

= David A. Johnston =

David Alexander Johnston (December 18 , 1949 ? May 18 , 1980) was an American USGS volcanologist who died during the 1980 eruption of Mount St. Helens in Washington . A principal scientist on the monitoring team , Johnston perished while manning an observation post 6 miles (10 km) away on the morning of May 18 , 1980 . He was the first to report the eruption , transmitting " Vancouver ! Vancouver ! This is it ! " before he was swept away by a lateral blast . Johnston 's remains were never found , but state highway workers discovered remnants of his USGS trailer in 1993 .

Johnston 's career took him across the United States , where he studied Augustine Volcano in Alaska , the San Juan volcanic field in Colorado , and long @-@ extinct volcanoes in Michigan . Johnston was a meticulous and talented scientist , known for his analyses of volcanic gases and their relationship to eruptions . This , along with his enthusiasm and positive attitude , made him liked and respected by many co @-@ workers . After his death , other scientists lauded his character , both verbally and in dedications and letters . Johnston felt scientists must do what is necessary , including taking risks , to help protect the public from natural disasters . His work , and that of fellow USGS scientists convinced authorities to close Mount St. Helens to the public before the 1980 eruption . They maintained the closure despite heavy pressure to re @-@ open the area ; their work saved thousands of lives . His story became intertwined within the popular image of volcanic eruptions and their threat to society , and a part of volcanology 's history . To date , Johnston , along with Harry Glicken , is one of two American volcanologists known to have died in a volcanic eruption .

Following his death , Johnston was commemorated in several ways , including a memorial fund established in his name at the University of Washington to fund graduate @-@ level research . Two volcano observatories were established and named after him : one in Vancouver , Washington , and another on the ridge where he died . Johnston 's life and death are featured in several documentaries , films , docudramas and books . Along with others who died during the eruption , Johnston 's name is inscribed on memorials dedicated to their memory .

= = Life and career = =

Johnston was born at the University of Chicago Hospital on December 18 , 1949 , to Thomas and Alice Johnston . They originally lived in Hometown , Illinois , but moved to Oak Lawn shortly after Johnston 's birth . Johnston grew up with one sister . His father worked as an engineer at a local company and his mother as a newspaper editor . Johnston often took photographs for his mother 's newspaper and contributed articles to his school 's newspaper . He never married .

After graduating from high school , Johnston attended the University of Illinois at Urbana @-@ Champaign . He planned to study journalism , but became discouraged after a poor grade in a large lecture class . He was intrigued by an introductory geology class , and changed his major . His first geologic project was a study of the Precambrian rock that forms Michigan 's Upper Peninsula . There he investigated the remains of an ancient volcano : a suite of metamorphosed basalts , a gabbroic sill , and volcanic roots in the form of a dioritic and gabbroic intrusion . The experience planted the seed of Johnston 's passion for volcanoes . After working hard to learn the subject , he graduated with " Highest Honors and Distinction " in 1971 .

Johnston spent the summer after college in the San Juan volcanic field of Colorado working with volcanologist Pete Lipman in his study of two extinct calderas . This work became the inspiration for the first phase of his graduate work at the University of Washington in Seattle , in which he focused on the Oligocene Cimarron andesitic volcanic complex in the western San Juans . Johnston 's reconstruction of the eruptive history of the extinct volcanoes prepared him to study active volcanoes . Johnston 's first experience with active volcanoes was a geophysical survey of Mount Augustine in Alaska in 1975 . When Mount Augustine erupted in 1976 , Johnston raced back to Alaska , shunting his former work on the Cimarron Volcano into a master 's thesis , and making Mount Augustine the focus of his Ph.D. work . He graduated in 1978 with his Ph.D. , having shown

that (1) the emplacement mechanism of the pyroclastic flows had changed over time , as they became less pumaceous , (2) the magmas contained high quantities of volatile water , chlorine , and sulfur , and (3) underground mixing of the felsic (silicic) magmas with less @-@ viscous mafic (basaltic) magmas could have triggered eruptions . Mount Augustine was also the site of an early near @-@ disaster for Johnston , when he became trapped on the mountain during an eruption after high winds grounded the first two evacuation aircraft .

During the summers of 1978 and 1979 , Johnston led studies of the ash @-@ flow sheet emplaced in the 1912 eruption of Mount Katmai in the Valley of Ten Thousand Smokes . The gas phase is extremely important in propelling volcanic eruptions . Because of this , Johnston mastered the many techniques required to analyze glass @-@ vapor inclusions in phenocrysts embedded in lavas , which provide information about gases present during past eruptions . His work at Mount Katmai and other volcanoes in the Valley of Ten Thousand Smokes paved the way for his career , and his " agility , nerve , patience , and determination around the jet @-@ like summit fumaroles in the crater of Mt . Mageik " impressed his colleagues .

Later in 1978 , Johnston joined the United States Geological Survey (USGS) , where he monitored volcanic emission levels in the Cascades and Aleutian Arc . There he helped to strengthen the theory that eruptions can be predicted , to some degree , by changes in the makeup of volcanic gases . Fellow volcanologist Wes Hildreth said of Johnston , " I think Dave 's dearest hope was that systematic monitoring of fumarolic emissions might permit detection of changes characteristically precursory to eruptions ... Dave wanted to formulate a general model for the behavior of magmatic volatiles prior to explosive outbursts and to develop a corollary rationale for the evaluation of hazards . " During this time , Johnston continued to visit Mount Augustine every summer and also assessed the geothermal energy potential of the Azores and Portugal . In the last year of his life , Johnston developed an interest in the health , agricultural , and environmental effects of both volcanic and anthropogenic emissions to the atmosphere .

Johnston was based at the branch of the USGS in Menlo Park , California , but his work on volcanoes took him all over the Pacific Northwest region . When the first earthquakes shook Mount St. Helens on March 16 , 1980 , Johnston was nearby at the University of Washington , where he had pursued his doctorate . Intrigued by the possible advent of an eruption , Johnston contacted Stephen Malone , a professor of geology at the university . Malone had been his mentor when Johnston had worked at the San Juan complex in Colorado , and Johnston admired his work . Malone stated that he " put him to work " almost instantly , allowing Johnston to escort interested reporters to a place near the volcano . Johnston was the first geologist on the volcano , and soon became a leader within the USGS team , taking charge of monitoring of volcanic gas emissions .

= = Eruption = =

= = = Precursor activity = = =

Since its last eruptive activity in the mid @-@ 19th century , Mount St. Helens had been largely dormant . Seismographs were not installed until 1972 . This period of more than 100 years of inactivity ended in early 1980 . On March 15 , a cluster of tiny earthquakes rocked the area around the mountain . For six days , more than 100 earthquakes clustered around Mount St. Helens , an indication that magma was moving . There was initially some doubt as to whether the earthquakes were precursors to an eruption . By March 20 , a magnitude 4 @.@ 2 earthquake shook the wilderness around the volcano . The next day , seismologists installed three seismic recorder stations . By March 24 , volcanologists at the USGS ? including Johnston ? became more confident that the seismic activity was a sign of an impending eruption . After March 25 , seismic activity drastically increased . By March 26 , more than seven earthquakes over magnitude 4 @.@ 0 had been recorded , and the next day , hazard warnings were publicly issued . On March 27 , a phreatic eruption took place , ejecting a plume of ash nearly 7 @,@ 000 feet (2 @,@ 134 m) into the air .

Similar activity continued at the volcano over the following weeks , excavating the crater , forming

an adjacent caldera , and erupting small amounts of steam , ash , and tephra . With each new eruption , the plumes of steam and ash from the volcano rose , eventually climbing to 20 @,@ 000 feet (6 @,@ 000 m) . By late March , the volcano was erupting up to 100 times per day . Spectators congregated in the vicinity of the mountain , hoping for a chance to see its eruptions . They were joined by reporters on helicopters , as well as mountain climbers .

On April 17 , a bulge was discovered on the mountain 's north flank , suggesting that Mount St. Helens could produce a lateral blast . Johnston was one of few people who believed this , along with a professor of geology at a Tacoma community college , Jack Hyde . Observing that Mount St. Helens did not possess visible vents , Hyde suggested that pressure would increase until the mountain exploded . Because Hyde was not a part of the USGS or in a position of responsibility , his opinion was generally dismissed . However , both were to be proven correct . Rising magma under Mount St. Helens had veered off to the north flank , creating a growing bulge on the surface .

= = = Final signs and primary blast = = =

Given the increasing seismic and volcanic activity , Johnston and the other volcanologists working for the USGS in its Vancouver branch prepared to observe any impending eruption . Geologist Don Swanson and others placed reflectors on and around the growing domes , and established the Coldwater I and II observation posts to use laser ranging to measure how the distances to these reflectors changed over time as the domes deformed . Coldwater II , where Johnston died , was located just 6 miles (10 km) north of the mountain . To the astonishment of the USGS geologists , the bulge was growing at a rate of 5 to 8 feet (1 @.@ 5 to 2 @.@ 4 meters) per day .

Tiltmeters installed on the volcano 's north side displayed a northwest trending tilt for that side of the mountain , and a southwest trending tilt was observed on the south side . Worried that the amount of pressure on the magma underground was increasing , scientists analyzed gases by the crater , and found high traces of sulfur dioxide . After this discovery , they began to regularly check the fumarolic activity and monitor the volcano for dramatic changes , but none were observed . Disheartened , they instead opted to study the growing bulge and the threat an avalanche could have for humans relatively near the volcano . An evaluation of the threat was carried out , concluding that a landslide or avalanche in the Toutle River could spawn lahars , or mudflows , downstream .

At that point , the previously consistent phreatic activity had become intermittent . Between May 10 and May 17 , the only change occurred on the volcano 's north flank , as the bulge increased in size . On May 16 and 17 , the mountain stopped its phreatic eruptions completely .

The active Mount St. Helens was radically different from its dormant form , now featuring an enormous bulge and several craters . In the week preceding the eruption , cracks formed in the north sector of the volcano 's summit , indicating a movement of magma from the bulge and towards the caldera .

At 8 : 32 a.m. local time the next day (18 May) , an earthquake measuring magnitude 5 @.@ 1 rocked the area , triggering the landslide that started the main eruption . In a matter of seconds , vibrations from the earthquake loosened 2 @.@ 7 cubic kilometers (0 @.@ 6 cu mi) of rock on the mountain 's north face and summit , creating a massive landslide . With the loss of the confining pressure of the overlying rock , the caldera of Mount St. Helens began to rapidly emit steam and other volcanic gases . A few seconds later , it erupted laterally , sending swift pyroclastic flows down its flanks at near supersonic speeds . These flows were later joined by lahars . Before being struck by a series of flows that , at their fastest , would have taken less than a minute to reach his position , Johnston managed to radio his USGS co @-@ workers with the message : " Vancouver ! Vancouver ! This is it ! " Seconds later , the signal from the radio went silent . Initially , there was some debate as to whether Johnston had survived ; records soon showed a radio message from fellow eruption victim and amateur radio operator Gerry Martin , located near the Coldwater peak and farther north of Johnston 's position , reporting his sighting of the eruption enveloping the Coldwater II observation post . As the blast overwhelmed Johnston 's post , Martin declared solemnly , " Gentlemen , the uh ... camper and the car sitting over to the south of me is covered . It

's gonna get me , too . I can 't get out of here ... " before his radio went silent .

The extent , speed and direction of the avalanche and pyroclastic flows that overwhelmed Johnston , Martin , and others were later described in detail in a paper titled ' Chronology and Character of the 18 May 1980 Explosive Eruptions of Mount St. Helens ' , published in 1984 in a collection published by the National Research Council 's Geophysics Study Committee . In this paper , the authors examined photographs and satellite images of the eruption to construct a chronology and description of the first few minutes . Included in the paper is figure 10 @. @ 3 , a series of timed photographs taken from Mount Adams , 33 miles (53 km) east of Mount St. Helens . These six photographs , taken sideways on to the lateral blast , vividly show the extent and size of the avalanche and flows as they reached northwards over and beyond Johnston 's position . Figure 10 @. @ 7 from the same paper is an overhead diagram showing the position of the pyroclastic surge front at half @-@ minute intervals , with the positions of Johnston (Coldwater II) and Martin included .

The eruption was heard hundreds of miles away , but some of those who survived the eruption declared that the landslide and pyroclastic flows were silent as they raced down the mountain . Krau Kilpatrick , an employee of the United States Forest Service , recalled , " There was no sound to it , not a sound . It was like a silent movie and we were all in it . " The reason for this discrepancy is a " quiet zone " , created as a result of the motion and temperature of air and , to a lesser extent , upon local topography .

Famous for telling reporters that being on the mountain was like " standing next to a dynamite keg and the fuse is lit " , Johnston had been among the first volcanologists at the volcano when eruptive signs appeared , and shortly after was named the head of volcanic gas monitoring . Though a careful analyst , Johnston strongly believed that scientists needed to take this risk for themselves in order to prevent civilian deaths , and therefore chose to take part in dangerous on @-@ site monitoring . He and several other volcanologists prevented people from being near the volcano during the few months of pre @-@ eruptive activity , and successfully fought pressure to re @-@ open the area . Their work kept the death toll at a few tens of individuals , instead of the thousands who possibly could have died had the region not been closed off . Johnston supported the lateral blast theory : he believed the explosive eruption would be ejected sideways out of the volcano , not upward . He also believed that the eruption would originate from the bulge . Because of this , he was more aware than most of the threat of a north @-@ directed eruption .

= = = USGS team and rescue efforts = = =

Many USGS scientists worked on the team monitoring the volcano , but it was graduate student Harry Glicken who had been manning the Coldwater II observation post for the two and a half weeks immediately preceding the eruption . The evening before the eruption he was scheduled to be relieved by USGS geologist Don Swanson in order to visit the graduate school at the University of California . Swanson , however , wanted to meet with a German graduate student who was returning to Germany on May 18 . Two days before the eruption , Swanson ran into Johnston in the hallway and asked him to take his place . Johnston hesitantly agreed to man the base for one day . That Saturday , the day before the eruption took place , Johnston ascended the mountain and went on a patrol of the volcano with geologist Carolyn Driedger . Tremors shook the mountain . Driedger was supposed to camp on one of the ridges overlooking the volcano that night , but Johnston told her to head home and said that he would stay on the volcano alone . While at Coldwater II , Johnston was to observe the volcano for any further signs of an eruption . Just prior to his departure , at 7 p.m. on the evening of May 17 , 13 ½ hours before the eruption , Glicken took the famous photograph of Johnston sitting by the observation post trailer with a notebook on his lap , smiling .

The following morning , May 18 , at 8 : 32 a.m. , the volcano erupted . Immediately , rescue workers were dispatched to the area . The official USGS pilot , Lon Stickney , who had been flying the scientists to the mountain , conducted the first rescue attempt . He flew his helicopter over the scarred remains of trees , valleys , and the Coldwater II observation post ridge , where he saw bare rock and uprooted trees . Because he saw no sign of Johnston 's trailer , Stickney began to panic ,

becoming " emotionally distraught " .

Frantic and guilt @-@ stricken , Harry Glicken convinced three separate helicopter pilots to take him up on flights over the devastated area in a rescue attempt , but the eruption had so changed the landscape that they were unable to locate any sign of the Coldwater II observation post , which had been swept away and buried in the blast . He and the helicopter crew did manage to find a car with people in it at a logging camp , but when they landed to attempt an evacuation , skin fell off the dead victims ' hands . Shortly after the eruption , Don Swanson found Johnston 's backpack and parka buried in the rubble , but he hid the discovery from all but a few people for fear that scavengers (who were already removing and selling souvenirs of victims of the volcano) would find and remove his friend 's body or belongings . In 1993 , while building a 9 @-@ mile (14 km) extension of Washington State Route 504 (also called " Spirit Lake Memorial Highway ") to lead to the Johnston Ridge Observatory , construction workers discovered pieces of Johnston 's trailer . His body , however , has never been recovered .

= = = Consequences and response = = =

The public was shocked by the extent of the eruption , which had lowered the elevation of the summit by 1 @, @ 313 feet (400 m) , destroyed 230 square miles (596 km²) of woodland , and spread ash into other states and Canada . The lateral blast that killed Johnston started at 220 miles per hour (354 km / h) and accelerated to 670 miles per hour (1 @, @ 078 km / h) . Even USGS scientists were awed . With a Volcanic Explosivity Index value of 5 , the eruption was catastrophic . More than 50 people were killed or missing , including Johnston , mountain resident Harry Randall Truman , and National Geographic photographer Reid Blackburn .

The disaster was the deadliest and most destructive volcanic eruption in the history of the United States of America . A total of 57 people are known to have died , and more were left homeless when the ash falls and pyroclastic flows destroyed or buried 200 houses . In addition to the human fatalities , thousands of animals perished . The official estimate from the USGS was 7 @, @ 000 game animals , 12 million salmon fingerlings , and 40 @, @ 000 salmon .

Two years after the eruption , the United States government set aside 110 @, @ 000 acres (450 km²) of land for the Mount St. Helens National Volcanic Monument . This protected area , which includes the Johnston Ridge Observatory and several other research and visitor centers , serves as an area for scientific research , tourism , and education .

= = Legacy = =

= = = Scientific = = =

Johnston , known to his friends as Dave , was commemorated by both his fellow scientists and by the government . Known for his diligent and particular nature , he was called " an exemplary scientist " by a USGS dedication paper , which also described him as " unaffectedly genuine , with an infectious curiosity and enthusiasm " . He was quick to " dissipate cynicism " and believed that " careful evaluation and interpretation " was the best approach to his work . An obituary notice for Johnston stated that at the time of his death he had been " among the leading young volcanologists in the world " and that his " enthusiasm and warmth " would be " missed at least as much as his scientific strength " . Co @-@ worker Andrew Alden states that Johnston had great potential , declaring that he " had many friends and a bright future " . Following the eruption , Harry Glicken and other geologists at the USGS dedicated their work to Johnston .

Because Johnston was believed to be safe at the Coldwater II observation post , the fact that he died shocked his friends and co @-@ workers alike . However , most of his colleagues and family asserted that Johnston died " doing what he wanted to do . " His mother stated in an interview shortly after the eruption , " Not many people get to do what they really want to do in this world , but our son did He would tell us he may never get rich but he was doing what he wanted . He

wanted to be near if the eruption came . In a phone call on Mother 's Day , he told us it 's a sight very few geologists get to see . " Dr. Stephen Malone agreed that Johnston died doing what he loved , and stated that he " was very good at his work " .

Johnston 's role in the study of the volcano in the weeks leading up to the eruption was acknowledged in 1981 in a chronology of the eruption , published as part of the USGS report titled ' The 1980 Eruptions of Mount St. Helens , Washington ' :

Among the many contributors of data , none was more essential to the systematic reconstruction of the events of 1980 at Mount St. Helens than David Johnston , to whose memory this report is dedicated . Dave , who was present through all of the activity up to the climactic eruption and who lost his life in that eruption , provided far more than data . His insights and his thoroughly scientific attitude were crucial to the entire effort ; they still serve as a model for us all .

Since Johnston 's death , his field of volcanic eruption prediction has advanced significantly , and volcanologists are now able to predict eruptions based on a number of precursors that become apparent between days and months in advance . Geologists can now identify characteristic patterns in seismic waves that indicate particular magmatic activity . In particular , volcanologists have used deep , long @-@ period earthquakes that indicate that magma is rising through the crust . They can also use carbon dioxide emission as a proxy for magma supply rate . Measurements of surface deformation due to magmatic intrusions , like those that were conducted by Johnston and the other USGS scientists at the Coldwater I and II outposts , have advanced in scale and precision . Ground deformation monitoring networks around volcanoes now consist of InSAR (interferometry) , surveys of networks of GPS monuments , microgravity surveys in which scientists measure the change in gravitational potential or acceleration because of the intruding magma and resulting deformation , strain meters , and tiltmeters . Though there is still work to be done , this combination of approaches has greatly improved scientists ' abilities to forecast volcanic eruptions .

In addition to his work , Johnston himself has become part of the history of volcanic eruptions . With Harry Glicken , he is one of two volcanologists from the United States to die in a volcanic eruption . Glicken was being mentored by Johnston , who relieved Glicken of his watch at the Coldwater II observation post 13 hours before Mount St. Helens erupted . Glicken died in 1991 , eleven years later , when a pyroclastic flow overran him and several others at Mount Unzen in Japan . Despite the deaths of other volcanologists in later eruptions at Mount Unzen and Galeras , prediction methods similar to Johnston 's allowed scientists to convince residents of settlements near the Mount Pinatubo volcano to evacuate , preventing thousands of deaths .

= = = Commemoration = = =

Early acts of commemoration included two trees that were planted in Tel Aviv , Israel , and the renaming of a community center in Johnston 's hometown as the " Johnston Center " . These actions were reported in newspapers during the first anniversary of the eruption in May 1981 .

On the second anniversary of the eruption , the USGS office in Vancouver (which had been permanently established following the 1980 eruption) was renamed the David A. Johnston Cascades Volcano Observatory (CVO) in his memory . This volcano observatory is the one most responsible for monitoring Mount St. Helens , and helped to predict all of the volcano 's eruptions between 1980 and 1985 . In a 2005 open day , the lobby area of the CVO included a display and painting commemorating Johnston .

Johnston 's connections with the University of Washington (where he had carried out his masters and doctoral research) are remembered by a memorial fund that established an endowed graduate @-@ level fellowship within what is now the department of Earth and Space Sciences . By the time of the first anniversary of his death , the fund had exceeded \$ 30 @,@ 000 . Known as the ' David A. Johnston Memorial Fellowship for Research Excellence ' , a number of awards of this fellowship have been made over the years since it was launched .

Following the eruption , the area where the Coldwater II observation post had been was sectioned off . Eventually , an observatory was built in the area in Johnston 's name , and opened in 1997 . Located just over 5 miles (8 km) from the north flank of Mount St. Helens , the Johnston Ridge

Observatory (JRO) allows the public to admire the open crater , new activity , and the creations of the 1980 eruption , including an extensive basalt field . Part of the Mount St. Helens National Volcanic Monument , the JRO was constructed for \$ 10 @. @ 5 million , equipped with monitoring equipment . Visited by thousands of tourists annually , it also includes tours , a theater , and an exhibit hall .

There are several public memorials where Johnston 's name is inscribed in a list of those known to have died in the eruption . These memorials include a large curved granite monument at an outside viewing area at the Johnston Ridge Observatory , which opened in 1997 , and a plaque at the Hoffstadt Bluffs Visitor Center , which was unveiled in a memorial grove in May 2000 .

= = = Depictions = = =

There have been several tellings of Johnston 's story in documentaries , films and docudramas about the eruption . Documentaries such as The Eruption of Mount St. Helens ! (1980) appeared the same year , while a movie was filmed in the year following the eruption and released to coincide with the first anniversary . The story of Mount St. Helens and Johnston continues to be told in documentaries and reconstructions several decades after the eruption took place .

In the 1981 film St. Helens , actor David Huffman starred as a renamed Johnston (David Jackson) . Controversially , Huffman 's character became involved in a love affair and was killed by the blast while on top of the mountain . Johnston 's parents criticized the production of the film , arguing that it possessed not " an ounce of David in it " and portrayed " him as a daredevil rather than a careful scientist " . They threatened to sue over the fact that they felt their son 's memory had been contaminated . Johnston 's mother stated that the film had changed many true aspects of the eruption , and depicted her son as " a rebel " with " a history of disciplinary trouble " .

Prior to the film 's release during the one @-@ year anniversary of the eruption , 36 scientists who knew Johnston signed a letter of protest . They wrote that , " Dave 's life was too meritorious to require fictional embellishments , " and that , " Dave was a superbly conscientious and creative scientist . " Don Swanson , a USGS geologist who was Johnston 's friend and who , due to other commitments , had convinced Johnston to take his place at the Coldwater II observation post on the day of the eruption , believed that a movie based on Johnston 's true life and exploits would have been a hit because of his friend 's character .

Several documentaries and docudramas have covered the history of the eruption , including archive footage and dramatisations of Johnston 's story . These include Up From the Ashes (1990) by KOMO @-@ TV , an episode of the 2005 second series of Seconds From Disaster broadcast by the National Geographic Channel , and an episode of the 2006 series Surviving Disaster , broadcast on the BBC and Discovery Channel .

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