Alpine Roulette

The Impermanence of Alpine Permafrost—and How This Changes Everything

IN MY MEMORY'S EYE, I can easily see the mistake. As I scampered up a granite wall on the Swiss side of the Aiguilles Rouges du Mont Dolent, I'd noted with mild curiosity that water was dripping from under the two-meter-tall block of rock I was about to climb over. But the granite face felt so solid after the choss of the last several pitches that I paid no mind to this wet patch. Then I touched the top of the block. Suddenly both the block and I were airborne. I flipped over and ground down the wall headfirst, thinking over and over, "I will not let this kill me, I will not let this kill me..." as rocks tumbled beside me and I waited for the rope to catch my fall.

Fifteen meters later, it did, having snagged on a flake that cut it halfway through. I was indeed still alive, but my feet had broken, as X-rays later revealed. A helicopter came to whisk me off to the hospital, then returned to pick up my partner.

In hindsight, it's obvious the dripping came from ice that had been holding the rock in place.The block would have fallen anyway that summer of 2010, whether or not I'd been there to catalyze its erosion.

I have no beef with erosion. After all, without erosion the Aiguilles would be an uplifted plateau that horses could walk over, not a spiny ridge attractive to climbers. I just don't want to be there when erosion happens. And it's happening hard and fast in the Alps these days. My particular nemesis-stone was a meaningless brick in a large mountain. But in the Alps it's becoming increasingly hard to recognize which brick of rock is solidly attached to the underlying structure, and which is held in place by frozen water—permafrost—at some unknown depth within.

Like most climbers, I knew the melt-thaw cycle would pry rocks from cliffs. What few Alpine climbers previously understood is just how much of the mountain we climb isn't monolithic. An awful lot of it is instead kept in place by permafrost. Heat up the wall and the ice inside turns to water, which transforms glue into grease. How do you know which rocks are trustworthy and which are held up by ice-glue that's in some stage of melting?

ACCORDING to Dr. Michael Krautblatter, lead author of 2018's Geographische Rundschau article "Permafrost in the Alps: features, geographic spread, and future development," permafrost is a sort of "hidden glaciation." The European Alps, he writes, hold approximately 6,200 square kilo-meters of permafrost—roughly three times more surface area than what's covered by glaciers.

The melting of this permafrost has a huge impact on climbers in the Alps, including when and where they go. July and August used to be known as the climbing months in the Alps, when (unless it was a particularly rainy summer) dry, warm conditions offered the most enjoyable climbing, spiced by occasional thunderstorms. Alas, the Alps are warming roughly twice as fast as the globe as a whole, and the problem with "dry" is that it removes the insulating blanket of surface icefields, which leads to rapid warming of the rock substrate that used to be sheltered. The rock itself contains a remarkable amount of ice filling deep cracks and weak layers—ice that is now liquifying.

A leading authority on the melting of the Alps is Ludovic Ravanel, a geomorphologist based out of

the Université Savoie Mont Blanc. A generations-long native of Chamonix, a former mountain hut guardian, and a member of the Compagnie des Guides de Chamonix, he's an expert from every angle. At the Sustainable Summits conference in Chamonix last June (2018), Ravanel noted that mountain permafrost degradation already has been studied for a long time, perhaps most extensively by the Swiss professor Wilfred Haeberli, who has been publishing in the field for half a century.

Ravanel explained the basic process of rock degradation like this: Each time the ground unfreezes, the rock shifts. Each time it refreezes, it locks up again. It also expands. Repeat this cycle enough times and the rock degrades, especially since more and longer unfrozen periods yield ever-greater movement. There's now tremendous movement of rock on the Aiguille du Tacul and the normal route on the Tour Ronde, as researched examples. This process is taking place earlier in the summer, too. In 2018, their recorded internal movement started in June. But what's changing fastest, said Ravanel, is that the massif 's arêtes are losing their ice: "The blocks that make up these arêtes are no longer cemented." Blocks like the one that nearly killed me on the jagged arête of the nearby Aiguilles Rouges du Mont Dolent.

"Mont Blanc is my laboratory," Ravenel likes to say. He delights that "permafrost in granite is much less understood than in some other rock types," which gives him as a scientist the chance to explore new territory at an opportune time. As a climber, though, he worries.

The most shocking illustration of the dangers of lubricating meltwater penetrating deep inside Alpine walls came from the collapse of the Bonatti Pillar on the west face of the Petit Dru, high above Chamonix. In 1965 my father, John Harlin II, put up a big-wall route on this face with Royal Robbins; at the time it was considered the hardest aid route in the Alps. It wasn't really an "Alpine" route, as its sheer granite face was more Yosemite-like than classic mixed Alpine fare. Seemingly, the wall was utterly dry, solid, monolithic. In 2005, however, Dad and Royal's 500-meter route fell to the ground along with the entire Bonatti Pillar next door—some 265,000 cubic meters of rock, the equivalent of 1,600 railroad boxcars. At first no one knew why. But in 2011, after another 43,000 cubic meters fell from the face, researchers discovered newly exposed ice that had been hidden deep inside the cliff. Rising temperatures had evidently softened the ice that had glued together this behemoth.

Last fall's massive collapse of the Petit Grépillon in Switzerland's Val Ferret was caught on an impressive video, and a large rockfall on the flanks of Mont Blanc's Taconnaz Glacier woke sleepers in the Chamonix valley far below. But, according to Ravanel in an interview with TVmountain.com, the emblematic event of the year for this range was the collapse of a huge section of the Trident du Tacul, destroying classic routes on its south face. Such collapses are happening all over the Alps. In Switzerland many of the biggest rock failures took place in the heat wave of 2015, including the west flank of Piz Cambrena in Graubuenden and the western flank of the Grande Dent de Veisivi in Valais. Ravanel said more than 850 such collapses have been catalogued since 2007 just in the Mont Blanc Massif, with degradation of the permafrost being the major factor behind most. The ice that's being revealed can be thousands of years old. After a rockfall near the Frendo Spur of the Aiguille du Midi in 2017, the newly exposed ice was dated at 4,000 years old.

Historically, the greatest ungluing has been on south faces, which have always been exposed to the most sun and thus freeze-thawed and deep-melted for ages. What alpinists are finding now, though, is that north is the new south. As heat waves pile up and extend longer, that heat has time to penetrate the shadowed sides of the highest Alpine summits.

DURING THE SUMMER of 2003, some 10,000 people died in France from unusual heat. The Alps lost more ice than ever in one season. The standard route up Mont Blanc—the Goûter—was closed due to rockfall. The Hörnli Ridge on the Matterhorn started collapsing, too; helicopters rescued over 70 climbers trapped on its crumbling ridge.

Meanwhile, Mark Jenkins and I shouldered massive packs in the heat of Courmayeur, under the Italian side of Mont Blanc, intent on putting up a new route on either the Freney or Brouillard faces. These walls mattered to me because my father had established new routes on each of them in the 1960s, one with Tom Frost and the other with Chris Bonington. Since I'd newly rekindled my desire for Alpine "roots climbing," retracing some of Dad's famous first ascents, I wanted to put up my own new route here. (After this, Mark and I intended to move on to the Eiger, where Dad died in 1966 on yet another new route.) But when we arrived at the Eccles bivouac shelters on the ridge that divides the Freney and Brouillard faces, our jaws dropped. The scene was of utter devastation. The glaciers under both faces were brown with the detritus of freight-car size layers of rock. As we watched, more blocks peeled from the walls and shattered onto the glaciers below. It would have been pure suicide to venture onto either face.

In Dad's day (the 1960s), the Eiger's north face was climbed in the summer. The problem with climbing it in winter was that the bitter cold and strong wind would sublimate autumn's wet ice so there wasn't much left to climb during winter. But in the 21st century, summer rockfall on the Eiger is too intense for just about anyone's taste. Meanwhile, winters have become so mild that the new favorite Eiger season is early spring. Also popular is late September, when storms plaster the face with thick, sticky ice that holds the surface in place. When I climbed the north face in late September 2005, it was covered in fresh snow and ice and we witnessed just one falling rock during three days on the face. Football sized, it arced through the sky before plunging into the Spider, where it stuck in the glue of fresh snow. Autumn's thick, soft ice now tends to stay put through the winter without sublimating, and new storms add layer upon layer of wet, sticky snow.

Surprisingly, this deep winter snow/ice can lead to even faster melting of permafrost. Snow acts as a blanket insulating the mountain from cold, high-altitude winter air. So the previous summer's heat buildup becomes trapped under this "feather quilt," to quote Dr. Marcia Phillips of the Swiss Institute for Snow and Avalanche Research (SLF). "The more snow there is on the ground, the warmer the soil remains, as the heat of the summer cannot escape." Then, as the snow melts in a hot summer, ground that was never deeply frozen the previous winter is even more easily penetrable by meltwater, which compounds the internal thawing in a vicious cycle.

Alpine climbing and skiing has always been known for its "objective" danger—things outside a climber's control, like storms, rockfall, and avalanches. These days, improved weather forecasting and the phone apps we view them on make storms much more foreseeable. But there's no app to warn of imminent rockfall. SLF does offer a web app where new events can be reported, but that's post facto. Nothing tells you ahead of time when an unknown subsurface ice bond on your climb or ski tour has decided to liquify.

Did I say "ski tour"? Isn't a mountain frozen solid during winter? Alas, no. On March 18, 2019, part of eastern Switzerland's Fluela Wïsshorn collapsed. The rockfall triggered a snow avalanche that swept over a classic Davos ski tour. "Luckily it happened at midnight and nobody was injured or killed," writes Phillips. She cited other large midwinter rock avalanches on the Pizzo Cengalo in December 2011 and Piz Kesch in February 2014. Ravanel explained the counter-intuitive timing like this: "The heart of the mountain continues to warm through December and into January" as summer's absorbed heat slowly migrates inward. "For this reason, the most significant permafrost de-icing occurs in late November and December."

More and more research on Alpine permafrost is being done. For example, the PermaSense project, an interdisciplinary effort between geo-scientists and engineers that started in 2006 with the goal of "maximizing technological advances," monitors the Matterhorn's Hornli Ridge at the 3,500-meter elevation level. This is just one of the project's 29 distinct sensor locations.

Elsewhere in Switzerland, Dr. Phillips reports the SLF has some "30 drill holes at 26 locations equipped with instruments that measure temperature and slope movements every two hours." Many of these data flow into PERMOS, the Swiss permafrost monitoring network, which is available online.

Phillips says the SLF's 32-year effort is "the longest measurement series in Switzerland." In Austria, Matthias Rode is part of a team studying permafrost distribution on the headwalls of two receding glaciers in the Dachstein Massif. Their article for the scientific journal The Cryosphere (the "cryosphere" is the frozen part of the world) was published online in January 2019. It reports that they're mainly finding permafrost on cold, northerly aspects. They declared permafrost distribution "an important factor for rock slope failure and rockwall retreat" and confirmed widespread findings that north slopes are in increasing danger as their permafrost thaws.

None of this will help you very much when you're climbing. Sure, you'll find that access trails to huts such as l'Envers des Aiguilles, Conscrits, and Charpoua have been rerouted due to rockfall, lowered glaciers, and/or missing snowfields. You can find out that some climbs, such as Dad's route (with Tom Frost and others) up the south face of the Fou in 1963, are now rarely done, in that case because the access couloir has become too dangerous. You can talk with hut keepers and keep an eye on climbing blogs for recent activity, especially if you know the local language. In some regions, like Chamonix, you can find excellent conditions reports in English. But there's no Alps-wide central bank of conditions reports yet. You can still be taken by complete surprise even on the most classic of routes.

WITH ITS EASE of access and egress via the Aiguille du Midi gondola, the Arête des Cosmiques was one of the most popular alpine climbs in the world. On August 21, 2018, climbers were belaying on a ledge when a guide climbed by, remarking in passing, "C'est bizarre, yesterday this ledge was a meter to the left." The next day, this ledge and everything around it fell off.

Caroline George, a mountain guide who lives in Switzerland, recalled, "I remember guiding one day up in Chamonix last summer (2018) when I felt sick to my stomach and just depressed by the sight of dry glaciers at 3,700 meters and all the mountains looking like they were suffering. I have been seeing this evolution for the past 15 years. I wonder what our job as guides will be like in the future. We are facing treacherous objective hazards now that didn't exist before."

But she continues to guide, as that's both her passion and how she makes her living. "Guides adapt and climb what's possible based on conditions and weather, as per usual," she explained. "We don't climb the Tour Ronde once it's dry, we don't climb the north face of the Droites in the summer like people did 20 years ago, the Frendo is collapsing. You see rockfall and you don't go. The mountains show signs, and we need to respect and adapt to them every day, all the time. That's what guides do for a living."

Meanwhile the ice keeps melting. When I was seven years old and living in a campground in Chamonix, Dad took me up the Mer de Glace and on to the Refuge de l'Envers des Aiguilles. The sight and sound of blue ice crunching under my crampons is one of my all-time happiest memories. At the time we could almost walk directly onto the glacier from the Montenvers cog-railway station. Now you take a gondola down. And then a series of stairways, each bolted onto the last as the glacier shrinks ever further. Dates are painted onto the rock to indicate when the glacier was last at that height. In a few years there will be no glacier at the bottom of these stairs. Each year we'll have to hike further upstream just to touch ice.

It's the same story everywhere in the Alps. Researchers like Haeberli are modelling the ground under the glaciers so they know where new lakes will appear. In a few decades most of the valley glaciers will be gone, just as they have vanished from Colorado's Rockies, California's Sierra, and even Austria's Eastern Alps. (In all these ranges, small remnant glaciers still cling to a few north-facing pockets, but these are fading fast, too.) It will be a new kind of landscape, with rivers of ice restricted to nostalgic photos from our time.

But now we know that glaciers are just one facet of the ice story. The ice that used to be known as permafrost, because it was thought to be permanent—this "hidden glaciation" inside the world's

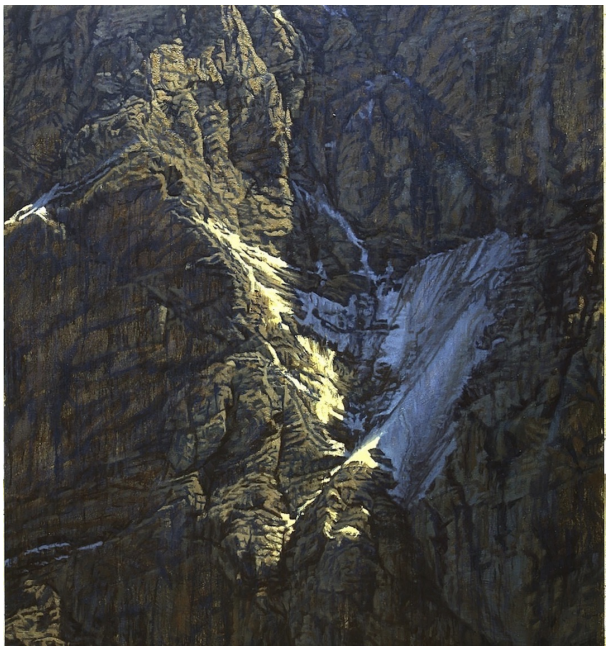
mountains—is vanishing, too. And for a climber, what's unseen can still very much kill you. How much of the rock we climb is a veneer held in place by the last vestiges of ancient cold? How much are we willing to trust that it's not drip-dripping somewhere inside? How much will we adapt our vacation schedule and climbing taste to the relatively frozen seasons?

We'll all make our personal risk assessments, as usual—alpine climbing has always featured risk as a kind of virtue. It's just that when you can't trust a mountain's skin to stay in place, and the weakening may (or may not) be taking place at some unknowable depth, we're in a whole new phase of alpine roulette.

About the Author: John Harlin III lived in or near the Alps as a child when his father was one of the leading alpinists of the 1960s. In 2014, "Young John" returned to work in his childhood village as the director of the Alpine Institute at the Leysin American School in Switzerland. He served as editor of the American Alpine Journal from 2002 to 2012.

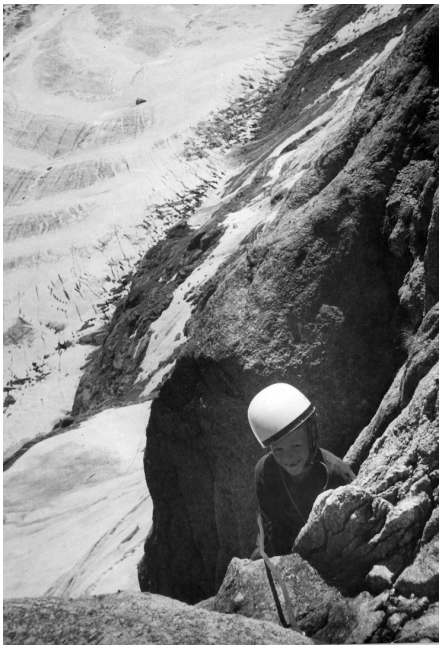
Images

The ice-draped faces of the Mont Blanc massif have lured alpinists for generations. But as ice melts, scientists are detecting great instability in formations like the Tour Ronde and Kuffner Arête (foreground center and right), changing the formula for some classic climbs and eliminating others entirely. Painting: “The Brenva Face, Mont Blanc,” 1998, by Julian Cooper; collection Reinhold Messner.

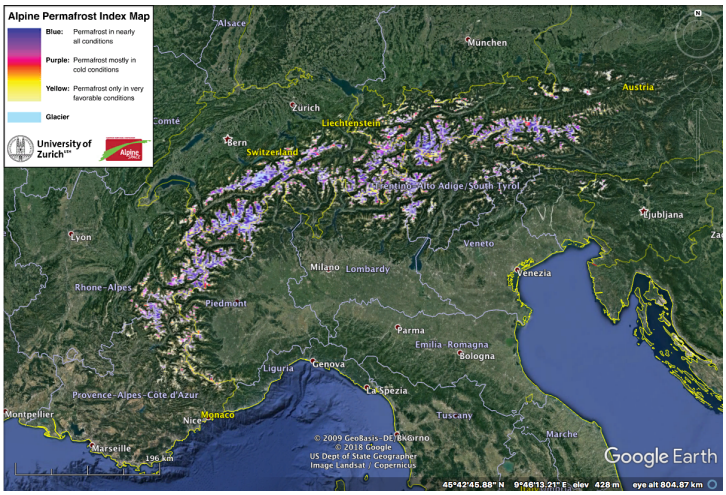


The Eiger’s north face, once climbed almost exclusively in summer, is now desiccated and dangerous in the warmer months. Painting: “The White Spider,” 2004, by Julian Cooper, collection Reinhold Messner.

A massive rockfall from the Cosmiques Arête, just below the Aiguille du Midi tram station, on August 22, 2018.



John Harlin III climbing above the Mer de Glace in the Alps at age 7.



Screen shot of the Alpine Permafrost Index Map, documenting extensive permafrost in the Alpine

regions of Europe. Information about the map and a .kmz file to access the map on Google Earth can be found at https://www.geo.uzh.ch/microsite/cryodata/PF_map_explanation.html.

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