *Carla* (September 1961), *Esther* (September 1961), *Ella* (October 1962), *Edith* (September 1963), *Flora* (Sept. –October 1963), *Ginny* (October 1963), *Cleo* (August – September 1964), *Dora* (August - September 1964), *Hilda* (September – October 1964) *Isbell* (October 1964), *Betsy* (August - September 1965), *Celia* (July 1966) and *Inez* (August – September 1966) to name just a few.

The first known hurricane secretly seeded by China Lake was Hurricane Carla (3-16 September 1961). Carla, like other Atlantic hurricanes during this period of the latter 1950s and early 1960s, was a



Hurricane Carla as it appeared on the Brownsville (Texas) radar scope in September 1961

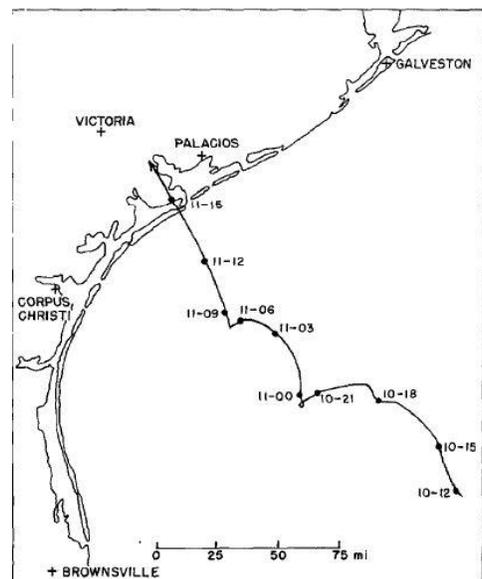
powerful hurricane with peak sustained winds in excess of 145 mph (233 km/h) and higher gusts exceeding 175 mph (282 km/h) as measured by reconnaissance aircraft. During the storm, three specially equipped A-3B Skywarriors from the NAS Sanford - based Heavy Attack Wing 1, seeded Carla while still out in the western Gulf of Mexico on or about 8-9 September.

Earlier in September 1961, several of the Wing's jets had traveled to China Lake to be equipped with Cyclops adapter racks (and wiring) to deploy the Cyclops seeding devices. The aircraft additionally conducted several test-drops on one of the test station's ranges before returning to Florida with full-loads of Cyclops ordinance.

For the Carla flight, the aircrews were pre-flight briefed by a civilian Navy scientist (now identified to have been Pierre Saint-Amand) and post-flight debriefed by the unit's Commanding Officer.

The flight crews were told that the seeding mission was an effort to reduce the intensity of hurricanes before they made landfall. Interestingly enough, this was the mission statement of Weather Bureau's Project Stormfury, that at this point, was not even envisioned yet and would not be until after the joint Navy and Weather Bureau hurricane seeding experiment into Hurricane Esther - about one week after the secret seeding of Carla.

The true track of Hurricane Carla (1961), while it was in the Gulf of Mexico, that demonstrates the marked deviation and irregular oscillations (with regard to direction, speed – motion, and pressure readings in the core of the storm) caused by unknown instabilities within the storms circulation, that may be evidence of hurricane control seeding – not evident in general publicly available tracks of the storm. (as described by C.L. Jorden in Monthly Weather Review, Vol. 94 / No. 7 – July 1966) Given that Carla was one of the first surveyed hurricanes by early weather satellites, newly established land-based weather radars, was flown over numerous times by a USAF U-2 Spyplane and flown on by hurricane hunting and hurricane research aircraft, there must be some documented evidence somewhere to verify that this storm was secretly seeded by US Navy jet aircraft – besides the assertions of the Navy pilots and crewmen that flew the jets that seeded this storm.



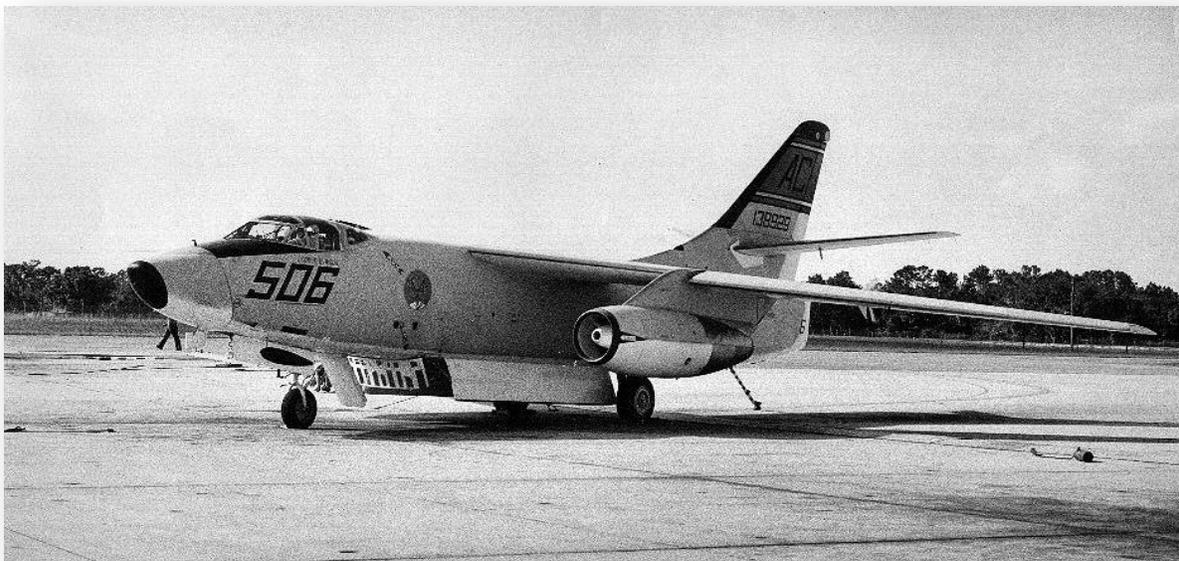


The eye of Hurricane Carla (1961) taken by a USAF GRD U-2 Spyplane that was under-flying TRIOS Weather Satellites passes of the storm.

During the seeding flight into Carla, the 3 aircraft's flight crews experience severe turbulence, with at least one of the A-3 jets having lost complete control at one point. Up and down drafts within the storm, tossed the aircraft up several thousands of feet one instant and several thousands of feet down the next.

Despite this, the aircraft survived and all 3 return to NAS Sanford unscathed after the seeding mission. The Navy jet crews that participated were later told that the seeding mission into Carla did not work. That the storm was seeded during a period of peak winds (175 mph or 282 km/h) in the Gulf of Mexico and that the material was too widely dispersed to have any great effect.

It's now been determined that also during this initial timeframe of the Navy's secret hurricane seeding program (1961- 1965), other aircraft were used to seed hurricanes. It has now come to light that the hurricane reconnaissance WC-121 Constellations of the US Navy's Hurricane Hunter Squadron (VW-4) were also conducting secret hurricane seeding operations, while flying their routine hurricane reconnaissance missions for the National Hurricane Center. Several of VW-4s Constellations were configured by China Lake to secretly seed hurricanes.



One A-3B Skywarrior Jets, from Heavy Attack Squadron 9's (VAH-9), that conducted cloud seeding missions into Hurricane Carla in September 1961. Heavy 9 Squadron-member GM2 William Buck, and crewmembers Lt. Jack Dunn and AM1 George Beers flew into Carla on the Navy's first seeding mission into a hurricane – as part of aerial experiments to turn hurricanes into weather weapons, towards the Cold War.



Thanks to the survey efforts of Walt Walters (*official Historian for the Navy's Hurricane Hunters Association*), canvassing a large group of Navy Hurricane Hunter squadron members, he was able to not only establish that WV-3 radar aircraft supported the secret hurricane control seeding flights (as *monitoring aircraft*), but actually conducted hurricane seeding missions themselves as part of the secret hurricane seeding program.

More disturbing is that the Navy hurricane hunters also conducted seeding operations into some of the same storms that were under experimentation by Project Cyclops / Stormfury – including Hurricanes Esther (*September 1961*) and Betsy (*August - September 1965*). Does this mean that the US Weather Bureau's hurricane seeding results were skewed by the unknown interference from the Navy's secret hurricane seeding flights (?)

Although the Heavy Attack Wing jet aircrews were not told that they were conducting secret hurricane seeding flights, thinking that they were flying the flights to weaken hurricanes or were flying for the Weather Bureau's Project Stormfury, the WV-3 hurricane hunting flight crews did know that they were conducting secret hurricane seeding missions and never disclosed this information to anyone at the Weather Bureau, the Hurricane Center or anyone at Stormfury.

Over the next 5-years, China Lake continued to secretly experiment on hurricanes, seeding dozens of storms. One of the most documented secret hurricane seeding missions, one that demonstrated an element of success for the Navy, occurred on 1-2 October 1963, when specially equipped Navy A-3B jets from NAS Sanford flew into Hurricane Flora (*26 September – 12 October 1963*).

On 4 October 1963, a small but very intense Hurricane Flora slammed into Cuba, making landfall in the Oriente Province, 30 miles (48 kms) east of Guantanamo Bay. The hurricane uncharacteristically stalled over portions of the Cuban mainland and coast for nearly four days. Flora would go on to become the second most deadliest storm in the Atlantic Basin (*at the time*) having killed more than 7,186 people in the Caribbean - including 1,250 in Cuba, mostly from flooding, and leaving more than 175,000 Cuban's homeless and destitute.

The official Weather Bureau records for Flora report that a very large high pressure zone over the northern Gulf of Mexico, and Gulf States blocked Flora's passage, causing the storm to stall over the island nation for four days, adding to the widespread destruction. Winds in Cuba were in excess of 90 mph (145 km/h) with gusts to 125 mph (201 km/h) and very heavy rains that caused severe flooding over the eastern part of the island.

Cuba's fertile valleys flooded from torrents of rain that dumped more than 50 inches on the island, severely damaging local food crops as well as the nation's coffee, sugar (*cane*) and tobacco export industries there. The storm's severe damage further pressured the Cuban economy, that at the time, was already teetering on the brink of collapse.

Although the secret hurricane seeding flights on Flora originated out of NAS Sanford before dawn, the aircraft actually stopped at NAS Key West to top off fuel and wait a little while for the storm to move closer, more within the range of the A-3B. Thus, permitting the aircraft to transit to the storm, seed it and return back to Key West. Flight planning for this mission of approximately 1200 miles, included a contingency to divert to Puerto Rico if problems arose and the aircraft were not able to get back to Key West.



Flora on Radar as it passes through the lesser Antilles

As outlined in the published memoir of Cdr. R. Scott Beat (*entitled; "So Many Ways to Die: Surviving as a Spy in the Sky"*), one of a number of Navy pilots tasked to fly these hurricane seeding missions, the extended flight of three A-3Bs took off from Key West and skirted along Cuban air space to the North of the island, before turning eastward and then southeast passing by the northwestern coast of Hispaniola. The lead navigator got a radar fix for the storm's center from the coastline of Dominican Republic to the eye and estimated the maximum winds to be in excess of 150 mph (241 km/h).

Upon reaching the storm, the three A-3Bs penetrated the northwest quadrant of Flora at 15,000 feet (4572 m) experiencing heavy turbulence. With the eye's diameter now down between 5-7 miles (8-11 kms) across, and unable to maneuver in it as planned, the jets proceeded directly to their first drop points and penetrated the storm's eyewall in the northeast quadrant. Each aircraft made two successful seeding runs in this area before returning to base.

Flora Aftermath

Flora struck Cuba, lingering over the island nation for nearly four days. This stalling effect inflicted maximum damage on the island. It has become evident to some that one of the characteristics of a seeded storm, at least those storms seeded by the Navy during this secret effort, is a so-called stalling

of the storms progression and / or a wobbling of the storm eye, where it rotates in place or in a tight circle before heading off in another direction.

It's been maintain that given the maximum wind speeds within the storm at the time of the secret seeding, the cloud seeding materials would have been too widely dispersed to have had any effect on the storm. Regardless of these opposing views, the Cuban Castro regime found it relevant to accuse the US Government (*and specifically the US Weather Bureau and Project Stormfury*) of having seeded Hurricane Flora, causing all the destruction and fatalities in Cuba.

Nearly from the beginning of the US Weather Bureau's Stormfury hurricane seeding operations, the Cuban government had complained that the US has been steering hurricanes over Cuba to wreak havoc and destroy crops with flooding rainfall. Castro repeatedly accused the US of using hurricanes in a Geophysical warfare campaign against him and his regime. A number of newspapers at the time carried articles that flatly stated that Hurricane Flora (*and later Hurricane Ginny / 16-29 October 1963*) were seeded, despite guarantees by the Director of the National Hurricane Center, Gordon Dunn, that they had not. No one knew that China Lake was conducting its own hurricane seeding program in the Atlantic. It's evident that this was the intension of Pierre Saint-Amand from the very beginning of his secret hurricane control program, to use Stormfury as a cover and let the US Weather Bureau take all the blame.

As the only visible US agency known for conducting hurricane seedings, the Weather Bureau and Project Stormfury attracted allot of heat from the US State Department responding to the numerous complaints and accusations from Cuba, and later Mexico, Honduras and El Salvador, claiming hurricane modification operations were adversely affecting their territories. Mexico had often complained that the Weather Bureau had conducted hurricane seeding flights that were causing droughts in their country, robbing them of the rainfall benefits from these seasonal storms.

The Weather Bureau's official position on Flora was that, as the storm moved in over Cuba, it was pinned down by an area of high pressure to the north and another low pressure zone to the west, blocking its progress towards the Northwest. After four-days, the pressures zones shifted towards the east, forcing Flora back east and north, allowing the storm to slide along the outer edge of the high pressure zone.

Despite the official denials in Washington, elements of the Government conversely promoted hurricane seeding as a potential weapon and supported it. Comments made within the Washington beltway, said to be associated with the Kennedy Administration at the time, suggested the destruction wrought by Flora was more successful than any weapons thus far developed to undermine the Castro Regime.

Note: *Gordon J.F. MacDonald; a Geophysics Professor at UCLA, a Pentagon consultant and member of President's Science Advisory Committee (under Johnson and Nixon) is on the record for having openly promoted the control of hurricanes as a weapon to terrorize any enemy of the US during this time.*

Although speculative, it's believed that another aspect of this secret Navy hurricane seeding program was continued between 1966-1969. After 1964, use of the NAS Sanford A-3 jets was no longer available to the Navy for their secret hurricane seeding flights. Although China Lake had developed their own A-3 aircraft equipped for cloud seeding and use towards seed hurricanes in both their secret seeding program and their augmenting support to Project Stormfury (between 1964-66), this aircraft crashed in March 1967 during a ferry flight to a forward deployed base in support of severe storms (*tornado-producing thunderstorms*) research program, leaving China Lake no viable hurricane seeding

capability. However, taking a chapter from Pierre Saint-Amand's post-Esther report, it's possible that China Lake sought to actually use seeding planes flying off aircraft carriers, to conduct hurricane seeding missions.



Pierre Saint-Amand proposed the use of aircraft carriers by which to conduct Hurricane Control operations. Any potential use of carriers requires additional archival research to confirm.

Under this scenario, Saint-Amand had previously suggested (*in his report*) that the Navy employ the use of aircraft carriers in hurricane modification. He suggested that an aircraft carrier could take up a position off the Cape Verde Islands, to catch hurricanes in their breeding grounds. Once a storm materialized, the carrier could move to within 50 miles (81 kms) of the storm's left rear quadrant. While maintaining a relative level of safety, the carrier could send seeding attack aircraft out into a storm on repeated seeding runs. The aircraft's range, back and forth from the storm, would be greatly reduced as compared to the previous land-based flights, and provide more time on target in the drop areas. Saint-Amand went on to say that aircraft carrier's radar suites, essentially equivalent to the radar setup on the Navy's WC-121 hurricane hunting (*radar*) planes, could provide similar observations towards any changes in those storms seeded.

This fits with NAWC China Lake archival materials that suggest that there was an added effort to develop hurricanes from embryotic tropical depressions and then intensify and or steer them as before. Most hurricanes develop from tropical disturbances and tropical depressions that roll off western Africa near the Cape Verde Islands.

Although there is (*currently*) only scant evidence of aircraft carrier's being used for hurricane seeding by China Lake's secret hurricane control program, claims against the US continued by Cuba and other regional countries, suggesting that some kind of secret hurricane seeding effort continued in some capacity between 1966 and 1969.

Knowledge

It is unclear if anyone knew about the Navy's secret hurricane control program beyond the NWC China Lake personnel involved, members of the Navy's Weapons Bureau, Weather Research Facility, ONR / NRL and VW-4. There are a few internet references to Bob Simpson (*and his wife Joanne*) knowing

something - *not clear what* – where their identified disgust over the weaponization of weather is a matter of record. It is the belief of this author that these references are seemingly associated to the disclosure of Pierre Saint-Amand's involvement with the Popeye weather modification efforts in Southeast Asia and nothing to do with any potential knowledge of the Navy's secret hurricane control program. Although some people associated with Project Stormfury have said Joanne Simpson knew about it.



Note: in a 2010 interview with Bob Simpson, conducted by this author as part of research on an upcoming book regarding the unrealized history of hurricane hunting aircraft – since WWII, Dr. Simpson was informed of the secret hurricane seeding flights and the involvement of Pierre Saint-Amand, that he had known personally. Simpson said that he was flatly unaware of the secret Navy hurricane seeding flights or Saint-Amand's involvement. Pressed to comment further, he simply said that if anyone could have conducted such a program it would have been Pierre Saint-Amand.

Bob and Joanne Simpson (circa 1963-64)

It's noteworthy to mention that it seems that Dr. Simpson never really cared much for Pierre Saint-Amand and in various publicly recorded interviews said that Saint-Amand was always troublesome – especially during their interaction in the run-up to seeding Hurricane Esther, during Project Cyclops, in 1961. Simpson has (*at least twice*) referred to Saint-Amand as a “*chemist*” in recorded interviews and magazine articles as well as a “*want-to-be-meteorologist*” in his recently published memoir. These are seemingly verbal slights towards Saint-Amand, who was a Geologist (*an expert in earthquakes*) with a PhD. However, there are various invisible territories among the scientific community with some disciplines looking down upon the others. However, there is a report (*attributed to Bob Simpson himself*) that suggests shortly after the Stormfury seeding of Hurricane Beulah (1963), the Navy (*via Pierre Saint-Amand*) tried to take-over Project Stormfury, forcing the US Weather Bureau out and moving it all completely to China Lake. Although a case was made by the Navy (*apparently at very senior levels*), in the end the Weather Bureau, the National Hurricane Research Project and Simpson, got to keep control of Project Stormfury. It's quite possible that it was this incident that generated the animosity between the two men.

Subsequently, there are rumors from the Saint-Amand camp (*of colleagues and friends*) that all during Project Stormfury none of Saint-Amand's ideas or concepts were accepted or taken seriously by the scientific teams because he was not a meteorologist. Additionally, none of his papers were accepted by peer-review meteorological journals, forcing Saint-Amand to sponsor the commercially-based Weather Modification Association to develop its own publication, “*The Journal of Weather Modification*”, by which to publish his numerous articles on the science and physics of cloud seeding. In fact, most of the journal's first 3 or 4 issues are loaded with Saint-Amand articles and those he co-authored with other China Lake colleagues.

One person that potentially believed this (*hurricane*) weather control program, or one like it, existed was Senator Claiborne Pell. A review of US Congressional records suggest the he knew there was another weaponized weather program out there, despite the denials of DoD. Almost every witness that testified in his committee hearings was asked if they knew if any storms were modified (?) and / or if there were any other classified weather modification projects in existence (?). It's very possible that Pell and his congressional staff of investigators were also cognisant of the third instance of a weaponized weather application that was conducted by China Lake under the supervision of Pierre Saint-Amand.

Now that the Navy's secret hurricane control program, conducted by China Lake under the direction of Pierre Saint-Amand, has finally been disclosed and represents the first ever application of weaponized weather (*Popeye having been the second*) the third and final application of China Lake's weather as a weapon can be revealed. This weaponized weather effort encompassed a formal or operational weather modification campaign against Castro's Cuba.

The Weather War on Cuba (1969-72)

Although there have been hints of a secret US war against Cuba referenced in the public record and the internet for many years, none of those references had any specific or substantive details as to how the effort was conducted and who was actually involved.

As previously mentioned, the secret Navy hurricane control project seemed to have purposefully steered hurricanes to Cuba's door to inflict maximum destruction upon the little island nation. This third China Lake weaponized weather modification operation sought to affect the weather of Cuba in other ways. Almost in a reverse to Operation Popeye, China Lake planned to cause droughts in Cuba and dry the island up, instead of trying to drown them in a sea of torrential rain. Between 1969 and 1972, China Lake conducted a secret cloud seeding project to cause severe drought-like conditions in Cuba, in an overall effort to destabilize the island nation's agricultural industries, including sugar (*cane*), tobacco, coffee and bananas.

By Pierre Saint-Amand's own definition (*as he defined it in his testimony before Senator Pell's committee*) this would have been a "*Strategic*" form of weaponized weather, whereby the goal would be "*..... to upset the economy of another country causing extensive damage to crops of that country*".

Brought to you by the same folks that sanctioned China Lake's Popeye operations in Southeast Asia, the Cuban weather modification scheme saw cloud seeding missions flown on tropical cumulus clouds out over the south-western Gulf of Mexico, to make the clouds dump all their moisture before reaching Cuba – causing persistent drought conditions throughout the whole of the island for an extended period. Aircraft from China Lake seeded tropical clouds in the wind current 200 miles (322 kms) to the west of Cuba. Atmospheric physics does suggests that creating a stronger convection in one particular area of a synoptic field, reduces the available moisture in the surrounding area.

Historical weather records do show that Cuba did inexplicitly experience severe drought conditions during this period, that further pressured the Cuban economy at a time when the nation was teetering on the brink of collapse.

Note: according to the book "*the Fish is Red: the Story of the Secret War Against Castro*" (by Warren Hinckle and William Turner) China Lake aircraft seeded the clouds out over the Gulf of Mexico, causing the drought in

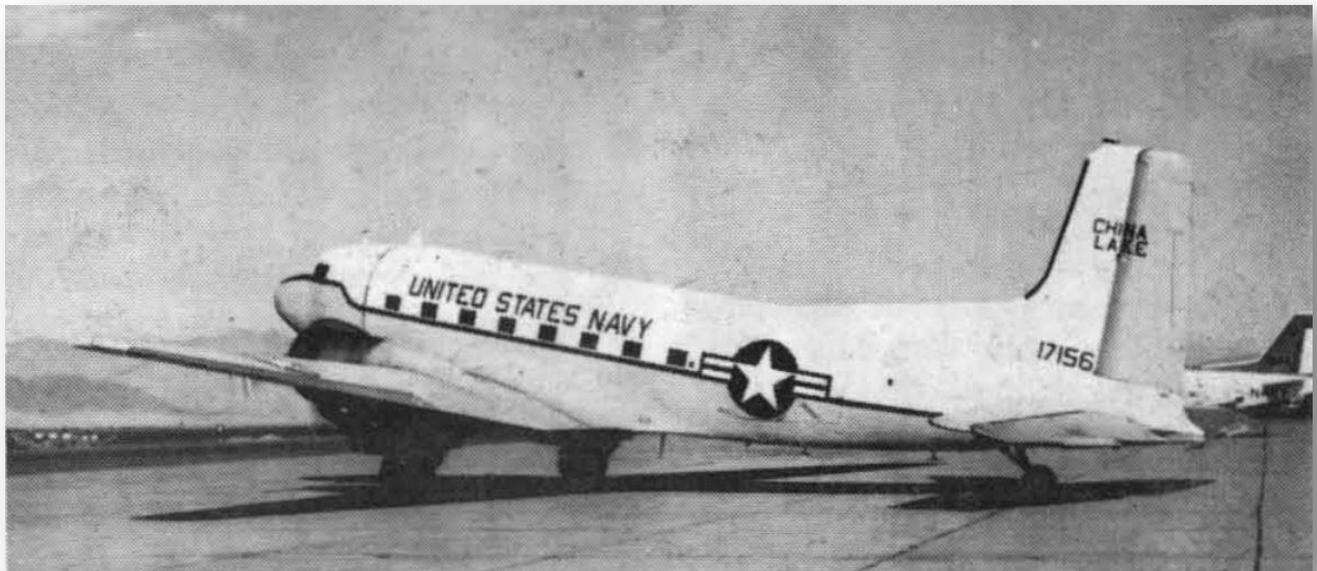
Cuba. The basis of these authors' claims came from an interview they conducted with a China Lake informer that had actually participated in the cloud seeding operation against Cuba 1969-72.

One might wonder how this blatant seeding operation was accomplished given the covert nature of the project and China Lake's *Modus operandi* of using other overt projects to cover their tracks. Well, it just so happens that during this same period (1969-1972), China Lake was discreetly conducting a cloud seeding experiment out in the Gulf of Mexico known as "Project Gulf Q". It was this seemingly unclassified experimental seeding project that was the cover for the weather modification operations against Cuba.

Project Gulf Q

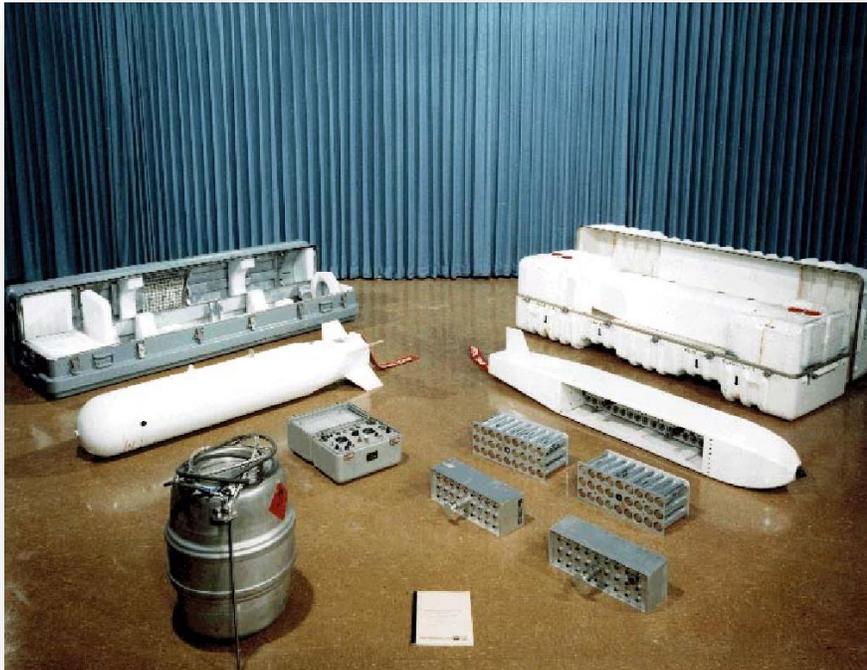
Project Gulf Q (also known as Project Q) was a China Lake cloud seeding project encompassing the experimental seeding of warm convective (*tropical cumulus*) clouds out in the Gulf of Mexico with Silver iodide, hygroscopic solutions and hydrophilic compounds. Although not classified, the project was not generally known to government and congressional officials either. If it had, the conclusions that it was a cover for a suspected covert cloud seeding operation in a geophysical warfare campaign against Cuba would have been obvious.

Note: *Hydrophillic seeding encompasses the utilization of microencapsulated dry-particle chemicals that absorb tiny water droplets that dry out the air within clouds and permit them to simply evaporate.*



The Navy C-47 (aka C-117D or R4D-8 Skytrain) seeding aircraft, supported a number of China lake seeding projects between 1967-1972. Two of China Lake's C-47s were equipped with two internal 500 gallon tanks and commercial (agricultural type) spray system mounted on each wing, consisting of 86 spray nozzles powered by two externally-mounted propeller driven pumps, for the dispersion of hygroscopic agents. The aircraft additionally were provisioned for the dispensing Hydrophillic compounds and the use of the Cold Cloud SUU-53A (Silver iodide cartridge) dispensing system. These were the same C-47 used in another of a series of China Lake cloud seeding projects, Foggy Cloud and Tule Fog seeding projects to dissipate warm fogs.

Conducted in specific open ocean areas of the western Caribbean, south-western and central Gulf of Mexico beginning in May 1969, Gulf Q's overtly stated project goals were to develop a "non-freezing" cloud seeding technique that could enhance rainfall and dissipate clouds - as a potential new method of controlling hurricanes. With flight operations based out of Brownsville (in extreme southern Texas) the project's aircraft comprised a number of airplanes, including two Cessna 210s (for cloud physics and monitoring), several contracted Cessna 205s and 206s (as photo reconnaissance and control planes) and two Navy C-47 transport aircraft (assigned to China Lake) as seeding planes.



The Navy's Cold Cloud Weather Modification System; comprising the SUU-53/A (Silver iodide cartridge) dispensing system and the SUU-56/A jet seeder pod (designed to formulate stratus clouds) developed by the folks from Naval Weapons Center, China Lake. (circa 1973)

Under the first season of Gulf Q, approximately 16 warm cumulus cloud seeding flights were flown, dispensing more than 600 gallons of hygroscopic solutions and hydrophillic compounds at the tops and mid-level areas of clouds out in the Gulf of Mexico. The project's experiments were reportedly to have been positive, with 9 out of 13 clouds having been dissipated within 20 minutes of seeding. Conducted over 3 years the Gulf Q seeding flights effectively dried out any and all seasonal clouds that would have provided the needed moister to maintain Cuba's agricultural areas.





It's interesting to note, that during the early to mid -1970s, the Cuban Government established a (*agricultural*) cloud seeding program jointly with the former Soviet Union to combat drought conditions throughout Cuba. This program utilized Soviet aircraft and technical expertise that continued well into the 1980s.

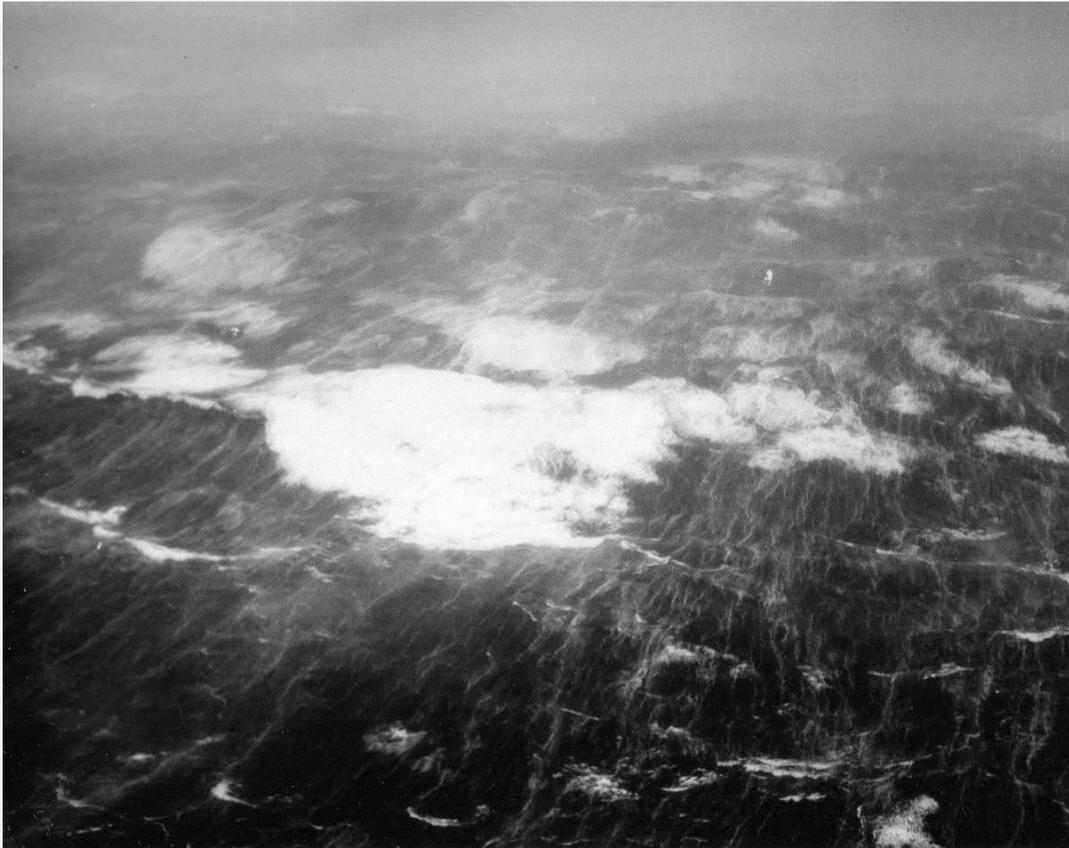
Despite numerous public record (*newspaper*) reports on Cuba's and others country's complaints of weather modification operations flown against them, the US Government (*CIA, DoD and DoC – NOAA*) repeatedly denied ever having conducted such operations around or near Cuba. DoD representatives in open US Congressional hearings (*between 1972-74*) repeatedly stated that there were "*no other*" classified weather modification experiments or research projects being conducted at the time. But these ascertains later proved to be misleading with the further disclosure of Operation Popeye details and reports of a secret weather war against Cuba. Its seems plausible that Gulf Q and the weather war on Cuba also came to an end in 1972 perhaps to provide truthful denials in Congressional hearings and to prevent unwanted details of this operation from coming out.

Hurricane Control Missions (1969-72)

It was also during this same timeframe of Gulf Q & the Cuban weather warfare operation, that Cuba (*as well as other neighboring countries*) continued to complain to the US Government about hurricane seeding flights that were being conducted by the US (*said to have been perpetrated specifically by Project Stormfury*) that was ruining its society from the damages inflicted by severe hurricanes.

Although speculative, the fact that there were hurricane seeding capable aircraft from China Lake operating in the same region at the time and in close proximity to those Gulf of Mexico hurricanes suspected of being seeded, it's very probable that China Lake conducted additional hurricane seeding operations between 1969-1972 - seemingly associated with a more aggressive strategic geophysical warfare campaign against Cuba.

There were several suspected Gulf of Mexico storms that are thought to have been seeded by China Lake during this period. They prospectively included Hurricane Camille (14-22 August 1969), Hurricane Irene (11-20 September 1971), Tropical Storm Laura (12-22 November 1971) and Hurricane Agnes (14-23 June 1972) to name a few. However, this specific area warrants continued archival research and verification of referenced information before the truth of these potential operations can be substantiated.



Angry seas out in the Gulf of Mexico, where China Lake is believed to have modified hurricanes directed at Cuba

With the subsequent disclosure of Operation Popeye in the July 1972, and the follow-on ratification of the weather modification treaty, any future weaponized weather or hurricane control operations conducted by China Lake seem to have stopped with no additional evidence of continued efforts being immediately evident.

For the record, personnel at China Lake involved in weather modification projects (*and their colleagues*) were disgusted by the actions taken by Congress against their work and their perceived mission of fighting communism throughout the world. Saint-Amand actually appeared before Senator Pell's congressional hearings twice to present the DoD (*US Navy's*) view point in support of weather as a weapon of war. Stressing the importance of the US to acquire and develop these capabilities before the Soviets could develop them and use them against the US Homeland. Saint-Amand was often unapologetic regarding the US development of weather weapons.

Note: in these appearances before Senator Pell's committee, Saint-Amand was always presented as a US Navy scientist familiar with the concepts of Geophysical Warfare. It was never disclosed that Saint-Amand was actually the pioneer of the weaponization of weather, nor the man in charge of Popeye on the ground in Southeast Asia. It's unclear if Pell ever really knew that he had the man before him that had actually used weather as a weapon.

Back at China Lake, Saint-Amand was viewed as a Cold Warrior trying to protect the United States against the evil empire of the former Soviet Union. In fact, Pierre Saint-Amand was seen as a hero by China Lake and the conservative enclave of Ridgecrest, California – and still is today.

In the years after the disclosure of Popeye and the ENMOD treaty, China Lake was prohibited from conducting weather modification field experiments or any operational weather modification projects. Saint-Amand's group continued to support and evaluate cloud seeding projects conducted by different US states and a few other countries. Saint-Amand and his group went on to develop state-of-the-art numerical (*computer*) models for weather modification and maintained particular interest in refining the technical processes of cloud seeding as well as pioneering new studies into micro-physical properties of clouds, cloud particles and properties of cloud nuclei.

Most of the cloud seeding technology and methodologies pioneered at China Lake, as well as its pyrotechnical seeding compounds and dispersing devices made it into the civilian sector and make up the principle capabilities of the commercial cloud seeding industry today.

In closing

This document was produced with several goals in mind, the foremost to set the record straight in the so-called public record with regards to the actual history of weather modification and the development of weather as a weapon during the Cold War.

The next goal was to demonstrate the flaws that exist within the public record and the internet, and point out the various in-accuracies that have occurred with respect to the subject of "*weather modification*" alone, due to superficial research and the persistent use of conspiracy-leaden biased information on internet websites and in books that are further based upon superficial research and bias opinions.

For those truly interested in understanding the history of weather modification, the weaponization of weather and the implications of perceived modern-day incidents of military based weather modification, they will have to do the hard archival research required to make an informed opinion on the subject.

The reality of this issue greatly differs from the speculative version that has been bantered about on the internet, that is rampant with superficially researched with non-evidential based (*biased*) information. Only archival research and seeking out those people actually involved with the activities in question will yield a true picture of the actual operations that have taken place.

Although I have not provided specific sources and references for most of this article, and have left out some specific details (*associated with the secret hurricane control program*) that will be presented in a future book on the unrealized history of hurricane hunting aircraft (*yes; the public record got this history wrong too*) I have provided a general scheme of the weaponized weather operations, the involvement of China Lake, project names and dates as well as key people involved. There is more than enough information for people really interested in this subject to pursue their own archival research and in doing

so will verify what I have reported. This will be the only means to understand the reality -vs- the rhetoric that makes up the universal public record on this subject.

- *End* -