Fall 2023 Vol. 64 No. 2

WINDswept

The Bulletin of the Non-Profit Mount Washington Observatory

2023 YEAR-END CAMPAIGN

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Mount Washington Observatory™ is a private, nonprofit, member-supported institution with a mission to advance understanding of the natural systems that create Earth's weather and climate. It serves this mission by maintaining a weather station on the summit of Mount Washington, performing weather and climate research, conducting innovative science education programs, and interpreting the heritage of the Mount Washington region.

Membership in the Observatory is open to all. Members who donate at least $60/year or $5/month receive: Tours of our famous mountaintop weather station (generally mid-May through mid-October); a one-year subscription to *Windswept™: The Bulletin of the Mount Washington Observatory*; meteorology and climate research news from the summit of Mount Washington, straight to your inbox; free admission to *Extreme Mount Washington™* museum; advanced notice of special events; a 15% discount on all purchases in our museum and online shop; and free admission to more than 300 science centers through the ASTC Passport Program (restrictions apply, please see the ASTC website for details).

Members will receive the three issues of *Windswept* for the year following the quarter in which they join. Please make checks payable to the Mount Washington Observatory and send to Mount Washington Observatory, PO Box 2310, North Conway, NH 03860-2310, or join at mountwashington.org.

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DEPARTMENTS

Mount Washington Observatory
2779 White Mountain Highway | PO Box 2310
North Conway, NH 03860-2310
603-356-2137 | email@mountwashington.org | MountWashington.org

Administrative Offices
2779 White Mountain Highway
North Conway, NH 03860-2310
603-356-2137 phone

Summit Facility
Mount Washington
603-356-2137 phone

WINDswept

Editor: Charlie Buterbaugh
Graphic Design: Brenda Court
Phone: 603-356-2137
Email: cbuterbaugh@mountwashington.org

Contributors:
Peter Crane, Brain Fitzgerald, Drew Bush
Cover Credit: Ryan Knapp. Undercast near sunrise looking at the northern Presidential Mountains.

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Fall Arrives with a Mood of Excitement for Winter

Charlie Buterbaugh

BY **CHARLIE BUTERBAUGH**, EDITOR

With the arrival of fall and fast-following winter storms in the White Mountains, recalling our founders' preparations for their first winter on Mount Washington strengthens our spirit for another cold season.

As expected, weather was the wild card on October 14, 1932. Mount Washington Observatory's first team needed to find a window of time between harsh storms to make their way to the summit and begin their meteorological work. Their convoy consisted of a pilot car, Appalachian Mountain Club truck, and an E. Libby & Sons Co. dump truck. We know this thanks to Observatory co-founder Robert S. Monahan's book, "Mount Washington Reoccupied."

In addition to generous start-up funding provided by the New Hampshire Academy of Science, the Mount Washington project benefitted from the enthusiasm of International Polar Year (IPY) leaders.

As Monahan writes, Dr. D. la Cour, the Danish president of the IPY commission, stated, "Certainly the observations from Mount Washington would mean a very valuable contribution to the continued watch of what takes place in the upper air." Dr. D. la Cour continued, "It is only by means of recording instruments working at high level stations on mountains with free horizons that the moments of passage of the front may be observed. I find the position of Mount Washington extremely suitable for such purposes and answering quite well the requirements [of the commission]."

The scientific community recognized the Observatory's potential for providing the world with new insights about the earth's atmosphere from Mount Washington's unique vantage point.

In this edition of Windswept, Peter Crane takes us for a trip through history with a focus on Henry Teague, who had the Observatory's first purpose-built weather station constructed in 1937, working with Observatory co-founder Joe Dodge. The sturdy wooden building served as the Observatory's home until 1980.

Teague's business acumen ensured the success of the early Mount Washington Cog Railway and the Mount Washington Club.

As we reflect on those who created opportunities for the Observatory's work to continue in earnest for the causes of weather observation,

Continued on page 6

Big Wind Day: Where We've Been and Where We're Going

Drew Bush

BY **DREW BUSH,**
EXECUTIVE DIRECTOR

When I started my work here at Mount Washington Observatory, the staff and Board of Trustees already possessed a Strategic Plan for the future of the organization. Under it, we began work to establish new partnerships, launch programs for schools, and attract research partners to our mountaintop weather facility.

This plan also calls for financial transparency and sustainability for the organization, with the funding and resources necessary to carry our mission forward into the future, sustainably. With your help, we celebrated a successful 23rd annual Seek the Peak, along with support from partners at the United States Forest Service, Appalachian Mountain Club, and Mt. Washington Auto Road.

As you know, this is one of our largest fundraising efforts of the year. We know how much you and your families love to hike and explore the White Mountains. If you were not able to join us this year, we hope you will take the opportunity to celebrate at our signature event next year, on July 19-20, 2024.

Looking at the year ahead, the 90th anniversary of Big Wind Day looms. In only its second year of existence, our fledgling Observatory recorded a world-record wind speed of 231 miles per hour—a record that would stand for over 60 years. April 12, 2024 will mark the 90th anniversary of that date in 1934.

Although a higher wind speed has since been recorded elsewhere (Tropical Cyclone Olivia, Barrow Island, Australia, April 10, 1996), the Observatory's measurement of the "Big Wind" still stands as the fastest wind speed ever recorded by human hands. The weather observers atop Mount Washington had been hoping to achieve such a record, yet no one anticipated it would occur on that particular day.

By the early afternoon, Wendell F. Stephenson (Steve) reported an average wind speed of 173 mph with gusts of 220+ mph. His fellow observers could not believe this, insisting that they time the gusts themselves. When Sal Pagliuca began measuring with the stopwatch, the telegraph clicks suddenly increased in frequency. Timing the next three clicks only took 1.17 seconds. Although the calculation to translate this into a wind speed had not been done yet, Pagliuca recalls knowing immediately that it was a record.

After a brief lull in the wind, Pagliuca heard the telegraph clicks increase in frequency once again, and timed three

clicks in 1.17 seconds another time. Upon performing the calculation, the summit team was astonished at what they had just witnessed—two wind gusts of 231 mph.

"We had measured by means of an anemometer the highest natural wind velocity ever recorded officially anywhere in the world," he wrote in his logbook.

This record provides a useful reminder of the value of high-altitude mountaintop research to understanding meteorological phenomena, our climate, and the changes that may lie ahead. While Big Wind Day represents only one moment in the distinctive history of our 90-year-old organization, our commitment remains strong as we seek cutting-edge solutions to provide needed data for forecasts, develop hands-on educational programs, and offer research opportunities for all ages and interests.

We are fortunate to celebrate the unique legacy of our private, nonprofit organization each year on Big Wind Day. The Observatory was established solely to observe and maintain a record of weather data, perform weather and climate research, and foster public understanding of Mount Washington and its environment. We are so proud to continue this legacy today.

As our Year-End campaign gets under way this fall, I ask you to consider making a gift early in support of this heritage, and the importance it holds for national conversations on extreme weather and climate. Without you, we cannot fulfill our mission on top of Mount Washington, one carried out every day of the year, hourly, to record weather observations for both the Observatory and the National Weather Service.

Your support also directly allows us to provide innovative programming for classrooms all over our region and cutting-edge scientific research platforms, including efforts to modernize the Mount Washington Regional Mesonet and update our operations.

With your help, we will begin the New Year with plans that continue to grow our organization's future. A future where the Observatory thrives and provides just as much day-to-day support to our community on everyday important weather phenomena as we do for the extremes found atop the Rockpile on windy and frigid days. Thank you each for all you do to make our work possible.

In My View continued from page 4

research, and education, two longtime members and life trustees were recently recognized for their decades of service. Read about the recipients of the first-ever Founders Award, Jack Middleton and Guy Gosselin, in Drew Bush's story. We are incredibly grateful for Middleton and Gosselin's contributions to the Observatory.

Hard work throughout our history, fueled by many generous supporters, has created foundations for our future, and we are thrilled to have new opportunities to improve access for students to Mount Washington, which Brian Fitzgerald celebrates in his article, "A Classroom on the Tallest Peak of New England."

23rd Annual Seek the Peak Exceeds Fundraising Goal

Hikers and sponsors participating in the 23rd annual Seek the Peak contributed over $195,000 to Mount Washington Observatory (MWOBS), funds that will propel MWOBS' commitment to real-time weather data and forecasting in the White Mountains. This result significantly exceeded the 2023 goal of raising $170,000.

"We are amazed and inspired by our fundraising hikers, sponsors, Mount Washington partners, and volunteers," Drew Bush, MWOBS Executive Director, said. "Their incredible efforts made it possible once again for the outdoor community to gather at this premier hiking event celebrating our trails and adventure lifestyle. It's because of this community that we can continue our 90-year legacy of overcoming extremes to study weather and climate on New England's highest peak."

More than 290 participants raised funds in the lead-up to completing their hikes and gathering for the Après Hike Party on Saturday, July 15 at Great Glen Trails. Thirty sponsors provided vital support for the event, with 22 organizations exhibiting in the vendor village and many contributing gear and outdoor experiences to MWOBS' epic gear raffle. Tuckerman Brewing Company hosted a beer garden at the Après Hike Party and, on Friday, organized a kick-off celebration so hikers could register early and gather for live music and additional gear raffles.

Observatory summit staff and volunteers gave weather station tours to more than 150 hikers who reached the summit. While summiting Mount Washington remains a focus for many, Seek the Peak is an inclusive peer-to-peer fundraising event welcoming participants of all ability levels. More than 20 hikers met at Pinkham Notch Visitor Center Saturday morning for the new Hike and Make Friends

Participants' numbers are called in the annual gear raffle.

Volunteer Adam Gill (former weather observer), Director of Technology Keith Garrett, and Executive Director Drew Bush chat with Mount Washington Valley Adaptive Sports.

program, which joined hikers who wanted to go at a "Gentle Breeze," "Near Gale," or "Hurricane Force" pace. This program will be available again in 2024, when MWOBS hosts its 24th annual Seek the Peak on July 19-20.

The Top Three Individual Fundraisers this year were Brad Griswold (22nd year), who raised $25,116; Christopher Nichols (15th year), who raised $17,211; and Lee Eckhart (22nd year), who raised $6,288. The Higher Ground Seekers were the Top Team Fundraiser, led by captains Valerie Griswold and Eric Naples. And Minus 33 Merino Wool won the Top Business Team Fundraiser award, a new category that will continue in 2024. Each top individual fundraiser wins an educational overnight trip with one guest at MWOBS' summit weather station. The top teams win a summit overnight trip with up to eight team members. All participants who raised $200 won a locally designed t-shirt, and all who raised $300 won an exclusive Cotopaxi backpack plus raffle ticket and other prizes.

Seek the Peak was made possible by Presenting Sponsors Great Glen Trails Outdoor Center and Eastern Mountain Sports, with additional valued support from Backpacker Magazine's Get Outside Tour, Mount Washington Radio Group (93.5 WMWV, Magic 104.5, and Easy 95.3), Consolidated Communications (Fidium Fiber Internet), Martini Northern, Mt. Washington Auto Road, Appalachian Mountain Club, White Mountain National Forest, New Hampshire State Parks, Mount Washington Cog Railway, White Mountain Oil and Propane, and Tuckerman Brewing Company.

Backpacker Magazine's Get Outside Tour, an event sponsor.

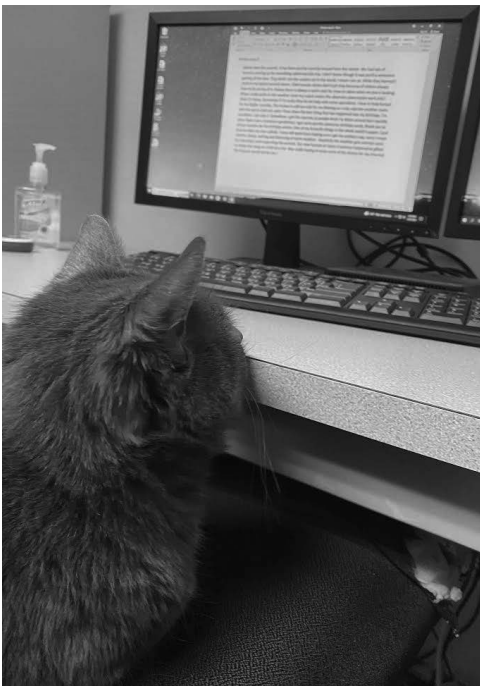
They Think I'm the Coolest Cat

Meow from the summit of the meowtain I call home. It has been purrtty eventful around here this summer. Lots of tails to share.

We had lots of humans coming up for weather station tours. It was purrtry awesome getting all the love. They think I am the coolest cat in the world. I mean, they are not wrong.

While visitors learned, I stuck to my typical summit duties. Chief mouser duties don't just stop because of visitors. There is always a purrrfectly warm seat for me to steal for a break.

If I'm lucky, when I go visit the observers in the weather room, they let me help with some opurrations. I love to help furcast for the higher summits. It's paws down the best.



Nimbus writing for Windswept.

Sometimes, when I get the zoomies, people think I'm kitten around, but I quickly show them I am a meowture gentleman.

One of my furvorite things in the whole world is paper. I just love to make my own catfetti. I tried to make the observers catfetti, but my attempts were quickly stopped. I was told the paper is too important for catfetti. Their loss.

I have been enjoying the warmer weather and expurrling the summit. There are so many kitty sized caves that have yet to be explurrred.

Our new furends at Cabot Creamery Cooperative gifted us some nice swag and cheese . I am hoping to taste some of the yummy cheese, but the humans keep saying no.

Well, that's all from me, I have to go now, meow till next time.

The Mount Washington Club

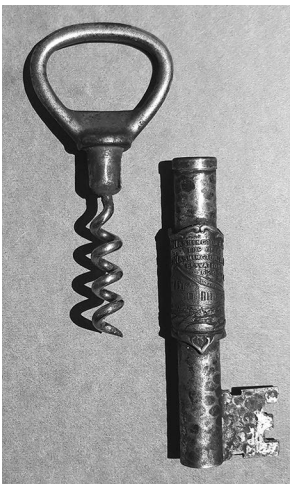
BY **PETER CRANE**

The Observatory recently received a thoughtful gift from the family of the late James E. Welsh Sr. of Limerick, ME. The donation is a corkscrew with an attached medallion from the "Mt. Washington Club." What, the family wondered, was this club, and what was its relationship to the Northeast's highest peak?

The item's medallion also features an image of the Summit House on Mount Washington, which was built in 1915, and which pointed the way to the significance of the "Club," and to its founder, Henry Teague.

Henry Teague was a larger-than-life entrepreneur whose story is intertwined with that of Mount Washington. In 1931, the Boston & Maine Railroad, owner of the Cog Railway, wanted to divest itself of the Cog, which did not fit into its usual business practice of routine passenger and freight service. They persuaded Teague to become manager and eventually owner of the Cog, and even made a loan to him for railway operations to sweeten the deal.

Teague picked up the reins in April of that year, with a full transfer coming in 1939. Unlike the Boston & Maine, which ran the Cog like a railroad, Teague sensed that it was a different entity altogether, and instead ran the Cog as a tourist attraction. His approach, and

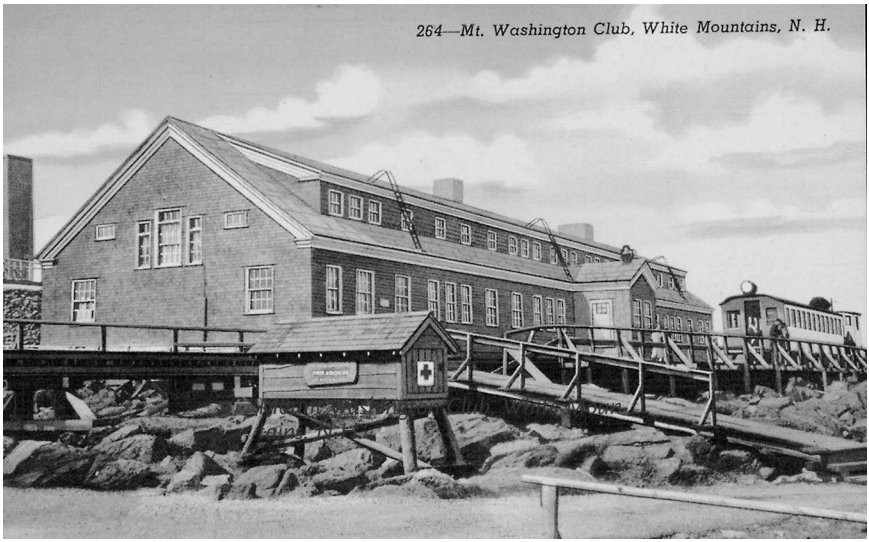


This corkscrew with an attached medallion from the "Mt. Washington Club" was recently donated to the Observatory.

his promotional efforts, proved successful throughout his involvement in the legendary Mount Washington railroad.

Along with the Cog came the Summit House – quite a package deal! That hotel, of course, served overnight visitors, some of whom had arrived via the Cog, others by hiking or by traveling up the Mount Washington Summit Road.

Teague, who had experience as a hotelier, was happy to have overnight guests, no matter how they arrived at the peak. However, he had some hesitation about the many day visitors who were not Cog patrons and still took advantage of the shelter of the Summit House, using the hotel's bathrooms and other services. They enjoyed those amenities and paid not a penny. Though



Mount Washington Club, White Mountains, N.H.

some of those transients doubtless purchased souvenirs or food at the hotel, Teague was dismayed that he was providing services for no compensation.

And so Teague transformed the Summit House into the "Mount Washington Club." Cog Railway patrons automatically became members of the club and were welcome to free entry into the summit building. However, for those who ascended via the road or up a hiking trail, a membership fee of fifty cents was charged to allow admission into the building. Members were given a membership card, which allowed them entry for the entire calendar year – such a bargain! Doubtless, Teague knew that most visitors would only visit the mountain once in a year. The club had its official opening on July 2, 1932, with honored guests including New Hampshire Governor John Winant.

The Mount Washington Club was not just a new name for an existing building, but was a formally established legal entity. For whatever financial, tax, labor, liability, operational, or other reasons, Teague arranged to have the hotel and its restaurant, and other Cog property on the summit, leased to the club.

Teague, Dartmouth College class of 1900, had Myron Witham, a former Dartmouth College football star, class of 1904, designated as president of the club. Witham had a career as a coach and also as a teacher of engineering and mathematics. One can't help but suspect that Witham was a figurehead, with Teague continuing to be in charge of all cog and hotel operations on the mountain.

Officially, Teague was treasurer of the club, and John Carleton of Manchester, Dartmouth class of 1922 (and one of the first skiers to descend the Headwall of Tuckerman Ravine), served as clerk. Teague was president and treasurer of the Cog Railway, and Hanover hotelier Arthur Fairfield, Dartmouth Class of

1900, served as a director. John Carleton also served as a director and clerk.

Teague was involved in another important activity on the mountain at this time: he built Mount Washington Observatory. Founded in 1932, the Observatory was housed in two different structures in its earliest years, the Stage Office of the Mount Washington Summit Road Company, and Camden Cottage, a similar small building associated with the Summit House and the Cog.

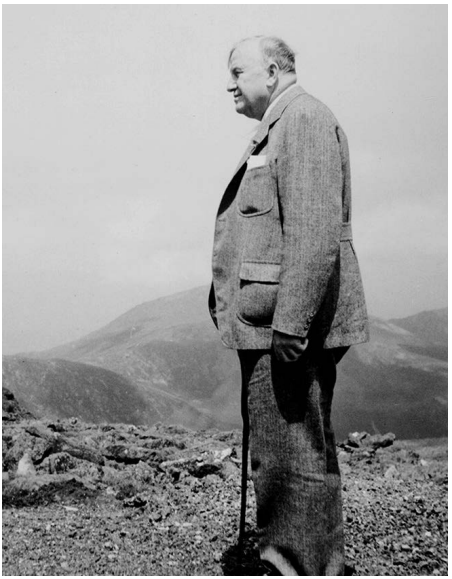
As the fledgling Observatory's operation evolved, the Stage Office became its winter home, and the Camden Cottage was its summer home. Since both of those buildings had other, albeit seasonal uses, neither was wholly suitable for use as a permanent summit weather station.

Teague, after significant communication with Joe Dodge, had a purpose-built structure erected for rent to the Observatory in 1937.

Initial terms in the 20-year lease called for a rent of $500 per year, and also prohibited the sale of food, supplies, postcards, souvenirs and the like at the Observatory whenever the Mount Washington Club was open for business.

In later years, Teague effectively lowered the rent to $250 per year, a kindness much appreciated by the Observatory. The sturdy wooden building remained in use as the summit weather station until 1980, when the Observatory moved into its new (and present) home in the newly built Sherman Adams Building.

The Mount Washington Club continued its operations on the summit until

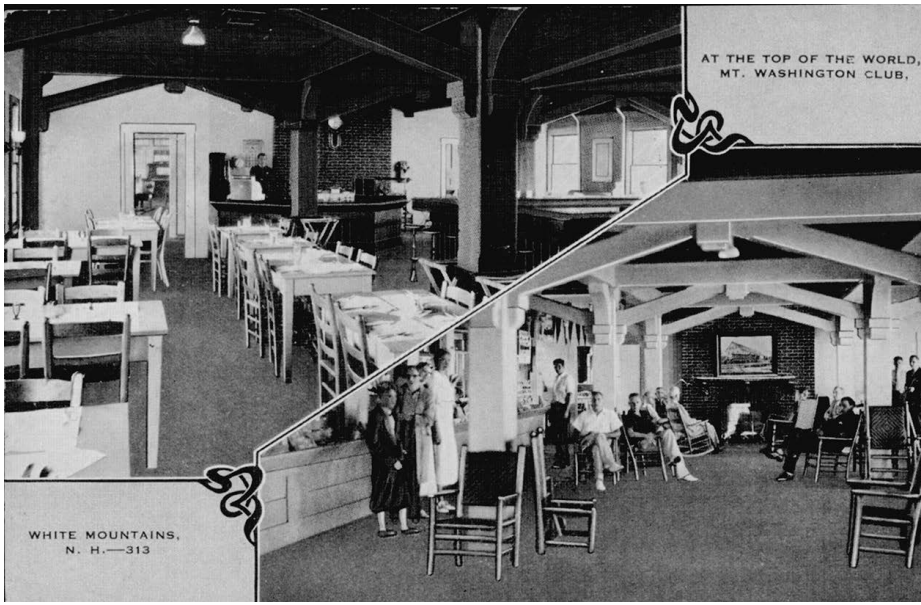


Henry N. Teague, (1875-1951). One former employee of Teague wrote, "He was quick of temper but as fair a man as I ever knew." His business acumen made the Cog Railway a stunning mid-20th century success.

Teague's death in October 1951. As Cog Railway historian Donald Bray noted of Henry Teague, "He was a dynamo of enthusiasm who motivated his people and won their trust."

Teague also kept his alma mater, Dartmouth College, in high esteem, and was doubtless thankful for the loan from the college that helped the Cog Railway make essential repairs after the hurricane of 1938. By the terms of Teague's will, all of his Mount Washington holdings, including Marshfield Base Station, the Cog Railway, the Summit House, and associated land were bequeathed to Dartmouth.

Arthur Teague, a very distant relative of Henry Teague who had worked at the Cog Railway before World War II and had been hired as vice president



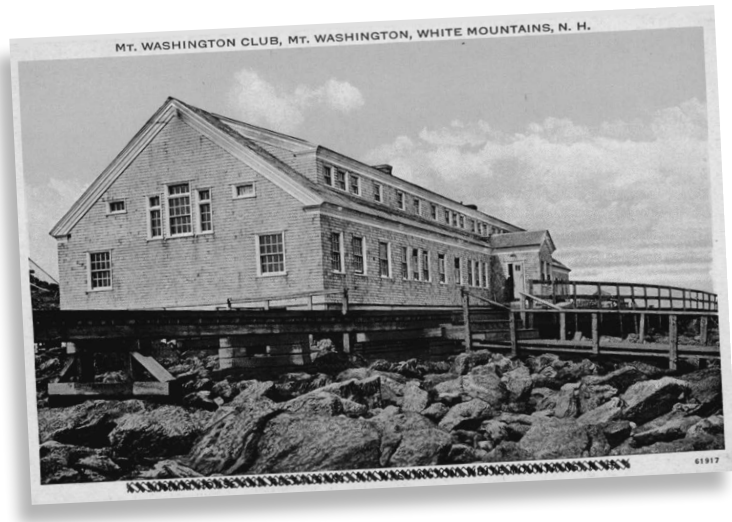
Inside the Mount Washington Club. The caption on the reverse of the card reads, "At the top of Mount Washington is the Mount Washington Club, a club in the clouds. Here is a modern hotel at the very top of New England. All the passengers of the Mount Washington Cog Railway are day members of the Mount Washington Club."

and general manager of the railway in 1945, was hired as general manager of the Cog by Dartmouth. While Arthur Teague was selected as president of the Mount Washington Club in November 1951, it seems that the club concept would soon be abandoned, and under Dartmouth ownership the original name of the Summit House was again employed.

As Observatory veteran (a member of the founding crew in the winter of 1932-1933) and Dartmouth College Forester Robert Monahan noted at a June 1952 meeting of the White Mountains Region Association, "The 'Mount Washington Club' is once again the 'Summit House,' as we knew it in the years of such hosts as Mrs. Dodge and Allie Wright." (Harriet Dodge had managed an earlier Summit House from 1877 to 1883; Alvah Wright worked at the Summit House for three stints between 1888 and 1931.)

In 1962, Arthur Teague purchased the Cog Railway from Dartmouth College, and entered into a lease arrangement with Dartmouth for use of the Summit House. In 1964 the State of New Hampshire purchased about 59 acres at the summit which became Mount Washington State Park. The purchase included the Summit House, which was leased, for a time, to the Cog Railway. It provided overnight lodging through the season of 1966; deterioration of the building and its infrastructure caused that year to be the last year of overnight accommodation.

In 1980, the Summit House – the third building to be known by that



"All the comforts of home may be enjoyed at the Mt. Washington Club on the summit of Mt. Washington — the best of food and a comfortable overnight lodging. From the 59-acre estate the Mt. Washington Club owns on the very summit of Mt. Washington, an unrivaled vista of lakes and mountains may be seen stretching far off into the purple distance."

name, and the only one also known as the Mount Washington Club – was razed, with the new Sherman Adams Building succeeding it as the visitor center for Mount Washington State Park. A further eight acres was added to the park when the state purchased Dartmouth's remaining land on the summit in 2008.

While reflecting on the Mount Washington Club, one might think that it was not especially hospitable of Henry Teague to charge summit visitors a fee to escape the harsh elements atop the mountain by entering his humble building. However, Teague did have bills to pay. Visitors were benefiting from the amenities of his summit hotel, whom he thought should contribute to the provision of such services.

Indeed, Teague is not the only person to consider charging admission to enter a summit structure. When Mount Washington stakeholders were discussing the operation of the state's Sherman Adams Building, opened in 1980, the possibility of charging a fee to enter the building, or part of it, was seriously discussed. One potential sticking point was access to the bathrooms, and the concern that if people could not readily access those facilities, an unfortunate and unsanitary result could occur.

Today's visitors will note that the Sherman Adams Building has entry doors, plus a significant doorway just beyond the restrooms and information desk, an architectural feature that would allow a barrier and admission station.

Could such a concept arise again? As recently as 2020, the possibility of charging an admission fee to the building was a matter of earnest discussion for the Mount Washington Commission, the state board that advises on operations of Mount Washington State Park and serves as a forum for the varied interests associated with the mountain.

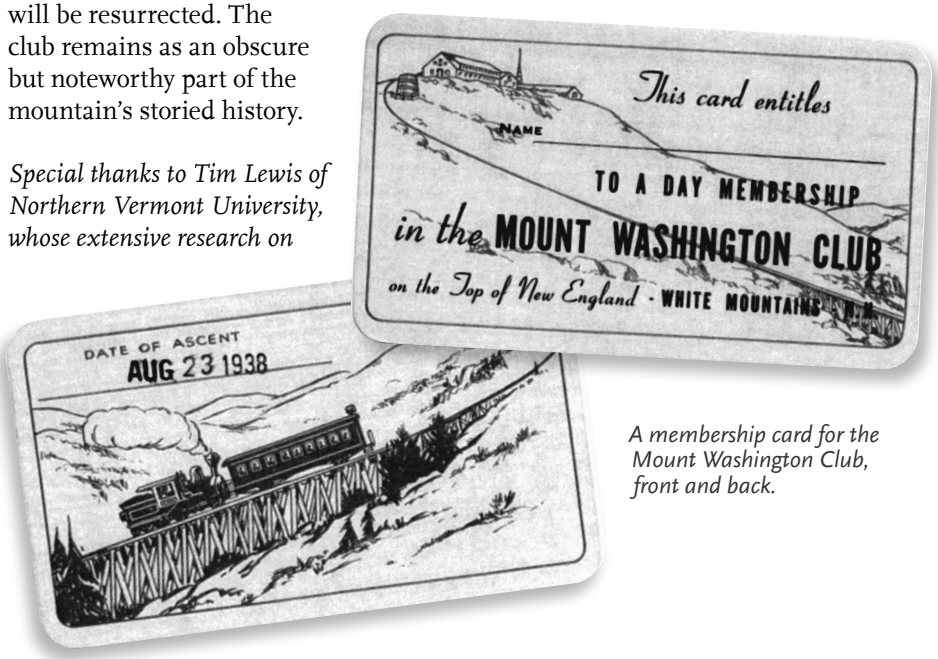
Recognizing the significant costs of state park operations, including the

A membership card for the Mount Washington Club, "A Club among the Clouds."

provision of water and the treatment of sewage, the commission seemed well disposed to the possibility of an entrance fee, but also acknowledged that persuading state officials in Concord of the desirability of a fee would be a challenge. Focus was shifted to updating the park's master plan, but with that document now accepted by the commission, governor, and executive council, discussion of a fee could be revisited.

While a fee to enter the summit building could return, it seems unlikely that the "Mount Washington Club" will be resurrected. The club remains as an obscure but noteworthy part of the mountain's storied history.

Special thanks to Tim Lewis of Northern Vermont University, whose extensive research on the Mount Washington Cog Railway has brought to light helpful information about the Mount Washington Club. The author benefited from communications with Professor Lewis and with historian Rob Bermudes. Mr. Bermudes has observed that, given the details of the Cog Railway arrangement with the Boston & Maine, and the nature of the loan (mortgage) from Dartmouth – which may have been more to settle with the B & M than to repair hurricane damage – perhaps Henry Teague never owned the Cog outright, a worthy subject for further consideration.



A membership card for the Mount Washington Club, front and back.

A Classroom on the Tallest Peak of New England

BY **BRIAN FITZGERALD**

In the spring, Mount Washington Observatory (MWOBS) staff began rolling out an expanded suite of school-based programs throughout the region, thanks in part to a bequest from the Sheldon Family Estate.

The gift allows the Observatory to develop and assess K-12 educational programs based on needs and interests expressed by teachers, administrators, students, and families. During conversations with these groups, the need for experiential, hands-on learning was a common refrain. Educators are searching for ways to connect learning beyond the classroom.

Well, what if your classroom was the tallest peak of New England?

In May and June, MWOBS welcomed sixth- through eighth-grade students from three schools in Coos County, NH to pilot a school field trip program in partnership with the Mount Washington Cog Railway. Made possible by the Empowering Coos Youth grant from New Hampshire Charitable Foundation's Neil and Louise Tillotson Fund, the pilot program has allowed the Observatory to provide a completely cost-free experience for schools that, like many, have limited funds to support out-of-classroom trips.

Unique to this field trip experience, MWOBS engaged teachers to form student advisory councils with volunteer student leaders from each school to support the planning process on behalf of their peers.

The student leaders selected from a range of topics and activities, aligned with Next Generation Science Standards (NGSS), which could be conducted during their Mount Washington visit while still connecting with subjects being covered in their classrooms.

Beyond funding, planning and coordination of a field experience stand out as additional barriers for schools that want to visit Mount Washington. For years, many determined teachers and schools have been planning visits to the summit, and in some cases have arranged special group tours of the Observatory's weather station. With so many Mount Washington partners active on the mountain, it can be challenging to coordinate a visit, especially for first-time visitors. A new approach was clearly needed.

For participating schools this spring, the Observatory took the lead to help coordinate a visit from start to finish in partnership with local busing companies, the Cog Railway, and Mount Washington State Park.

Eighth grade students from Whitefield, NH visit the summit of Mount Washington in late May.

MWOBS educators joined students for their entire field trip, guiding the experience from the moment they arrived at the base of the mountain until it was time to head back on the school bus. The Observatory hosted nearly 170 students across four trips from Stratford School, Groveton High School, and Whitefield Elementary School.

While each trip varied based on student, teacher, and school interest, each experience was composed of a welcoming activity at the Cog Railway base station, a guided train ride up and down the mountain, one hour of summit activities, and a concluding activity back down at the Cog base.

Just like the weather on the summit, each trip had its own flavor. For two groups, weather observation was a primary focus, with students collecting and observing weather data to provide evidence of how temperature and barometric pressure change with elevation.

In addition to data collection, students on each trip toured the Observatory's weather station and learned from MWOBS scientists why Mount Washington experiences such world-renowned extreme weather.

For other groups, students took interest in the historical and cultural aspects of Mount Washington through the lens of the Cog Railway and historic structures and events witnessed on the summit.

Students from one group were in the midst of a wind turbine engineering

challenge that pushed experimentation with different turbine blade designs to achieve an efficient and effective means of generating energy. They brought their turbine designs to the summit to test in the same location where MWOBS staff welcome private and government groups to test equipment in a "natural laboratory," while also learning about the Observatory's own engineering work to develop custom anemometers for measuring wind speeds and directions in unique environments.

Across the span of roughly a week, student groups witnessed 50-mile per hour winds, snow, record-breaking warmth, sub-freezing temperatures, and surprisingly calm, clear, and insect-filled skies. They took class photos at the summit sign, climbed to the top of the instrument tower, and spread their wings to fly on the observation deck, coming close to the sensation of standing in a hurricane.

For many students, this was their first visit to a mountain that is essentially in their backyard but can feel like visiting another planet.

Heading back down on the train and later at school, students reflected on the experience with the end of the school year drawing near. At Stratford Public School, lead teacher Rebecca Oberti organized a culmination event for students to share pizza and presentations from their trip with their peers, family members, and MWOBS staff in attendance.

For other groups, the visit itself was a culminating experience for a school year filled with hard work and growing knowledge about the world around them.

As MWOBS staff continue to gather participant and partner feedback, one thing is clear: the opportunity for students to spend any time, no matter how short, on Mount Washington is worth the effort to connect New Hampshire's youth with this important cultural and scientific landmark.

MWOBS education staff have taken lessons learned from this spring, along with continued input from local educators and advisors, to redevelop the field trip program for a broader launch of school-based programs for the 2023-24 school year.

In addition to field trips, educators from MWOBS will offer virtual programs, school day and after-programs, curricula and other educational resources, and teacher professional development experiences such as the Arctic Wednesdays program.

Based on conversations with educators around the region, there is significant interest from schools to participate in a field trip experience as part of a broader relationship with Mount Washington. To try to overcome financial hurdles along the way, MWOBS will continue to seek funders to offer low- and no-cost programs for youth in a region.

While it is still early days for this fledgling field trip program, MWOBS staff look to a not-too-distant future when every New Hampshire student is able to visit the tallest peak in New England.

Jack Middleton and Guy Gosselin Each Receive Founders Award

BY **DREW BUSH**

Mount Washington Observatory Trustee Gary MacDonald, left, congratulates Life Trustee and Founders Award recipient Jack Middleton in front of the Observatory "Shaky Shack" at McAuliffe Shepard Discovery Center.

When Mount Washington Observatory (MWOBS) members, trustees, and staff gathered in Concord, NH recently at the McAuliffe Shepard Discovery Center for MWOBS' Annual Meeting, two longtime members and life trustees were recognized for their decades of service. The recipients of the organization's first-ever Founders Award are Jack Middleton of Freedom, NH and Guy Gosselin of Gorham, NH.

The Founders Award, given by the MWOBS Board of Trustees, recognizes individuals who have rendered

exemplary service to the organization over a period of many years. It is the highest form of recognition and honor that MWOBS gives to any individual. It is awarded at the Annual Meeting, when the trustees determine there is a clear and deserving recipient.

"Both Jack and Guy have given of themselves tirelessly, for many, many decades," Rob Kirsch, MWOBS Immediate Past Board Chair, said. "Their efforts have meant the world to MWOBS. Without them, we would quite literally not exist. I can think of no better way to recognize Jack and Guy for all they have done to create and develop the organization we know and love today."

As tokens memorializing their recognition, both recipients received customized glass tumblers bearing the MWOBS logo along with their preferred drink of choice for celebration after the meeting. Middleton and Gosselin both have long histories with MWOBS, and each has been integral to Observatory operations throughout their lives.

Middleton worked at MWOBS from 1952 to 1953, served as Secretary from 1956 until 2019, then as a trustee from 1957 to 2022, and he is anow a life trustee. While working for Observatory co-founder Joe Dodge, Middleton met and later married Ann Dodge, making Mount Washington and MWOBS a part of his family. He has played a myriad of roles in service to MWOBS, including 60 years on the Executive Committee, 40+ years as the Observatory representative on the Mount Washington Commission, decades on the Governance Committee, leadership roles in major fundraising programs, and service on too many committees and projects to list here.

Middleton received his A.B. from Lafayette College in 1950 and his J.D. from Boston University School of Law in 1956. He is president of the law firm of McLane, Graf, Raulerson & Middleton, and has been active in numerous civic, professional, and bar association activities for many years. He has three grown children.

Gosselin is one of the North Country's most respected modern pioneers and regional historians, but he says the "high point" of his career began February 15, 1961, when he became a MWOBS weather observer. Indeed, that proved an important date for the organization and for Gosselin.

He came to Mount Washington to fill a short-term, several-month position and stayed with the mountain for 35 years. Gosselin became chief observer in 1963 and was appointed to the director's post in 1971. He joined the Board of Trustees in 1978. During lean times in the 1960s, his family and that of another observer shared a single, meager observer's salary so the organization could continue with an adequate minimal staff.

Gosselin conceived of and built the Observatory's Summit Museum, the predecessor to our current Extreme Mount Washington museum. Under his leadership, the Observatory's research program extended into

Guy Gosselin is shown in an earlier photo during one of his many trips to the summit weather station.

solar and wind energy. He was instrumental in the transition from the organization's 1937-1980 wooden summit structure to its current home in the Mount Washington State Park Sherman Adams Building.

For many years, Guy and Betty, who served as our membership secretary, allowed MWOBS to run its back office from their home. Since retiring as executive director in 1996, Gosselin went on to serve his community as a substance abuse counsellor, reduced recidivism in the state prison system by introducing therapies based on meditation, and wrote and published novels. During that period, he continued to serve MWOBS in a variety of important roles, including by advising the organization as a consultant and serving as managing editor of Windswept.

Gosselin became a life trustee in 2002. He lives in Gorham, NH and has three grown children.

Both Middleton and Gosselin have made MWOBS what it is today. We hope you will join us in celebrating their accomplishments.

Winter 2022/23 Weather Data

	DEC	JAN	FEB	MAR
Temperature (°F)				
Average	14.2	16.1	9.3	14.0
Departure	+2.4	+10.3	+3.4	+1.1
Maximum	42	38	38	33
Date(s)	30th	4th	17th	23rd
Minimum	-13	-13	-47****	-7
Date(s)	24th	31st	4th	19th
Precipitation (inches)				
Monthly	10.41	6.81	4.13	4.99
Departure	+3.06	+1.07	-1.32	-1.73
24-hour Maximum	4.22	1.75	0.84	0.97
Date(s)	22nd/23rd	25th/26th	28th	4th
Snowfall (inches)				
Monthly	46.1	53.0	32.2	44.8
Departure	-1.6	+11.6	-11.1	-1.4
24-hour Maximum	17.3	14.6	9.5	9.5
Date(s)	16th/17th	25th/26th	28th	4th
Season Total	73.2	126.2	158.4	203.2
Departure	-30.4	-18.8	-29.9	-31.3
Wind (mph)				
Average	45.9	39.1	48.8	41.8
Departure	+1.9	-6.8	+4.2	+2.0
Peak Gust/Direction	150 E	108W	130 W	121 N
Date(s)	23rd	24th	15th	5th
Days 73+	21	20	23	21
Days 100+	6	2	7	9
Other				
% Sunshine	27	31	38	33
Clear Days	3	2	0	0
Partly Cloudy Days	3	4	5	5
Cloudy Days	25	25	23	26
Days with Fog	29	29	28	31
Days with Rain	5	8	4	3
Days with Snow	23	26	24	26

** FEB MINIMUM TEMPERATURE - NEW MONTHLY RECORD LOW OF -47°F; PREVIOUS RECORD OF -46°F ORIGINALLY SET ON 15 FEBRUARY 1943 AND EQUALED ON 3 FEBRUARY 2023. ALL TIME RECORD LOW OF -47°F EQUALED; RECORD ORIGINALLY SET ON 29 JANUARY 1934.

A Winter of Extemes

BY **FRANCIS TARASIEWICZ**

After a mild and less snowy fall, the winter of 2022 and 2023 will be remembered for its extremes. From tying the station's all-time record low temperature in February to establishing new daily record high temperatures, this season presented the summit crew with plenty of surprises. Despite numerous intense storms, the season was also defined by a nearly 3-foot snowfall deficit.

December 2022

December started on a windy and cold note as a cold front passed through the region and brought lingering upslope snow that accumulated to 1.3". December 2nd featured high pressure cresting overhead and gradually moved offshore. Low pressure pushing in from the Great Lakes pushed a warm front north of the summits allowing for temperatures to warm above freezing and an additional inch of snow, sleet, and freezing rain on the 3rd. Another cold front brought 0.3" of new snow and a period of blowing snow on the 4th. High pressure shifted overhead on the 5th and brought clear skies. On the 6th, the summits were influenced by warm front that approached from the west and delivered 1.3" of snow, sleet, and freezing rain. The parent low of the warm front passed over the summits on the 7th bringing an additional trace of snow, and a half inch of liquid precipitation. Upslope snow and colder weather marked the storm's departure with 1.3" of new snow falling on the 8th. A two-day span of high pressure brought clear skies to the summits for the 9th and 10th of the month. A shortwave trough brought 0.3" of new snowfall on the 11th. Brief high pressure returned on the 11th after upslope snowfall accumulated to 0.2". Low pressure moving to the north of the summits dropped 3.1" of snow on the 13th and resulted in winds over 100mph. Strong winds and upslope snow continued into the 14th as low pressure retrograded back from the Canadian Maritimes.

High pressure followed closely on its heels on the 15th ahead of a developing storm system off the Mid Atlantic coastline. The system tracked northeast, intensifying as it did so on the 16th and delivered 9.6" of snowfall. An additional 9.2 inches of snow fell on the 17th as the low center slowly meandered from the benchmark into the Gulf of Maine. Temperatures quickly fell into the single digits on the 18th as the system dragged a cold front into the region. Northwest flow allowed for continued snow showers throughout the 19th. The

combination of freshly fallen snow and strong northerly winds resulted in a failed shift change. Retrograding low pressure reintroduced fog and light snow showers on the 20th and then gave way to brief clearing as a shortwave ridge approached. The influence of the ridge was strongest on the 21st and provided for clear skies. Low pressure developing across portions of the upper Midwest on the 22nd pushed high level clouds, and fog into the higher summits. A strong southerly flow ushered in milder air on the evening of the 22nd. Precipitation began as a period of moderate to heavy snowfall on the night of the 22nd and continued into the morning of the 23rd. Snow changed to sleet, and then rain on the 23rd as the low deepened just east of the Great Lakes. Southerly flow ahead of the storm brought the month's strongest wind speed of 150 mph. Temperatures quickly dropped behind the system as it pulled away on the 24th. The system lingered near the Hudson Bay on the 25th keeping winds elevated and resulting in high temperatures below zero. Winds fell somewhat on the 26th as the low over the Hudson Bay weakened and temperatures warmed into the lower single digits as a result. A shortwave trough to the north brought 1.5" of snowfall to the summits on the 27th. A nearby stationary boundary brought more snow and fog to the summits on the 28th. A warming trend began on the 29th ahead of a cold front. As a result, record high temperatures were established on the 29th, 30th, and 31st. These warm temperatures allowed for nearly 10" of snow to melt as the month came to a close.

January 2023

The new year started on a messy note with the summits embedded deep within a low pressure system's warm sector. The systems trailing cold front dropped temperatures and resumed summit snowfall later in the day. Upslope snow showers continued on the 2nd as a trough departed to the west. An area of high pressure built in from the west on the 3rd and slowed the northward progression of a warm front to the SW. Mist and light rain arrived at the summit on the 4th as the warm front moved north. Weak low pressure approached from the Great Lakes on the 5th and brought a round of light freezing rain and snow showers. A more substantial system arrived on the 6th and resulted in 3.1" of new snowfall. Upslope snow lingered into the 7th with an additional 1.1" falling. The 8th was a clear day under high pressure. A return flow resulting from offshore high pressure brought summit moisture and light snowfall on the 9th. Low pressure tracked north of the international border and trailed a cold front across the area on the 10th. Light snowfall and below-zero temperatures followed the passage of the front. High pressure took control of weather conditions on the 11th allowing for a clear and calmer day. The 12th pressure tracking from the Ohio River brought a period of snowfall that amounted in 3.3" of new snowfall. A push of warmer air on the 13th changed snow showers to a wintry mix, ahead of this changeover, 2.5" of new snow fell. A pair of low pressure systems began to impact the higher summits on the 14th. These systems

tracked into the Gulf of Maine and pushed a moist flow into the region resulting in a period of freezing rain and snow.

High pressure built in from the west on the 15th and drier air mixed out lingering fog and an undercast. A broad area of low pressure approached from the coast on the 16th and moved NE into the Canadian Maritimes. High pressure approached from the west on the 17th and gave a reprieve from precipitation. A weak cold front crossed over the summits and brought very light snowfall on the 18th. High pressure crested over the area early on the 19th and gave way to a pair of coastal low pressure systems. The first system brought 3.7" overnight on the 19th and the second brought an additional 6.3" throughout the day on the 20th. Low pressure exited towards the Canadian Maritimes and high pressure built in from the west on the 21st. High pressure continued its influence during the first half of the 22nd before giving way to a period of upslope snow associated with warm advection as high pressure moved offshore. A strong area of low pressure approached from the southwest and brought 7.2" of new snowfall on the 23rd. The highest wind gust of the month of 108 mph occurred on the 24th as the storm pulled away and high pressure built back in. On the 26th, another significant storm system moved from the southwest and pushed a warm front that delivered 7.7" of snowfall. Snow, freezing drizzle, and sleet continued in earnest on the 27th as low pressure tracked directly over the summits with another 7.8" accumulating throughout the day. Much colder air followed as NW flow was established behind the storm on the 27th and brought temperatures down into the upper single digits. Warmer flow ahead of an approaching cold front brought summit temperatures into the teens on the 28th. A weak wave of low pressure brought 1.6" of snow on the 29th. Snow showers continued into the 30th bringing an additional 1.3". The month ended on a cold note as a sharp cold front ushered in the coldest temperature of the month (6 above).

February 2023

The second month of 2023 was a month marked by extremes. February began below zero with zonal flow and elevated on the 1st of the month. A change in wind direction from the W to the SW cleared summit fog on the 2nd. A strong arctic front moved through shortly after midnight on the 3rd and started a rapid fall in temperatures. Temperatures fell to 46 below on the evening of the third, breaking the monthly low temperature record. Temperatures fell slightly more to 47 below early on the 4th. This historic low tied the summit's record low established in 1934. Temperatures quickly rebounded to near 20 on the 5th as a warm front moved up from the southwest. A cold front moved over the summits on the 6th bringing additional fog and 0.1" of snowfall. High pressure moved in on the 7th and shunted a coastal low well to the southeast. Yet another cold front tracked through the area of the 8th and resulted in a period of light snow. Low pressure over the Great Lakes pushed a warm front through the region on the 9th and sent temperatures above freezing which led to a period of mixed precipitation that

accumulated to 0.12". Low pressure tracked just north of the summits and brought 0.58" of precipitation in the form of rain, ice pellets, and snow on the 10th. Temperatures quickly dropped on the 11th with NW flow and upslope snow showers. Relatively quiet conditions prevailed on the 12th as high pressure took control. An area of low pressure passed well offshore on the 13th ahead of a weak disturbance.

The disturbance then moved over directly over the summits on the 14th and dropped 2.2" of new snowfall. Return flow around an offshore high pressure pushed temperatures above freezing on the 15th. The 15th also had the month's highest wind gust which topped out at 130mph. A series of weak disturbances passing to the west of the summits continued above freezing temperatures and mixed precipitation on the 16th and 17th which tallied to 0.40" of liquid and 0.4" of new snow. The 17th saw thunderstorms and a new record high of 38 degrees. High pressure moved in from the NW pushing temperatures back to near normal on the 18th. The 19th featured a weak shortwave trough that delivered 0.2" of snowfall to the summit. An additional 1.5" of snowfall occurred on the 20th as a series of reinforcing fronts moved pushed colder air into the area. More disturbed weather moved in from the Great Lakes on the 21st and continued snowfall into the 22nd with a total of 2.3" of new snow resulting. A pair of low pressure systems delivered 4.8" of snowfall on the 23rd. Lingering snow showers persisted into the first half of the 24th ahead of a cold front. The passage of the front dropped high temperatures on the 25th into the negative single digits. Continued cold advection kept temperatures in the single digits on the 26th. A weak wave of low pressure traveled southeast from Ontario toward the Gulf of Maine dropping 0.3" of new snow on the 27th. The month closed on a snowy note as low pressure over the Ohio Valley redeveloped offshore and dropped 9.5" of new snow on the 28th.

March 2023

March began on the heels on a significant snowstorm. Lingering snow gave way to brief high pressure and partial clearing on the 1st. A weak coastal low ushered fog and light snowfall back to the summits on the 2nd and 3rd. A significant storm system tracked from the south central US to coastal New England and delivered 9.5" of snowfall on the 4th. High pressure closely behind and brought a clear albeit windy day on the 5th. High pressure building in from the west paired with a retrograding low to the east to produce the strongest winds of the month and significant blowing snow on the 6th. Nearby low pressure brought persistent light snow and fog to the summits on the 7th and 8th. Arctic high pressure centered over the Hudson Bay pushed any weather disturbances well to the south of the region between the 9th and the 12th resulting in intermittent fog and partial clearing. A coastal low began to materialize well to the south of the summits on the 13th and delivered an inch of snow. The low strengthened and move north and produced periods of heavy snow that accumulated to 7.0" on the 14th.

Shift change was delayed on the 15th

due to the storm stalling in the Gulf of Maine and continuing light to moderate snow that paired with continued hurricane force winds. High pressure nudged east over the area on the 16th and began a warmer regime that pushed temperatures into the upper 20s. A warm front associated with a storm over the Great Lakes arrived on the 17th with a mix of freezing rain, ice pellets and snowfall. Showery mixed precipitation continued into the 18th with lingering moisture. 1.9" of new snow fell on the 19th as a favorable flow for upslope was established behind a departing low pressure. Weak low pressure tracking to the north of the international border brought an additional 0.3" of snow on the 20th. A cold front pushed southward on the 21st bringing yet more snow and fog to Mt. Washington. High pressure built from the north and allowed for a calmer and clearer day on the 22nd. Low pressure moving north and west of the summits trailed a warm front that delivered a wintry mix on the 23rd. Fog and blowing snow lasted into the 24th in the wake of the system. High pressure built in from southern Canada on the 25th allowing for a clearing trend. A weakening area of low pressure to the north of New England dusted the summits with 2.1" of new snowfall on the 26th. After a morning of upslope snow showers, gradual clearing characterized the weather on the 27th. A cold front followed and brought another round of snow showers on the 28th. Skies fully cleared on the 29th as high pressure moved overhead. March exited with a strong front delivering snow squalls in the early hours of the 30th. These squalls gave way to a record low of 6 degrees below zero.

The Observatory's instrument tower is shown at sunrise on Feb. 9.

COMPILED BY **KARL PHILIPPOFF**

3:56 p.m., Thurs., Jan. 12: Autumn 2022 Weather Was Warm, Wet, and Less Snowy

The fall of 2022 on Mount Washington will go down in the record books as a warm, wet, and less snowy season than average.

September started the season off on a slightly cooler note, 0.3 degrees below the 1991-2010 mean, while a tendency for ridging over the eastern United States created ideal conditions for anomalous warmth in October, 6.4 degrees above average, the fifth warmest October in our 91-year record. This record warmth extended into the first half of November, and we matched our monthly record high on the 12th, before cooling off later in the month, but still remaining 3.1 degrees above average for the month.

There were several impressive precipitation events of note during the fall on Mount Washington. Precipitation totaled 11.45 inches in September (3.79 inches above average), with 5.36 inches falling between the 18th and the 20th as a parade of storms rode along a stalled frontal boundary. October also had its share of heavy rainfall, with 5.74 inches falling between the 13th and the 14th as a slow moving cold front transported copious amounts of rain and embedded thunderstorms over the summit, though the month as a whole ended up 0.66" below normal.

The fall typically signals the return to substantial snowfall on the higher summits, and this fall certainly took its time doing so! September had average snowfall with 1.1 inches falling when Hurricane Fiona spread showers into an incoming (and very cold) upper level low, but October was well-below average. Our snow season generally begins in October, which averages 19 inches of snow for the month, but in October of 2022, we received only 2.1 inches for the entire month, making it the fourth least snowy October on record! As if someone flipped a switch, the warmth and rain of early November was followed by numerous snow events in the second half, totaling 23.9 inches for the month, though this was still well below the monthly average of 35.6 inches.

–Francis Tarasiewicz

7:45 p.m., Mon., Jan. 16: 2022: By The Numbers

Looking back at weather stats, I would summarize 2022 weather conditions on

the summit as warm, wet (however, not snowy), foggy, and windy. To find out why these words were chosen, let's look back at some of the stats from last year.

Our average temperature for 2022 was 29.3°F (-1.5°C), which is 1.3°F above the 1991-2020 mean for our station, and tied with 2006 for the sixth highest average in our 91-year dataset. Our warmest temperature was 65°F (18.3°C), which occurred on June 26, Aug. 4, and Aug. 6, and our coldest temperature was 31°F below (-31°F/-35°C), which occurred on Jan. 11. The summit received 94.00 inches of liquid precipitation and 236.7 inches of snow, which were 2.77 inches above and 45.1 inches below the 1991-2020 mean for our location, respectively. Our average wind speed for 2022 was 36.4 mph, which was 1.5 mph above the 1991-2020 mean for our location. Our highest gust was 150 mph and it occurred on Dec. 23. Between January and December, we had 157 days with gusts >=73 mph and 45 days with gusts >= 100 mph. The summit experienced 39% of the possible sunshine minutes for the year, with only 16 days categorized as clear or mostly clear and 54 additional days as partly sunny. The summit experienced fog for at least a portion of 320 days, and had rain on 135 days and snow on 149 days.

–Ryan Knapp

3:31 p.m., Sat., March 4: Traditional Mount Washington Rockpile Crunch Recipe

Winter on top of Mount Washington means high winds, snow, and of course, lots of rime ice! Rime ice is a phenomenon that occurs when supercooled water droplets freeze on contact with a below-freezing surface. When foggy conditions occur concurrently with high winds, opaque, light and fluffy rime ice can accumulate pretty quickly. These qualities make it the perfect ingredient for ice cream!

Rime ice cream (also known as Rockpile Crunch or R'ice cream) is a Mount Washington Observatory tradition that has been passed down through many generations of weather observers. Eric Pinder, a former observer, wrote about the unique dessert in his book Life at the Top.

Ira Seskin, a long-time summit volunteer, contributed the recipe for rime ice cream which was published in the book. According to Ira, the recipe was derived from the classic maple syrup snow, but using sweetened condensed milk gives it a creamier texture. When it comes to mix-ins, Ira says, "there are no rules, I would just use whatever they had up [on the summit]". He says for the base, "you can use rime ice or fresh snow." While it has been many years since Ira came up with the recipe, he still enjoys making it, although he currently prefers to mix-in strawberries and blueberries rather than candy. A recent test subject noted that recipe below "tastes like a New England winter day."

Rime Ice Cream aka Rockpile Crunch
(Contributed by Ira Seskin)

- 2 quarts rime ice or plain fresh, white, clean snow
- 14-oz can sweetened condensed milk

- Chocolate chips
- M&M candies
- Reese's Pieces
- Chopped Nuts
- Raisins

Place a 2-quart mixing bowl outdoors prior to a predicted snowfall (or fill it with existing rime ice). Carefully fold in the condensed milk until the mixture is slightly granular. If the milk is added too quickly, mix with a fork to correct the consistency. Fold in all remaining ingredients until it looks and tastes right. The mixture should be soft and creamy-like soft ice cream. Use ice pellets for an extra crunchy texture" (*Life at the Top*, Eric Pinder).

–Alex Branton

4:33 p.m., Thu., March 16: Red Sky at Morning, Hikers Take Warning

Having grown up along the coast of Maine, there was a saying instilled in me by my parents every time I was planning to go outside for an extended period of time: "Red sky at morning, sailors take warning. Red sky at night, sailors' delight." Working for the Mount Washington Observatory, I have heard a similar phrase from hikers I have encountered on the summit while out taking weather observations, albeit with the 'sailors' replaced with 'hikers.'

Does this common saying have any scientific backing?

Yes, it appears it does. To understand how this lore can be used to predict the weather, we must first look at colors in the sky and the prevailing winds.

In the mid-latitudes, the prevailing winds are westerly, meaning the wind blows from the west and storm systems generally move west to east. A deep sunrise and sunset often suggest that the lower atmosphere has high concentrations of dust and aerosols which more efficiently scatter shorter (bluer) wavelengths of light, leaving longer (redder) wavelengths of light relatively unimpeded. High levels of dust and aerosols in the lower atmosphere are most often located beneath high pressure systems and stable air masses. At sunrise and sunset, sunlight travels extended distances through the lowest layers of the atmosphere where dust and aerosols are most often concentrated, making this scattering most noticeable and photogenic. In addition, the most brilliant sunrises and sunsets often coincide with clouds being present, but, importantly, not obscuring the horizon. And, finally, the sun rises in the east and sets in the west.

So, now, to put it all together. Brilliantly red skies in the morning are associated with high pressure systems leaving an area to the east with mid- and high-level clouds associated with a storm system moving in, hence the 'take warning' portion of the phrase. Red skies around sunset, however, are associated with high pressure systems moving in to an area, with sunlight illuminating the departing clouds of a storm that has already passed over an area and is in the process of leaving. High pressure the next day will likely

bring drier, more pleasant weather, hence the hiker's delight.

Necessary caveats apply however. This phrase will apply in any region where the predominant storm track is from west to east. In the tropics, where disturbances often move east to west, it would have to be reversed. Also, while storm's may generally move west to east in the mid-latitudes, not all storms will move this way at all times.

–Hayden Pearson

1:27 p.m., Fri., March 24: Re-tracing February's Arctic Air Mass and Record Cold

It took 89 years, but as the headlines have reported, on Feb. 4 Mount Washington Observatory managed to tie its all-time record low air temperature of -47 °F, originally set in January 1934. Let's take a look at the meteorology behind this event.

Feb. 3 and 4, however, were not ordinary days for both the summit staff and the polar vortex. On this day, the polar vortex was a long way from its typical home high in the Arctic. A powerful storm system helped dislodge it and displace it southward toward New England and the White Mountains. By running a reverse trajectory, we can see that over the course of four days, the cold airmass traveled 1,300 miles from near Baffin Island in the Canadian Arctic to New England.

Did the summit make it into the stratosphere during the Feb. 3-4 storm?

The short answer is no. For starters, the stratosphere contains the highest ozone concentrations of any layer of the atmosphere. If we were indeed in the stratosphere, then we would have noted an increase in its concentration at summit level. Fortunately, the New Hampshire Department of Environmental Services (DES) maintains an ozone monitoring instrument on the summit, which showed that ozone levels actually decreased during the coldest period of time. Even though a weather balloon launched by the National Weather Service at Gray, ME (~80 miles SE of the summit) showed that the lower limit of the stratosphere was located at approximately 795mb while the summit was at 777mb, the higher summits of the White Mountains tend to stretch and uplift air as it flows over the terrain. We suspect that this lift may have pushed the stratospheric boundary higher over the immediate summit area, before quickly falling in elevation with air sinking on the leeward side of the Whites where Gray is located.

–Francis Tarasiewicz

The Sling Psychrometer

BY **HAYDEN PEARSON**

If you have ever taken a weather station tour, you will undoubtedly come across someone talking about the use of a sling psychrometer.

Many people have also heard the spiel that it measures wet bulb and dry bulb temperatures, allowing observers to determine ambient air temperature, relative humidity, and dew point.

But why is it that Mount Washington Observatory (MWOBS) still uses this instrument? What are the advantages? And wouldn't it make more sense to install an automated sensor instead of sending someone outside every hour to spin an overly expensive thermometer around for several minutes?

To start, let's first talk about what the sling psychrometer (or sling for short) is and does. The sling is a type of hygrometer, measuring how much water vapor is within a gas, or the humidity. The sling is a wet-and-dry-bulb thermometer that contains two calibrated thermometers. One is kept dry, and the other has a sock, or wick, that is placed over the thermometer bulb and is submerged in distilled water when not in active use.

When used, the sling is spun in the air, and at temperatures above freezing, the water on the sock evaporates as the air passes over it. This results in evaporative cooling and lowers the temperature of the thermometer with the sock below that of the dry thermometer, reading the ambient air temperature.

When done at temperatures below the freezing mark, the wet bulb will freeze and the thin coating of ice that forms on the sock will have to sublime before an accurate wet bulb depression can be obtained. This is why in the winter, it can take 10 to 12 minutes to accurately capture the temperatures, compared to only a few minutes during the summer months.

The relative humidity, or the ratio of how much water vapor is in the air and how much water vapor the air could potentially contain, is then calculated by the difference between the dry bulb temperature and the wet bulb temperature. The greater the difference between the two temperatures, the drier the air is.

MWOBS has been using a sling since its start 90 years ago in 1932. At the time, this was the most accurate and reliable way to measure the temperature in the extreme environments found on the top of New England's highest peak, and it retains that status to this day.

Former Weather Observer Hayden Pearson spins the sling psychrometer.

There are several advantages to using this method over newer, automated systems. The first reason is that the Observatory has always used a sling in order to take the hourly temperature readings, so the use of it in modern times ensures the continuation of one of the longest running alpine weather datasets in the world. The sling also allows a correlation factor to be calculated between the automated sensors that we do have, and the historical data.

The second is the use of the sling means temperatures can continue to be collected even in the most extreme conditions, like those regularly seen on Mount Washington's summit.

While autonomous data collection stations are useful for locations that regularly experience extreme weather, they additionally have setbacks. On Mount Washington, one of the major flaws of autonomous data collection sensors is the amount of moisture that is regularly experienced. The summit is in the fog 60% of the year, leading to large amounts of moisture being deposited on equipment.

While the sling is not used when the summit is in the clouds, there would

be no temperature depression as the air is fully saturated, when moisture is evaporating it can cause thermometers to read lower than the actual temperature. We discussed earlier how the wet bulb thermometer within the sling worked. That same principle applies here. The evaporating moisture, either from snow, rain, or just saturated fog, can re-condense on the temperature sensors. As this occurs, the sensor becomes saturated, much like the wet bulb, and as the water again evaporates, the same temperature depression will occur with the sensor. This will lead the recorded temperature to read lower than the actual ambient air temperature, or the temperature to remain at a constant value until all the moisture has been removed.

The second issue faced is icing. Those large, beautiful feathers of growing rime ice so often seen covering every inch of the summit in winter can play havoc on electronics. Most of the instrumentation used by the Observatory requires heating or constant deicing to ensure that the equipment can keep functioning properly and not break in these conditions.

Since the sling is stored inside when not in use, this is not an issue that observers have to worry about with its use. In addition to the ice breaking equipment on the summit, it can also create false readings, especially from temperature sensors. The phase change of a liquid to a solid (freezing) or a gas to a solid (deposition) both release heat known as latent heat. While this may seem counterintuitive, both of these processes require the removal of energy from the "system," which is done by the release of heat into the atmosphere.

This process can be seen in real world applications on citrus farms. Before a forecasted frost, farmers will spray citrus trees with water and, as it freezes, heat is released which is enough to preserve the inside of the fruit from freezing. In the case of the automatic sensors, they become the 'fruit' and as the water freezes the heat is released onto the sensor causing it to read higher than what the actual ambient air temperature would be.

Another issue the ice can cause is due to insulation of the temperature sensor. Once enough snow and ice has built up around it, the sensor has grown its own igloo and will stay at a more constant and steady temperature despite what the surrounding ambient air temperature might be. While less of an issue closer to the freezing mark, the separation becomes more pronounced the farther the temperature drops.

Third, and arguably the most important, is that using the sling adds a human factor into the data collection process. Extreme weather can produce conditions that automated systems still struggle to accurately process. Having a weather observer going outside with the sling allows a sanity check in these conditions to make sure that the conditions occurring outside are aligning with those that are being recorded inside. It helps to ensure that the quality of extreme weather data collection that has occurred for the past 90 years will be able to carry on for the next 90 and be just as reliable and accurate moving into the future.

New Programs Put Renewed Focus on Schools

BY **BRIAN FITZGERALD**

Mount Washington Observatory (MWOBS) staff have worked hard to prepare the formal launch of the Observatory's school-based programming for K-12 students and teachers in the region.

In a strategic effort to develop and implement innovative educational programs and resources, MWOBS staff have been busy (and growing) over the course of the year as we look to roll-out an expanded menu of programs, particularly for students in northern New England. Through conversations with superintendents, principals, teachers, and out-of-school educators, MWOBS staff and its education committee are excited to offer distance learning, school-day, after-school, and field trip programs, along with an expanded suite of learning resources.

Integral to carrying out these programs for students in the region will be a dedicated group of MWOBS educators, who will be able to bring learning opportunities to many under-resourced and sparsely populated districts in our rural area.

Beginning over the summer, Jackie Bellefontaine joined our team as a year-round School Programs Coordinator, along with Emily Veh, who joined the organization through AmeriCorps as the School Programs Educator.

Through a broad partnership with the AmeriCorps-supported Lakes Regional Conservation Corps, MWOBS aims to become a full-year host site for AmeriCorps members to add the critical capacity needed to reach students in a variety of settings.

One of the K-12 programs that has been generating a lot of excitement both in the office and in the community is the start of school field trips to the Observatory's mountaintop weather station. While many schools visit the mountain on an annual basis, logistical planning, costs, and other challenges present significant barriers for students visiting the mountain and Observatory.

Through a grant of the New Hampshire Charitable Foundation's Neil and Louise Tillotson Fund, and collaboration with the Mt. Washington Cog Railway, MWOBS has been able to pilot the initial round of school field trips with 6th-8th graders at Stratford Public School, Groveton High School, and Whitefield Elementary at no cost to students or schools.

These programs benefit from not just having Observatory educators providing interpretation and support from start to finish, but also from the visiting students themselves who have a hand in helping to plan the trip in the form of smaller student leadership groups.

Stay tuned for more field trip updates and we look forward to hosting more students in the near future.

Our fall program launch kicked off with a backpack giveaway, providing free Cotopaxi backpacks with home weather stations, NWS cloud charts, and weather safety materials to hundreds of middle school students across northern New Hampshire and western Maine.

Students learn about measuring precipitation on Mount Washington.

Another exciting initiative to recently launch is the White Mountains Connected Learning Ecosystem (CLE). This professional learning group, which is part of a broader "Learning Ecosystem Northeast" program across New York, Vermont, Maine, and New Hampshire, brings formal and informal educators together in support of student learning in and out of the classroom.

As a core focus, the White Mountains CLE shares, develops, implements and evaluates weather, climate and data literacy learning experiences primarily for students in grades six through eight. Practically speaking, this group convenes once a month to build connections, share data and climate resources, and collaborate on projects that ultimately serve youth learning in our community. Mount Washington Observatory is proud to serve as one of the science and technology centers in the Northeast convening these innovative groups that aim to share access to resources, facilitate communication and build community partnerships.

While lots of attention has been paid to developing and implementing programming for K-12 programs, adult and family programs remain a priority as well, namely the *Science in the Mountains* lecture series. Two long-awaited programs delivered in April and May about Atmospheric Optics and the Aurora Borealis, and the legacy of the Keeling Curve, provided expert perspectives on Earth's atmosphere.

For those who join the programs, either for the first time or thirty-fourth, it's been a privilege to get to explore these fascinating topics with you. If you haven't joined us before, or if even if you haven't checked in in a while, be sure to attend a program and learn with us and one of our great speakers. For more information and to register for a program, be sure to check out mountwashington.org, or as always, reach out to me directly at **education@mountwashington.org** for all your education-related questions.

Continuously Refining Our Data

BY **JAY BROCCOLO**

Writing these updates is similar to replying when someone asks, "How was work today?" Obviously, there is a lot that is happening, but for me, the struggle is putting enough context into such a short summary.

It is also quite similar to the feeling I have when starting a new project, whatever it may be. I have found the best way to get through that first hurdle is to just dive right in. The diving part took years to realize, but we are here now and this is as good a transition as any other, so here we go.

There are a few projects going on that have a lot of crossover and synergy throughout Mount Washington Observatory's (MWOBS) operations. The first is the work we have started this year with the University of Delaware (UDel).

Overall, our goal is to establish collaborative relationships between MWOBS and UDel so that we can work together on research. We are accomplishing this by first implementing a new and expanded metadata database, with the ability to more efficiently record the data about the data.

This new method will meet many industry standards and even allow us to expand upon them while strengthening the longevity of our historical records.

From here, MWOBS and UDel will work together to provide projects for upper-level undergraduate and graduate students, which will lead to co-authored publications after these students spend time on the summit and return to UDel to do their analysis. This collaboration also puts us in the classroom at UDel through educational outreach.

A good crossover between the aforementioned UDel collaboration and our three-year project being funded by the Northern Border Regional Commission, led by Drew Bush, pertains to the Mount Washington Regional Mesonet (mesonet). Through multiple funding opportunities, we are working to expand the mesonet through the North Country as well as add and update instrumentation at existing stations to make a more, though never complete, automated weather station network throughout the White Mountains.

The new metadata database is the first part in building out our mesonet by having the capability to effectively and efficiently store and update data and any changes to the system moving forward. The added instrumentation throughout our mesonet will allow us to collect data for interdisciplinary studies, add to our own research arsenal, and modernize our research infrastructure.

Part of modernizing our infrastructure and research capabilities entails collaborating with other folks who operate regional mesonet systems. Over the past year or so, scientists from MWOBS, Univeristy of Vermont, Sleepers River USGS, and the ASRC Whiteface Mountain Field Station have been meeting and building out a Northeast Network of Mountain Observatories (NENMO). Our goal is to build a website and method for users to view slightly delayed station data and pull a small amount of data from the site before having to reach out to the individual organization for a deeper data pull or real-time data.

One of 18 weather stations that make up the Mount Washington Regional Mesonet.

There are also two Synoptic projects that we are currently working on. You may be familiar with our Near Surface Lapse Rate project, focusing on Mount Washington, and which is now in the write-up phase. We will have a draft to submit for publication soon, reflecting a culmination of the work of our past three interns, Henry Moskavitz, Jackson Hawkins, and Karl Phillipoff. Philippoff, who has moved into a Research Observer role, has been wonderful to work with on this project, and I look forward to working with him more on future projects.

Our other Synoptic research project concerns the frequency and characteristics of rain-on-snow events on the summit of Mount Washington. It has seemed like we are experiencing more events where we have rain or unfrozen precipitation falling on our snow pack, so now we are focused on seeing if our assumption is correct or not, and we also aim to assess the future of rain-on-snow events. Stay tuned for further details as this new project gets kicked off this summer.

Hopefully, I've explained some of our research projects in a way that shows their synergy and focus on aligning the projects we work on with our overall goal of being the go-to resource for mountain meteorology and atmospheric climatology.

Volunteers Help Make Seek the Peak a Success

BY **LINDA & HANK DRESCH**

Over 30 volunteers played a vital part in making Mount Washington Observatory's 23rd annual Seek the Peak a success.

They helped with planning and executing the kick-off party at Tuckerman Brewing Company, weather stations tours at the summit weather station, and the Après Hike Party at Great Glen Trails.

Over this past season, our activities have also included membership mailings every second Thursday of the month at the Observatory's North Conway offices. These take place at 9:00AM and new volunteers are always welcome to participate. In fact, former Observatory Executive Director Donna Dunn has joined us for recent mailings. We would also like to take this opportunity to thank Kim Henry for coordinating the April mailing while we were on a much-deferred trip.

We couldn't accomplish the activities without the support of our fabulous volunteers. The folks who have most recently given of their time include:

Peter Crane
Floyd Corsun
Linda Denis
Linda & Hank Dresch
Donna Dunn
Peter Fisk
Karen Franke
Kim Henry
Ava Honan
Bill Housum
Marie Kaspar
Jane & Ken Rancourt

Seek the Peak Volunteers:

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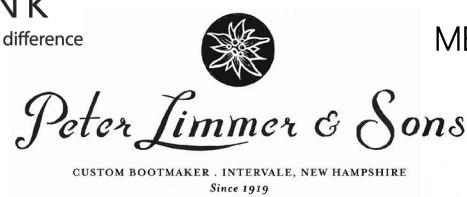

Summit Intern Myah Rather and Director of Education Brian Fitzgerald complete the Mt. Washington Road Race on June 17.

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