UNDERSTANDING THE CAUSES OF CLIMBING ACCIDENTS • DEFINING SAFETY TERMINOLOGY • RECOGNIZING AND IDENTIFYING HAZARDS • AVOIDING AND MITIGATING HAZARDS • CLIMBING SAFELY

CHAPTER 23
SAFETY

No mountaineer begins a climb intending to become seriously hurt, yet every year climbing accidents injure and kill novice and experienced climbers alike. No climb is worth serious injury or death. Every climber's number-one priority is to return home alive and well.

For an individual climber, serious injury or death is not some esoteric probability; it's as real as it gets. Although climbers universally believe that nothing about a climb is worth their lives, it is surprisingly common to watch climbers gamble with their lives, many unaware that they are doing so. Climbing safely can be contrary to our brains' wiring to discount risk and take shortcuts to save time and effort. In the short term, we usually get away with such shortcuts. Over time, shortcuts and unsafe practices tend to catch up to those who are enchained to these habits, and many of these adventurers eventually succumb to the odds.

Ed Viesturs, the first American to climb the world's 14 highest peaks—whose summits are all above 26,000 feet (8,000 meters)—without supplemental oxygen, has spoken extensively about turning back on many climbs because he insisted on safe conditions. Several of his contemporaries with similar aspirations—but without his safety focus—have perished.

While climbing is less safe than staying home, climbing is not as dangerous as public perception portrays it. Climbing—even difficult, challenging climbing—can be done safely. Nearly all climbing accidents can be avoided with a reasonably straightforward safety focus. Safety-conscious climbers can climb the same peaks or routes as the risk takers. Often, safe practices—which are sound practices—lead to greater successes. In some instances, climbing safely may take more time, gear, or another attempt to reach the summit. But in the long term, safe climbers can expect to live longer and enjoy more years of climbing, more enjoyable adventures, and more successful summits.

The strategy for safe climbing is pretty simple to state but a bit harder to put into practice. First, climbers need to know what the climb hazards are and address them when planning and preparing for the trip. Then on the climb, it's about spotting and avoiding hazards, or where they can't be avoided, mitigating their consequences.

In *Extreme Alpinism*, Mark Twight shares, "As an alpinist who carries a long list of dead friends and partners, I approach the mountains differently than most. I go to them intending to survive, which I define as a success. A new route or the summit is a bonus."

UNDERSTANDING THE CAUSES OF CLIMBING ACCIDENTS

A common misunderstanding is that climbing is unsafe because of mountain hazards largely out of our control. Shrugged shoulders and comments such as "Stuff happens" are common after climbers learn of an accident.

Yet this view isn't accurate. Accidents don't have to happen. Upon analysis, it turns out we are our own worst enemy; climbers themselves are responsible for nearly all climbing accidents. Due to poor planning and preparation, some parties will even set themselves up for an accident before they leave town for their trip.

TABLE 23-1. REPORTED CAUSES OF MOUNTAINEERING ACCIDENTS

MOST FREQUENT *IMMEDIATE* CAUSES

- Fall or slip on rock

- Slip on snow or ice
- Falling rock, ice, or object
- Exceeding abilities

MOST FREQUENT *CONTRIBUTING* CAUSES

- Climbing unroped
- Exceeding abilities
- Placing no or inadequate protection
- Inadequate equipment or clothing
- Weather
- Climbing alone
- No helmet

Source: ANAM (see Resources)

There is no official organization responsible for soliciting, collecting, or analyzing information on mountaineering accidents. The best source of mountaineering incident information is *Accidents in North American Mountaineering* (*ANAM*), published annually by the American Alpine Club and the Alpine Club of Canada (see Resources). *ANAM* focuses on injurious and fatal climbing incidents in North America. As the sources of most of this data are voluntary contributions, the number of accidents is underreported. *ANAM*'s cumulative data represents decades of accident reporting and provides historical statistics and trends.

ANAM data shows accidents are generally spread across age groups and experience levels. Many reports are gripping accounts by the victim or party members. In these accounts, it becomes apparent that nearly all accidents could have been prevented by following sound mountaineering practices.

Table 23-1 shows the most common causes of North American mountaineering accidents in descending order of relative frequency. The most likely to occur are first on the list. An *immediate cause* is one that directly precipitates the incident, such as a fall. An immediate cause is generally a surprise, a trigger of the incident. A *contributing cause* is one that sets up the incident and/or increases its harm. Contributing causes often precede an incident, and often the climbing party has missed or dismissed them. According to *ANAM*, falls and slips dominate immediate causes, while a variety of other dangers, from climbing unroped to weather, are roughly equally likely to be contributing causes.

A typical incident results from one immediate cause and several contributing causes. In one specific example, a novice was on steep snow when she slipped, lost her ice axe, was unable to self-arrest, and broke her leg after sliding 150 feet (45 meters). The slip was the immediate cause; contributing causes were climbing unroped, not having an ice-axe leash, and exceeding one's abilities. An alert climber sees contributing causes as warnings; acting on these warnings may prevent an incident.

Though poor decision making is not included in *ANAM*'s list of accident causes, the analysis of individual reports in *ANAM* discuss poor decisions made, and they are the overwhelming reasons behind injuries, much more so than mountain hazards. The lesson is that climbing is not singularly dangerous —rather, the decisions climbers make are what lead to accidents or bring mountaineers home safely.

DEFINING SAFETY TERMINOLOGY

Learning a number of terms helps a climber understand how and why incidents occur and how to prevent them.

Hazards. Hazards are sources of serious illness, injuries, or death. Such sources may be people or routes themselves, or they can be related to the environment, timing, or weather. (see "Recognizing and Identifying Hazards" later in this chapter). Most serious climbing injuries are *outcomes* (see below) arising from *exposure* (see below) to hazards the victims opened themselves to.

This chapter uses the term "hazard" synonymously with "climbing hazard." Hazards have a recognizable risk for serious injury or death. The definition used herein excludes very low-probability hazards that are not likely to but theoretically could result in serious injury or death, such as tripping while crossing a boulder field, slipping on exposed Class 2 terrain, equipment manufacturing defects, ineffective water treatment, losing footing on a modest snow slope, a car accident while driving to the trailhead, poking an eye with a hiking pole or tree branch, and the like.

Depending upon a climber's experience, skills, equipment, et cetera, what may be hazardous to that climber may not be hazardous for another climber. For example, seasoned climbers ascending or descending steep faces and slopes will have better balance and technique and moresolid foot placements,

reducing the hazard of steepness for them compared with people new to climbing.

Exposure. A climber who is subject to the influence of a hazard is "exposed" to that hazard. If there is no exposure to a hazard, there can be no bad outcome, such as injury or death. (Exposure is also used by climbers to denote a place where there is a danger of falling, termed "falling exposure.")

Exposure time. The amount of time a climber is exposed to a hazard increases the *risk* (see below). For example, on a route known to have rockfall, several hours of exposure is riskier than a few minutes. Similarly, quickly crossing a snow slope with suspect stability is less risky than spending more time on that slope.

Outcome. The consequences of exposure to hazards, or outcomes, are unpredictable. Outcomes range from favorable (a climber saves some time by not having donned crampons for a couple of steps across an exposed icy runnel) to lethal (the climber slips during the crossing). Most exposures to hazards will not result in injury—the climber gets away with it. However, any outcome is unpredictable and the full range of consequences exists with every exposure. Repeatedly getting away with hazard exposure leads to an underappreciation of risk, an inflated perception of the *margin of safety* (see below), and a tendency or willingness to be exposed to similar hazards in the future.

Accident. This term is normally not used because it suggests either chance or an unavoidable outcome, which is almost never the case. Terms such as "outcome" and "incident" are better descriptors.

Incident. Any undesirable outcome is called an incident. Incidents are usually grouped as near-miss, non-injurious, injurious, or fatal. In everyday life, injurious incidents would commonly be called accidents.

Risk. Risk is the mathematical probability that a climber's exposure to a hazard will lead to an outcome with serious or lethal injury. A climber's risk for a particular hazard is impossible to accurately calculate. Furthermore, for a particular hazard the risk is unique for each climber and is linked to personal knowledge, skill, experience, fitness, et cetera. Irrespective of statistical probability, the outcome of the next exposure is unforeseeable; it is independent of the probability.

Margin of safety. This term is another way of describing risk—in an inverse fashion. Climbers look to keep risks low and safety margins high. Margin of safety represents how far a climber is from—rather than how close

a climber is to—a bad outcome. Each climber's equipment, skills, and knowledge influence that climber's margin of safety, just as risk is unique to each climber.

Here are some illustrations of margin of safety. Crossing a snow bridge has a lower margin of safety than walking around the end of the crevasse: there is greater risk in crossing on the snow bridge; there is a greater margin of safety in circumnavigating it. A climbing move with fall exposure has a lower margin of safety than the same move without such exposure. Crossing a tumultuous stream by walking across a log over it has a lower margin of safety than scooting astride the log on the haunches. An anchored belay has a higher margin of safety than an unanchored one.

Risk perception. How climbers personally perceive their risk for serious injury or death from an exposure to a hazard is their risk perception. Humans have biased risk perception; we overestimate our safety margin and underestimate risk of injury or death outcomes. Also, new climbers have a tendency to overestimate risk, while experienced climbers tend to underestimate risk.

Risk tolerance. Each climber's comfort with their personal perception of risk is called their risk tolerance.

Mitigation. Mitigation is an action that can help avoid, but does not necessarily prevent, injuries. It is an intervention that does not prevent an incident but may prevent an adverse (injurious) outcome. Belays are a good example: If a climber slips while rock climbing where there is considerable falling exposure, the outcome without a belay could be fatal; but with a belay and arrest, the climber may keep climbing (successful mitigation). However, the arrest might fail or the falling climber might pull out the protection and hit the ground or strike a ledge before the belay stops the fall and be injured (unsuccessful mitigation). In another example, if an avalanche buries a climber, his or her beacon (mitigation) might allow other climbers to find and save the climber (successful mitigation), or other climbers might find the buried climber, only to discover the climber has died from trauma (unsuccessful mitigation).

Safe climbing. Climbing that avoids or adequately mitigates climbing hazards is safe climbing.

RECOGNIZING AND IDENTIFYING HAZARDS

Climbing hazards have historically been classified as either objective (mountain-based) or subjective (human-based) hazards. Using driving a car as an analogy, road and driving conditions such as road surface, curves, shoulders, potholes, lane width, lighting, and other traffic are objective hazards. Speeding, tailgating, weaving, diminished alertness, mechanical deficiencies of the vehicle, and distractions such as the radio or conversation are subjective hazards.

Mountain hazards. Examples of mountain hazards include steepness, dangerous route conditions, falling distance, duration of exposure, river crossings, bad weather, other environmental considerations, loose rock, rockfall, avalanches, icefall, crevasses, moats, cornices, unstable snow and ice, and many more.

Human hazards. "To err is human"; people make mistakes. Human hazards are underpinned by heuristics. *Heuristics* are mental shortcuts we take to help us agilely draw conclusions and make decisions. Usually they work, but sometimes their oversimplification leads to deficiencies in how we think, termed *biases*. *Cognitive biases* adversely impact memory, team interactions, and decision making. Psychologists have verified dozens of biases that distort a person's thinking and lead to inaccurate conclusions. Unless people are trained to spot these biases, they are unaware of their influence.

For example, a bias leads people to confidently believe they are objective in their assessments and decision making, even when they are not. Another bias leads people to believe they are better at assessments and decision making than others in their group, even when they are not.

Many biases adversely impact decision making. Other examples of how biases manifest include:

- Overconfidence
- Dismissing negative outcomes
- Underestimating the time something takes
- Inaccurate memory
- Favoring statistical outliers
- Relying on bad facts and presumptions
- Faulty analysis and conclusions

Humans are biased toward downplaying risk. The human brain convincingly justifies exposures to hazards. But, always remember: the outcome of an exposure to a hazard is unpredictable no matter what you think, how experienced or skilled you are, or how steadfastly you believe

otherwise. Most climbers are unaware of the extent to which cognitive biases distort observations, analyses, and safety decisions.

Besides these biases, climbers can add other human-related "hazards" such as stress, fatigue, dehydration, injury, emotions, adrenaline, and incomplete or poor information, which further corrupt the ability to make safe decisions. As climbers we tend to attribute incidents to mountain hazards alone instead of acknowledging that we should have chosen a safer option or mitigated the outcome of the hazards we took on (fig. 23-1).

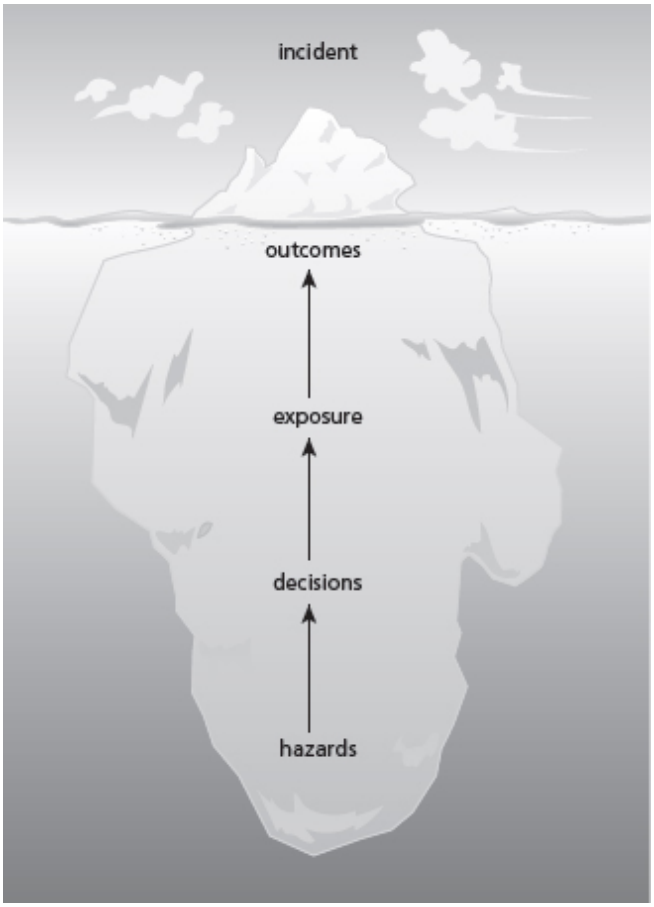

Fig. 23-1. Several underlying hazards and decisions contribute to the causes of an incident.

AVOIDING AND MITIGATING HAZARDS

Some hazards are obvious, but many are not. New climbers often embrace the sport with a narrow focus on climbing technique. As a result, they may get into situations beyond their capabilities and become hurt in the process. Images of leading or soloing sheer rock and ice couloirs are inspiring, but

beginning climbers can't appreciate the years of training and experience that prepare climbers for those routes. Nor do sensational pictures reveal the detailed planning and preparations undertaken prior to the photo shoot.

Education, training, practice, and experience all help climbers become better at discovering hazards and recognizing their biases and compensating for them when making decisions. Until climbers gain these, they will not know their personal limits nor will they know all the ways things can go wrong. You don't know what you don't know. It takes time and experience to become an objective and safety-focused decision maker.

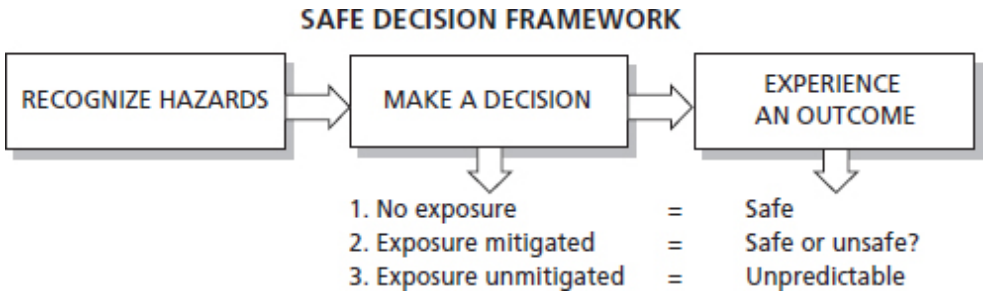

Fig. 23-2. Safe climbers recognize hazards and avoid them. If hazards cannot be avoided, they mitigate to abate or allay those hazards.

One technique to help make decisions less biased and more objective is to think up multiple solutions to a hazard. This forces some objectiveness and analysis into the process. Some suggest coming up with three alternatives, accessing the merits of each, and then picking the best one.

National Park Service search and rescue ranger John Dill gives a sobering overview of Yosemite climbing accidents in an article titled "Climb Safely: Staying Alive." His view is particularly insightful about climbers' states of mind: "It's impossible to know how many climbers were killed by haste or overconfidence, but many survivors will tell you that they somehow lost their good judgment long enough to get hurt. It's a complex subject and sometimes a touchy one. Nevertheless, at least three states of mind frequently contribute to accidents: ignorance, casualness, and distraction."

MAKE SAFE DECISIONS AND RECOGNIZE DISTRACTIONS

Studying the *ANAM* reports helps climbers learn from the misfortunes of others. These reports are poignant reminders that very few of the incidents arise from extraordinary situations. Almost all incidents result from not

adhering to well-accepted practices and techniques. Most of the incidents would have been shockingly simple to prevent. Reading the latest *ANAM* every year is a sobering and useful practice to keep this point fresh.

Poorly reined in desire to reach the summit is the most common bias leading to poor decisions: as the Climbing Code (see Chapter 1, First Steps) says, "Never let judgment be overruled by desire when choosing the route or deciding whether to turn back." Sadly, a number of climbers have lost their lives trying to complete a socially designated list of peaks, when their intense focus on scoring that summit overrode safety. A party motivated by the quality of the trip is less likely to press on into hazards than is a party motivated by the "must-get" summit.

If you are unsure if the hazard is significant or the risk high enough to be dangerous, ponder what would happen if dozens of climbers were exposed to the same situation you face (fig. 23-2). Would it be reasonable to expect some to suffer a mishap resulting in serious injury or death? If so, and recalling that the outcome of a specific exposure is unpredictable, in the scheme of your life, is it worth serious injury or death to go ahead with this exposure to this hazard?

If a climber is "lucky" and a good outcome follows a poor decision, bias can lead to incidents in the future. If you won the roll of the dice this time, a dangerous practice then becomes more tolerable. What about next time? Will you act differently, or will one parameter be slightly different and lead to a devastating outcome? Be sure your biases and decision-making habits are not setting you up for an incident. Do not rely on luck, because when it runs out, the consequences may be serious.

Yosemite ranger John Dill says that "distraction is caused by whatever takes your mind off your work: anxiety, sore feet, skinny-dippers below—the list is endless. Being in a hurry is one of the most common causes." Many experienced climbers, he says, are hurt on easy pitches because they were thinking of a cold beer or a good bivy and made "errors only a beginner would make" by taking shortcuts to get to these goals. One particular climber Dill writes about was distracted by darkness, which led the climber to hurry —he died after rappelling off the end of his rope.

Sometimes many small things, none of which by themselves are significant enough to begin eroding the trip's margin of safety. These changes can involve everything from a little poor weather, some temporary navigation confusion, the party moving slowly, or a mildly ill party member (tired, blisters, heavy

pack, lack of fitness, leg cramps). At some point, even little things add up to have an impact. Heed Kurt Diemberger's message:

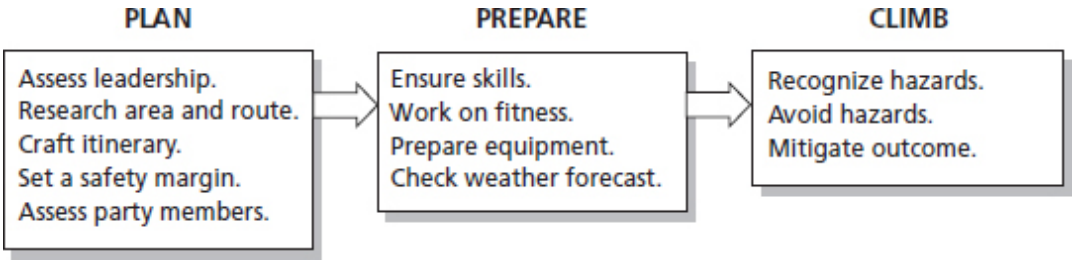

Fig. 23-3. Three-part focus for a safe trip: plan, prepare, climb.

> *It was diabolic machinery, into the cogwheels of which all of us were imperceptibly but irretrievably being sucked—the mechanism being so complicated that it was not recognizable to the individual: every way that might have led us out eventually became blocked by the taking of single decisions, which by themselves would never have been so critical, but in their conjunction opened the death trap for seven people up at 8,000 meters.*
>
> —*Kurt Diemberger,* The Endless Knot

PLAN AND PREPARE FOR THE CLIMB

Discovering and eliminating hazards starts before the party takes the first step on the trail—while the climb is being planned and prepared for. Many hazards can be avoided through preparation and planning (fig. 23-3). Following checklists and acronyms helps guard against forgetfulness and memory errors (see "Organizing and Leading a Climb" in Chapter 22, Leadership).

An oft-quoted climbing adage is "The number-one rule is don't fall." It is smart to learn technical skills in a safe environment such as at a crag or climbing area, where the focus can be on skill development and enhancement, rather than in the backcountry, while also dealing with the myriad trip skills and hazards typical of more-remote venues. In the backcountry, it is best not to climb a route near your maximum skill level. Instead, choose a route that is below your technical best, and focus on the orchestration of all components necessary for a successful trip. The technical portion of a climb may be the highlight, but it is only one of many aspects of a mountaineering trip. There is a tendency to focus too intently on the technical aspects, only to be tripped up by something simple.

When heading to locales subject to adverse weather, plan another trip elsewhere to improve the odds for a successful outing for a given date. Similarly, when a particular peak is the foremost goal, schedule the climb on several calendar dates to improve the odds for acceptable (even stellar) weather.

Once a plan is put together, participants need to prepare for it. For example, if a certain level of fitness is needed for the trip, then all participants must work up to at least that level of fitness.

Careful planning and preparation helps reduce the number of surprises on the trip. However, despite the best possible planning, real-life surprises can arise. With poor planning, the possibility of unexpected hazards rises, and it becomes increasingly challenging to safely avoid or mitigate these hazards.

OVERCOME HAZARDS DURING THE CLIMB

During a trip, climbers should be alert for expected and unexpected hazards. As hazards are identified, the key to safety is to avoid exposure to the hazard or, if the hazard cannot be avoided, to mitigate the possibility of an injurious outcome. If the hazard cannot be avoided or undesirable outcomes mitigated, then the prudent course is to retreat and return when the climb can be done safely.

In another look at the car-driving analogy, maintaining the car, slowing down, selecting a safe route, avoiding congestion, extending vehicle spacing, taking a restful break, being patient, and allowing extra drive time are examples of hazard avoidance. Using shoulder restraints and driving a car with airbags and modern vehicle construction are examples of mitigation: while these factors would not prevent an incident, they will likely mitigate and lessen injury.

On the climb, recognize that safe practices for one type of climbing may not be safe for another type. It may be socially intimidating to use practices contrary to the local norm, and bad habits may develop. For example, at sport climbing areas with bolted anchors and established landings, it may be standard rappel practice to forgo stopper knots in the ends of the rope. A climber habituated to this practice is unlikely to tie stopper knots elsewhere when a safe landing is not ensured.

Redundancy substantially improves safety. Where there are independent backups the probability of all of them failing is the product of the failure rates of each independent part—comparatively, a very low number. For example,

lead climbers normally place double or triple pieces of protection when building an anchor—this results in strong redundancy. In contrast, many climbers rappel from a single anchor without a second thought. While frequently used single rappel anchors are "proof tested" by each rappeller and may not benefit from redundancy, temporarily backing up new and infrequently used rappel anchors provides a substantial margin of safety compared with a single anchor.

When considering what to do, decision making requires an objective perspective, which is not easy. You might have a last day of vacation in which to achieve a long-desired summit, but it began to rain during the night and the weather looks unsettled. Do you try for the summit even though you suspect weather and route conditions could be hazardous? Are there safe options for proceeding? How long can you wait for improvements, or can you retreat if hazards arise? Do you decide to go home and come again another time?

CLIMBING SAFELY

Few sports engage us physically and mentally to the extent that climbing does. Perhaps mountaineering exercises us in ways our minds and bodies evolved eons ago. Today, we do not grow up in the wild, so we have to learn safe practices as adults. Safe climbers seek to minimize hazards prior to their trips. While on the climb, they strive to identify hazards and then make decisions to avoid them or mitigate adverse outcomes, so that they return home safely.