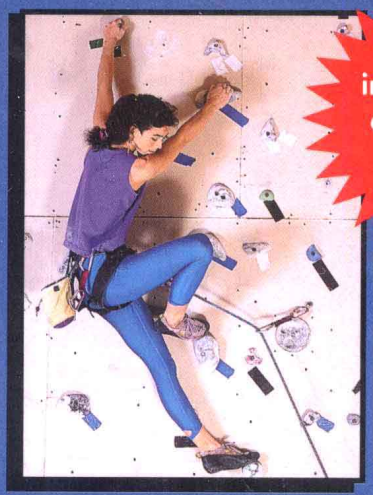


"Essential insights from a master of the sport" *Outside*

The Complete CLIMBER'S Handbook

REVISED AND EXPANDED

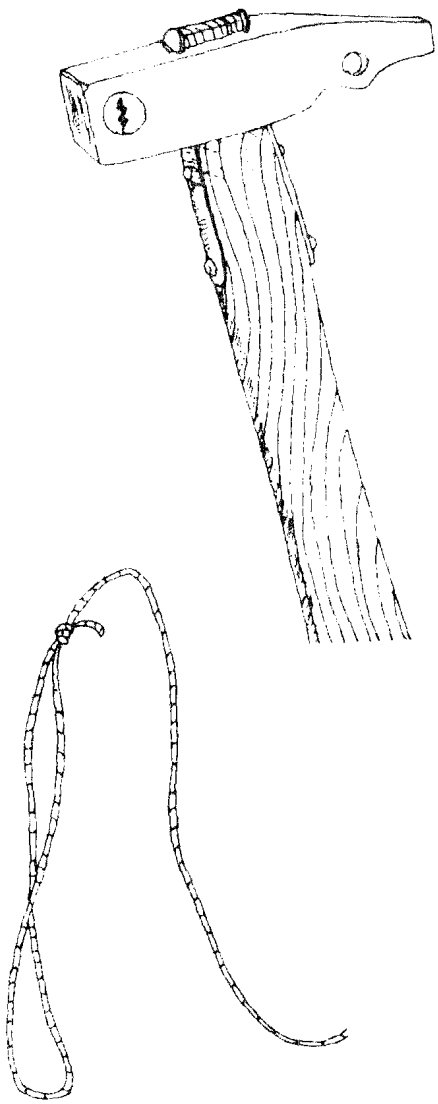
JERRY CINNAMON

Climbing walls, rock, and ice • Equipment • Movements and holds • Anchoring systems, setting protection, knots, belays • Leading climbs • Safety, risk management, first aid

Ragged Mountain Press

The Complete Climber's Handbook

SECOND EDITION



Jerry Cinnamon

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This book is dedicated to the friends and fellow climbers who helped shape my vision of what is possible.

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Preface

This book grew out of many years of teaching climbing to individuals, many of whom have become masters of the sport. My premise has been that novices begin to learn under the tutelage of an experienced friend, instructor, or guide and eventually reach a point of mastery where they can climb safely with peers and perhaps teach others.

This book should remain valuable to you throughout your climbing career for review, as a guide to skill presentation, as a source of additional references, and to introduce you to new areas to master, such as working with groups.

You can enjoy and practice climbing throughout your life at whatever level of athletic ability or conditioning you possess as long as you are aware of your own limits. More than athletic ability, climbing demands thought and decision-making. This book tries to show currently accepted techniques and procedures of climbing, but it can never replace your own judgment as to how to apply them in the fluid situations that climbing offers.

The book is divided into three parts. Part 1 focuses on locations and tools for climbing rock because the central focus of climbing is movement in the vertical world, supported by companions, gear, and techniques. Chapter 1 teaches individual movement techniques and sequences and when to use them. Chapter 2 explores the climbing gym, where climbers are introduced to the sport and where many climbers train and practice movement skills. This chapter explores wall design, route setting, competition climbing, and the important differences between climbing in the gym and in the outdoors. Chapters 3 through 11 focus on the tools to climb rock: basic knots, harnesses and helmets, rope, protection, and anchor systems, as well as the techniques of belaying and rappelling. A chapter on leading rock (chapter 9) and a discussion of fall forces (chapter 11) round out this section.

Part 2 covers the special skills needed for movement on ice and snow, the kinds and use of protection in this environment, the nature of ice, and the techniques of climbing on steep ice. Throughout this part, I assume that the reader is already familiar with the information in Part 1, especially the sections concerning ropes, belaying, and anchors as used in rock climbing. Part 2 also deals with avalanches, an environmental hazard that occurs in terrain where snow and ice climbing take place.

Part 3 is written for experienced climbers who wish to help manage a climbing site when working with organized groups, and who recognize that the dangers of climbing also require management for safety.

Appendices on first-aid programs, fitness, lightning, and pulleys conclude the book.

The climbing community has come to recognize that great climbs can be accomplished by both women and men. Results depend largely on the amount of time and effort that individuals wish to spend learning, training, and putting skills to use. Throughout the book I have attempted to use gender-inclusive terminology, except when referring to a specific, illustrated climber.

Acknowledgments

I wish to take this opportunity to thank the following individuals who have contributed to my personal growth or have directly contributed to the success of this book by sharing adventures, modeling for photographs, critiquing illustrations and text, or providing support: Jeff Alexander, Rich Baker, Tom Davis, Jim Ewing, Gene Francis, Dave Getchell Jr., Dave Getchell Sr., Eric Harms, Geoff Heath, Damon Johnston, Scott Kimball, Dan Koch, Matt Lawler, Jon Leonard, Heather Lindquist, Laurie Little, Mike Lockett, Dan Lowell, Dodi Marvell, Doug McMullin, Dorcas Miller, Chris Misavage, Jim F. Morrisey, Marty O'Keefe, Nick Prvulov, Dot Quimby, Ed Raiola, James Reed, David Smith, Debbie Sugerman, Mark Tenney, Shawn Tierney, Ben Townsend, Steve Tweito, Marjory Ulin, Kathy Dixon-Wallace, Peter Wallace, and Mary Ward, as well as others whom I might have inadvertently omitted. Thanks to the Unity College Board of Trustees, who granted a semester of free time to initiate this book, and to other members of the college community for their support.

I wish to thank the following individuals and their organizations for reviewing the text, transmitting information, and making it possible for me to further my education on subjects related to specific chapters: Roger Damon and the Eastern Division of the National Ski Patrol; and John (Jed) E. Williamson and the American Alpine Club.

Thanks also go to the following individuals and organizations for permission to use copyrighted works: Michael L. Benge, managing editor of *Climbing* magazine, to quote from an article by Paul Piana in volume 110 on the Salathé Wall; Yvon Chouinard to quote from his book, *Climbing Ice*, concerning the origin of the radically drooped ice-axe pick; Bruce Temper, editor of the *Avalanche Review*, to quote from the 1991 article "White Death: A Review of Fatal Accidents in Colorado, 1950–91" by Dale Atkins; John (Jed) E. Williamson and the American Alpine Club to quote individual case studies from *Accidents in North American Mountaineering*.

Thanks to all the individuals who generously contributed to the second edition. Models include Matt Lawler, Dave Smith, and Sari Hou. Jari Karcey and Lauren Karcey gave permission to use an excellent photograph of Lauren in competition, taken by Bob Lockhart. Bob Giolitto provided shots of wide-crack climbing at Acadia.

Sander Culliton of Stoneage-gear provided a draft of the Route Setting Guide written for the Climbing Wall Industry Group (CWIG) of the Outdoor Recreation Coalition of America (ORCA). Chris Harmson of Black Diamond Equipment Ltd. provided the results of tests on ice screw strength and gave permission to quote from a letter by Alex Lowe placing the test results in perspective. Ben Johnson of Petzl America provided both climbing gear and illustrations. Paul First and Ben Townsend read a draft of chapter 2, Indoor Climbing, and contributed to it.

Finally, I wish to thank the generations of climbers before me who have contributed to the literature, technique, and knowledge of climbing.

Introduction

Climbing is about having fun. It is about pumping adrenaline, enjoying the outdoors, ascending impossibly vertical or smooth walls, viewing space beneath our feet, sitting quietly on a ledge reflecting on nature, and sharing tall tales and adventures with friends. At its heart, climbing is about moving our bodies from one spot to another, at our best, with the accomplished, graceful steps of a dancer.

Dancers are not born as masters with the gift of springing into the air and landing softly again on their toes to hold an audience in rapture. Like dancers, climbers start as apprentices; we rehearse our steps time and again to move fluidly and to develop grace. We practice by climbing, whenever we can, at the cliffs, on rock walls, or in the gym. One type of climbing, bouldering, was originally practiced on small glacial boulders but can be practiced on any climbing surface low enough from which to safely jump. Bouldering frees us from encumbering ropes, rope partners, and tools. We use our hands, climbing shoes, and bodies to move for long periods of time and to try movement problems at our current limits. This promotes muscular endurance and power, increases fluidity of motion, and allows us to spend time doing what we enjoy most. Practice gives us the opportunity to incorporate thinking about climbing technique, or mind knowledge, into actual climbing, or body knowledge.

Climbing was once the pastime of a few privileged Victorians with the money and leisure to climb mountains. Its popularity gradually spread during the 1900s to a wider public looking for physical challenges. During the 1960s, with the introduction of advances in ice tools, ice climbing became a separate sport from mountain climbing. A rapid revolution of tools, protection, boots, and clothing followed to make this cold-weather sport more enjoyable and safer than ever before. During the 1980s, "sport" cliffs, indoor climbing walls, "sticky" shoes, and technologically advanced gear made rock climbing accessible to tens of thousands of climbers.

Currently, novices—men and women alike—can begin the sport close to home under the supervision of accomplished friends, climbing gym personnel, school climbing clubs, or guide services. Anyone of average physical ability can profitably spend the first climbing season under the tutelage of a seasoned climber to gain familiarity with the sport. If you want to do advanced intermediate climbs, you will need to develop a general fitness program that involves endurance and strength training. This program can become highly specialized as you train to climb at an advanced level.

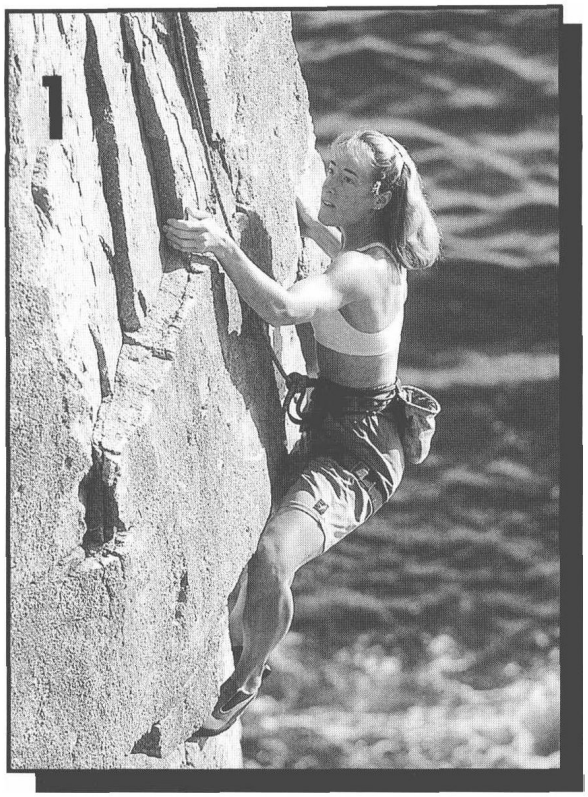
Climbing includes a number of disciplines, including bouldering, rock climbing on small and large cliffs, sport climbing, water-ice climbing, and mountaineering. These disciplines present opportunities to develop new skills and knowledge; to encounter diverse internal responses to the effort demanded, ranging from exhaustion to heightened states of awareness; and to gain new summits. The view from the top of any climb is both beautiful and far. On the way to the top, you will see new places, meet new people, make new friends, and experience successes as well as failures. All of these experiences will seep into you and, upon reflection, enrich your daily life.

As you read and as you practice climbing, think positive thoughts and enjoy yourself!

Contents

Part I

Climbing Locations and Tools



1 Movement

FACE CLIMBING

Cliffs range from low-angle to very steep indeed. Climbers began exploring cliffs by using cracks that split otherwise featureless faces: the cracks provided handholds, or *jams*, and places to insert artificial *protection*—anchors used to shorten a fall—to safeguard the climber. (This is known as *crack climbing*, and we will come to it later in this chapter.) Climbers did venture out onto the rock face, but often were limited by the scarcity of protection. Today you have a multitude of specialized protection pieces that, in combination with sticky climbing shoes, safeguard you in what was once an alien place. As a result, you can find many of today's *test pieces*—climbs on the cutting edge of the sport—as well as fun climbs on faces, where you need precise footwork, concentration, and excellent balance.

Basic Moves

When you climb, you use your feet in combination with your hands to keep yourself on the rock. Since good balance requires that you position your feet below your hands and not off to the side, you must often make a choice between using the largest footholds available or using the largest handholds. When resting, you will probably choose the largest footholds to stand on. When attempting to pull up with your arms on a steep wall, you will often use the largest handholds and whatever small footholds are directly underneath your hands. On less steep walls with positive, or jutting, footholds, you may find that you can balance from foothold to foothold without much use of your hands to support your body weight. As handholds get smaller and the wall gets steeper, take shorter steps a few inches apart to help maintain balance. As a general rule, the higher you step, the larger the handhold you will need to maintain balance. The two common techniques used on these small holds are *edging* and *smearing*.

When small positive edges or the tops of semidetached rock flakes are available, you edge on these, as shown in figure 1-1. This means that you use the inside edge of your shoe, adja-

cent to the big toe; on bigger holds, you use the inside ball of your foot. When you take this stance with both feet turned outward, you can bring your body closer to the rock while remaining upright. Alternatively, you can stand on the outside edge of your foot, which puts much of your weight directly over the bone structure of your foot but usually feels less secure than inside edging because your foot and ankle tend to roll. You can counteract this by tensing involved muscles. Most climbers use an outside edge as a transitory move on small holds while trying to get to better holds where they can pause.

When the rock on steep faces and slabs offers you holds that are rounded so you cannot edge, you place your entire foot on the hold, at right angles to the fall line—the most direct line up and down the cliff—to create the maximum contact area between the bottom of your foot and the rock. You use the maximum surface area of the bottom of your foot. This is called *smearing*. You can use any small surface that is of a lower angle than the overall cliff (fig. 1-2).

On low-angle rock slabs, extend both the smearing concept and shoe-to-rock surface contact by pointing the toe of your shoe up the fall line (fig. 1-3). This is the *friction foothold*. Do not attempt to edge on rounded holds, as edging reduces the area of the shoe making contact with the rock.

For any single friction move there are usually places to step on that are less steep than the general overall angle of the rock. Place your foot on one of these spots and then shift your body weight over your foot. You want a smooth shift from one foot to the other, as if you were ice skating. Climb by linking these moves until you get to a resting place where you can place protection and start over. Moving directly up the slope is easier than moving sideways, where a pronounced weight shift is necessary to transfer from one foot to the other. If the route requires you to move sideways, it is almost always easier to plan ahead and ascend in a diagonal line rather than a horizontal one.

Handholds and Finger Holds

You can grip handholds and finger holds in many ways, as shown in figure 1-4. Possible grips include the open, cling, vertical, pinch, finger grip, and finger wrap.

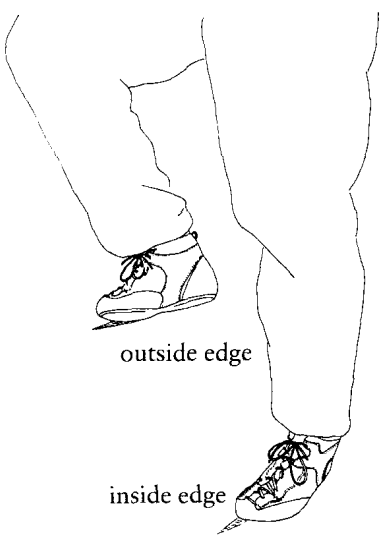


Figure 1-1. Edging: *The left foot, at the lower right corner of the figure, is edging on the inside. This places body weight directly over the inside of the big toe. The right foot, at the upper left corner of the figure, is edging on the outside of the foot. Body weight is over the outside of the ball of the foot.*

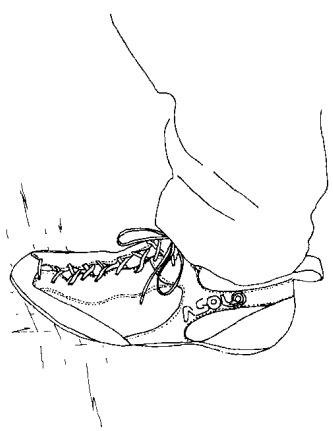


Figure 1-2. Smearing on Rounded Holds

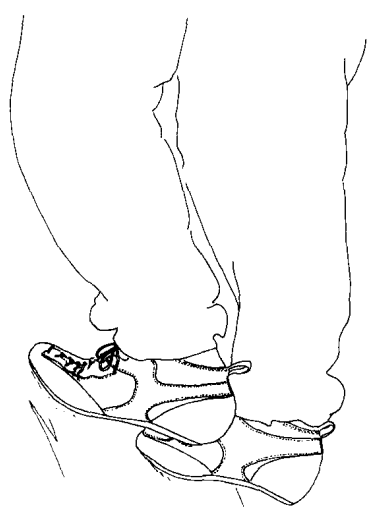


Figure 1-3. Frictioning

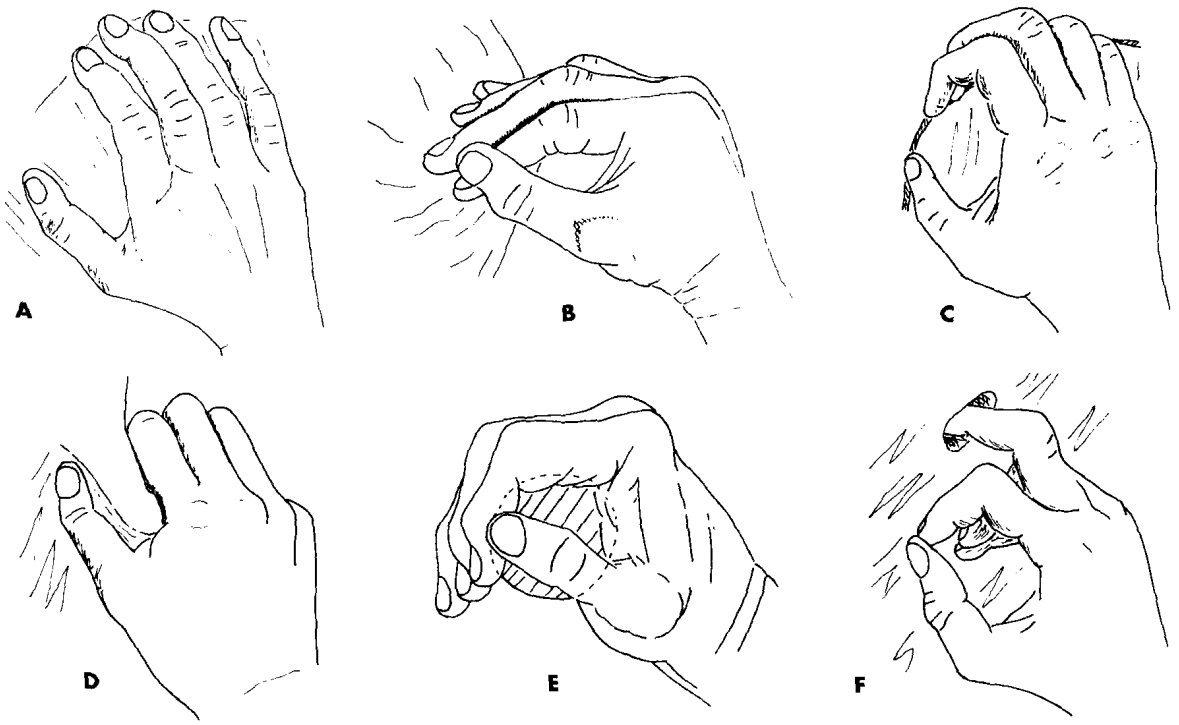


Figure 1-4. Handholds and Finger Holds: A—Open grip; B—Cling grip with thumb as stabilizer; C—Vertical grip; D—Pinch grip; E—Finger wrap; F—Finger grip.

In the open grip (A) you use a maximum amount of surface area of your fingers and hand to grip a hold; this works well on large and rounded holds. You can use the friction of your palm, called *palming*, to increase the security of the hold. Use a cling grip (B) when the pads of your fingers fit on the hold. You can stabilize the grip by placing your thumb over the adjacent finger to provide support and additional strength.

On narrow positive holds, use the vertical grip (C). Bend your fingers at the second joint and fold the first two joints into the third, forming your hand into a hold-grabbing hook. This grip transfers your weight to the rock through your fingertips. The hold does place stress on the bone structure and tendons of your fingers, so using this grip extensively can damage finger tendons. The ends of your fingers are also likely to hurt. The vertical grip does allow you to *crank*—pull your hardest—on the smallest of positive holds and to feel relatively secure while you do. On very small holds you can make the vertical grip more secure by hooking your fingernails over the rock crystals to provide a powerful but potentially painful hold.

Use the pinch, or squeeze, grip (D) on holds with two surfaces that you can pinch together. On large holds this grip can engage the whole hand; on holds the size of a pebble you use a couple of fingers. On small holds pinch the hold between your thumb and the side of your index finger for the greatest holding power.

You can often more securely hold protruding rounded knobs and even large protruding crystals that you might otherwise pinch-grip by using a finger wrap (E). Wrap your small finger, and as many other fingers as you can, around the knob to create maximum surface contact between your fingers and the rock. Maximize contact between the side of your small finger and the rock, and hook the bend in the second joint

of this finger over an upper sharp bend in the knob. Pressing your thumb against either your fingers or the knob may help to stabilize the wrap.

You can use a finger grip (F) in thin cracks, piton scars, and small pockets. Insert a finger into the hole and *cam*, or twist, your finger. Combine this with a pull to the side to enhance the cam. Fitting two or more fingers side by side in the hole increases the strength of the grip. Stack fingers on top of each other in holes that are taller than they are wide. Experiment with different ways of inserting your fingers to determine what works best. Remember that handholds should help you maintain balance, while footwork actually moves you up the cliff. Pulling up mostly on finger strength can be very strenuous and may lead to injury.

Balance and Progression in Face Climbing

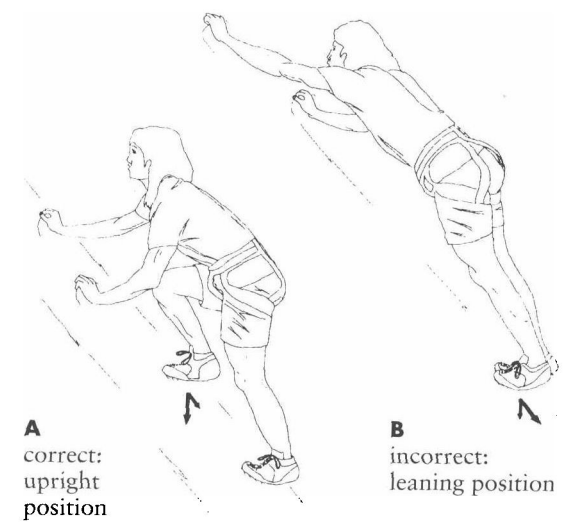
Once you know individual foot and hand techniques, you need to put them together. Do you use a vertical grip while edging with the inside of your left foot, or do you use an open grip while smearing with both feet? Is it better to go fast or slow? How do you transfer body weight from one hold to another? To use the dance analogy, these problems are like knowing the individual steps to a dance, and then learning how to link them together into a graceful choreographed pattern that flows over the dance floor.

Face climbing, like dance, emphasizes balance over the feet and smooth body shifts. By standing upright over your feet, you use gravity to stay on the rock, as shown in figure 1-5. If you stand upright on a slab, the downward force of gravity pulls you into the rock. If you lean into the rock, on the other hand, gravity pulls your feet away from the rock, resulting in a slide down the rock face.

Small steps, often measured in inches, help you maintain balance. They also bring the power of large leg muscles into play and substitute leg strength for that of weaker forearm and upper-arm muscles, so you will not need to hang off small finger holds as much.

The Hand Traverse on a Slab

In a hand traverse, you have positive holds for your hands while your feet smear, friction, or occasionally edge. A classic rising hand traverse leading diagonally across a slab illustrates how you put together different foot and hand techniques. The climber in the photos on page 6 maintains his center of gravity by squatting over his feet and leaning back on his arms. This stance keeps his body weight over his feet so that they do not slide out from under him. He frictions with his feet, but will smear on rounded holds and stand on his inside shoe edge if appropriate holds appear at points on cross-



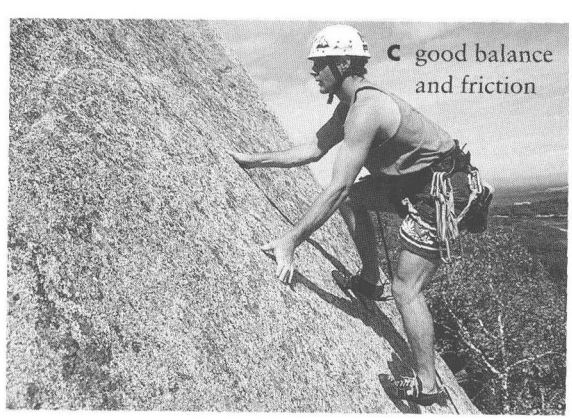
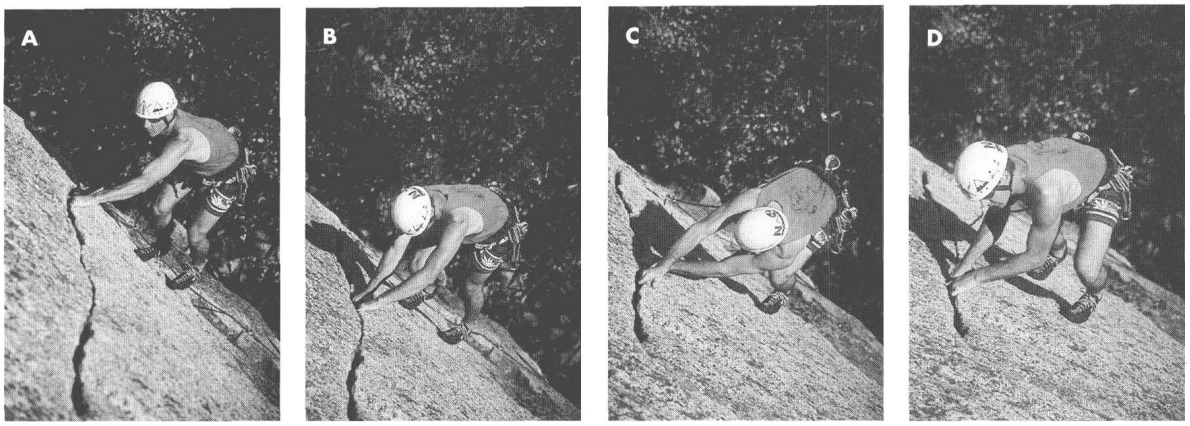


Figure 1-5. Gravity and Balance on Slabs



A Classic Hand Traverse across a Slab: A—Leaning back and frictioning; B—Working up the crack; C—Crossing hands; D—Finishing the crossover.

ing the slab. As you hand-traverse up a crack with your feet frictioning on the slab, you may cross hands, as the climber does in B and C in the photos above, to reach from one good hold to another as you move your feet to keep them beneath your body.

Mantleshelves

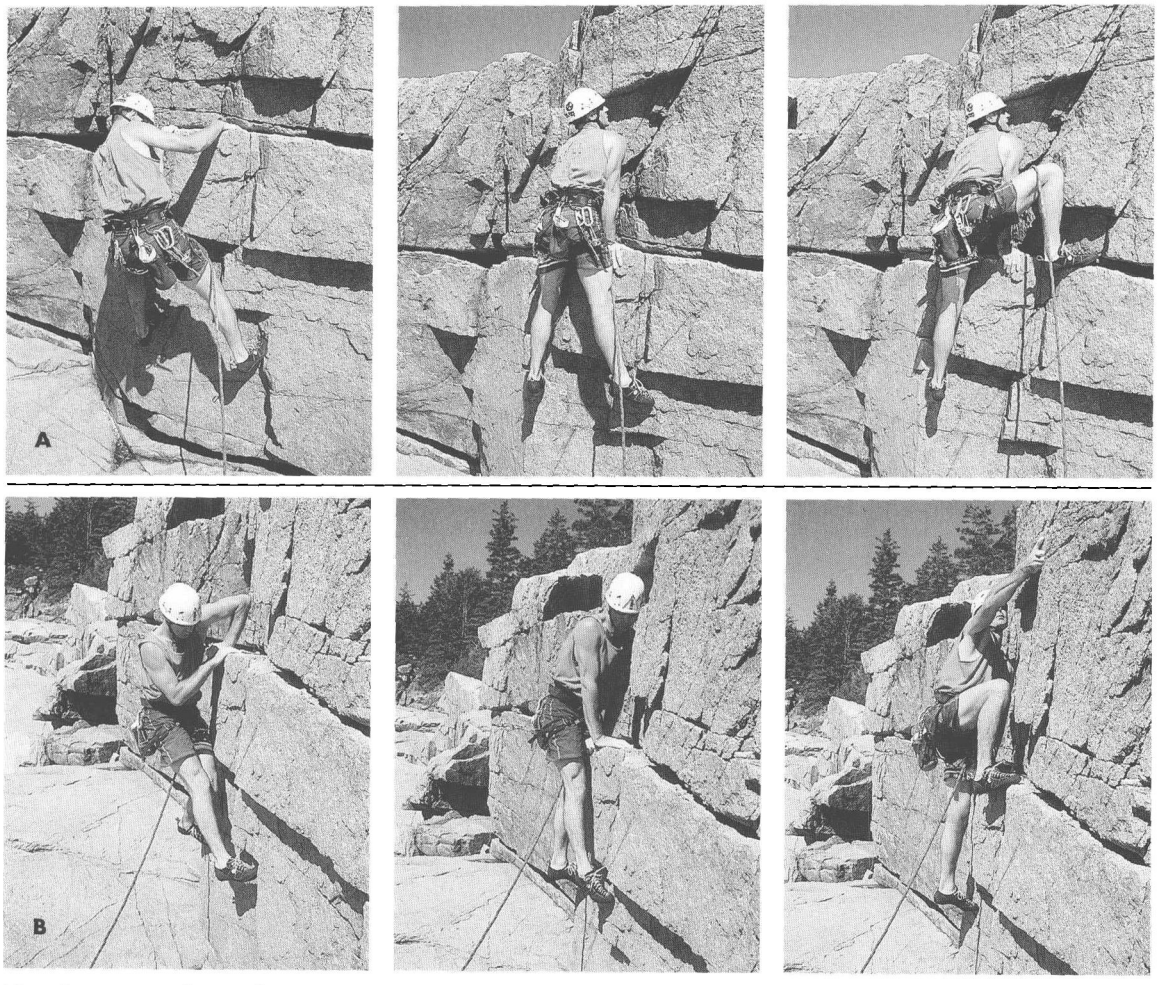
A mantleshelf is a rock shelf with a wall behind it. (The shelf found above a fireplace is a mantelshelf.) When you approach this shelf from below, it first provides handholds. Climbing past the shelf presents problems of balance that become greater if the shelf slopes outward, if it has a rounded edge, and if the wall behind gets steeper and more featureless.

Mantling, the act of surmounting the shelf, is a skill that can be broken up into a number of steps. For a wide shelf (see A in the photos at right), mantle facing the rock. From below, feel around on the shelf for the best finger holds so you can start pulling yourself upward; leave room for your foot on the shelf so you do not step on your hand. If the shelf is not too high, you may be able to place your palm on the shelf to bear weight as you move up in the next step.

In the second step, hoist your upper body as high as possible to enable you to cock your arm next to the wall. You can use small footholds or friction with your feet to assist upward movement. You need to get high enough to lean your upper body over your cocked arm and the palm of your hand. This places your body's center of gravity over your hands and allows you to straighten your arm. This position also uses your triceps efficiently to push your body weight upward. If you do not get high enough to get your body weight over your cocked arm, the mantle move will fail and you will have to reverse the movement in order not to fall. To succeed in mantling you must commit to an active, forceful, or dynamic move (as opposed to a slow-motion, near-static move) and a vulnerable position of balance to get your body weight well over your palm. This challenge makes hard mantles interesting.

As you move your body upward, you can rotate your hand on the shelf to bear your body weight over your palm if you could not do so in the initial setup. It takes coordination to hoist yourself and turn your hand at the same time. Getting as much friction as possible on the palm of your hand is important when the shelf slopes outward and is slippery.

You can mantle onto small shelves by turning your body sideways (see B in photos at right), a position that allows you room to lean forward. If the shelf is very small, you can place one hand on top of the other to leave room for your foot. Otherwise you may find that you have to place your foot on top of your hand, making it difficult to stand. (Some experienced climbers have actually fallen and broken bones after standing

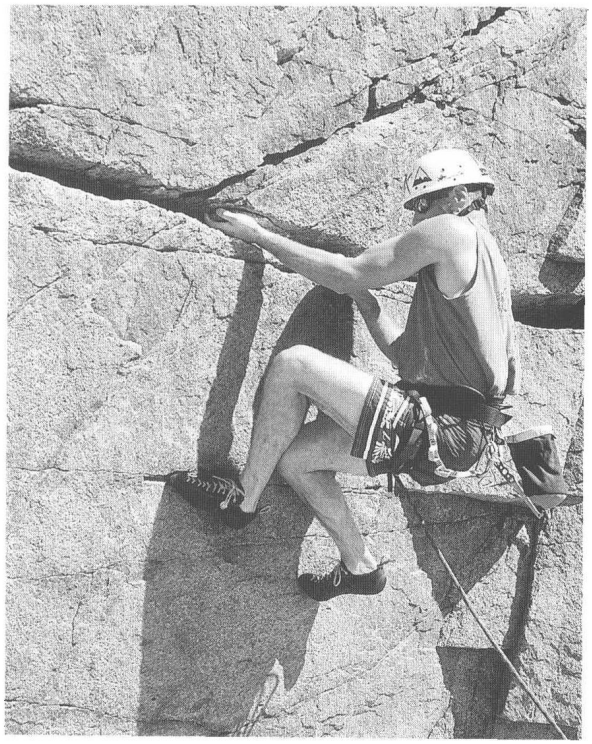


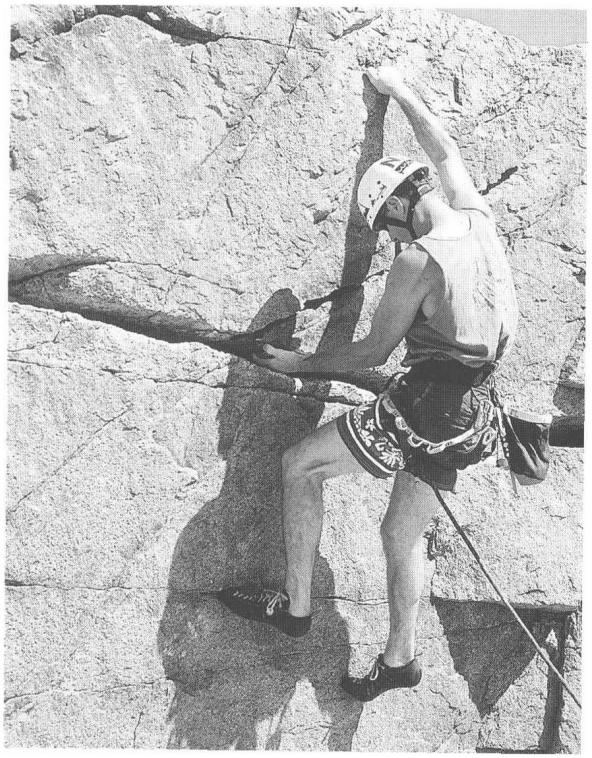
Two Sequences of Mantling onto a Shelf: A—Directly; B—On one side.

on their own hands.) Once you are positioned sideways, hoist yourself upward and lean forward to get your body weight over your cocked arm. Stabilize your balance in this position before attempting to bring a foot up onto the shelf. Then press your body upward to complete the mantle sequence. Finish by bringing a foot up onto the mantleshelf and standing up.

Small handholds or finger holds above the shelf that enable you to pull downward or to the side will greatly enhance this final move onto the shelf. In the absence of positive holds, you can try smearing the palm of your hand on the steep wall behind the shelf to create a tenuous friction hold. While you are using one hand on the wall behind the shelf, you can use the other hand to push up off the shelf or even off your foot (which is on the shelf) to help you stand. The act of standing is easier if your foot is underneath your body, rather than out to the side. This movement means you need to use your leg muscles to help walk your foot sideways, in a series of small movements, until you can load it fully.

On some steep face routes, climbers run into a situation where there is a large positive foothold slightly off to the side, but almost no handholds to help you stand up. You can over-





come this problem by placing your instep and heel, rather than the ball of your foot, over the hold before standing up, using leg power to lift you over the hold. This maneuver works because it places your center of gravity over your foot as you attempt to stand. Combine it with mantle technique and side pulls to aid in standing.

Counterforces: Underclings, Liebacks, and Stemming

Counterforce is a general technique applied to many types of climbing. You generate forces that act in opposite, or counter, directions to create friction and provide balance. You can create these forces by opposing your hands, as if you were attempting to spread open a crack, or your feet (*stemming*), or you can produce a counterweight to help balance your body over your feet, or by leaning off holds as in underclinging, liebacking, and stemming.

Underclings and liebacks differ in the orientation of the holds used for opposition. Underclings involve using your hands palm up in an upward pull that you oppose by pushing downward with your feet (see photos at left). A pure undercling allows you to make a long reach from beneath a horizontal overhang or flake. With your feet smearing, edging, or frictioning, you push down with your feet and walk them higher, while pulling up with your arms. This produces forces in opposition that glue you onto the rock while you make that long reach to a high hold. Many undercling sequences last only one or two moves, although you can undercling rock flakes for long stretches.

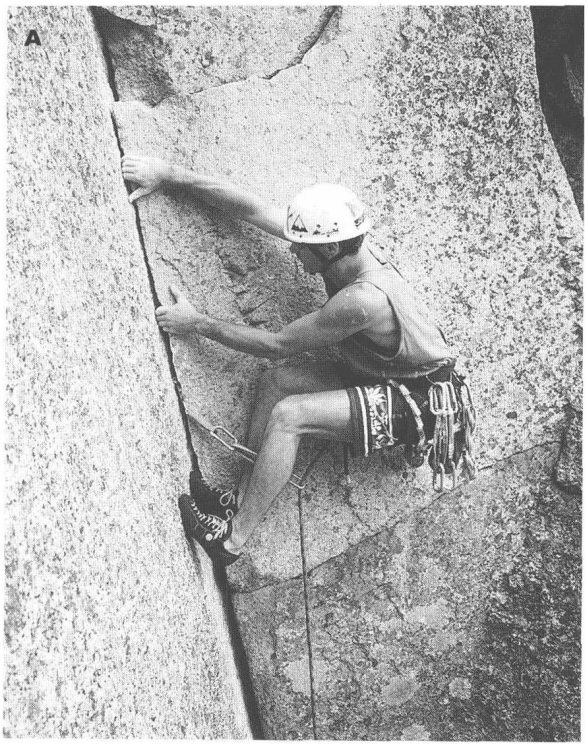
Liebacks often follow vertical cracks for long distances between stances that allow you to rest. You can use lieback technique one move at a

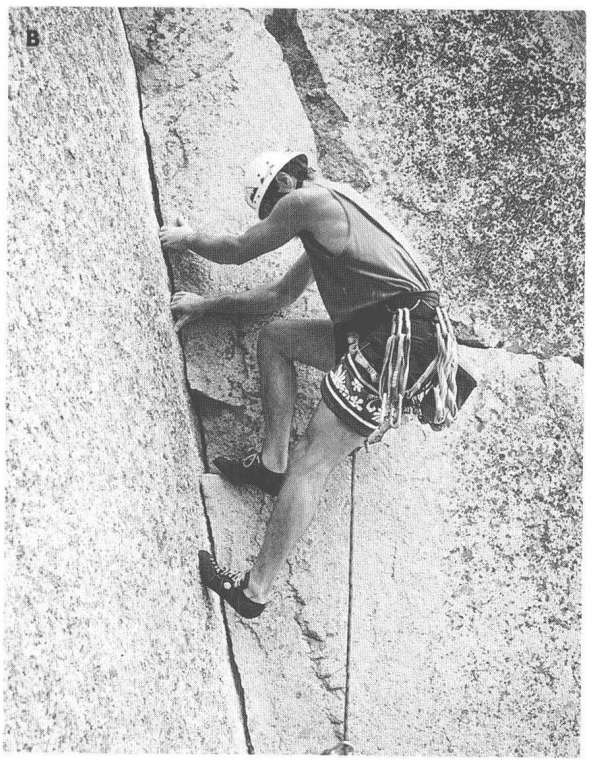
The Undercling to a Long Reach: *The climber initiates the undercling by pushing insecurely against the roof of the horizontal crack while his feet push downward onto thin edges. He stands to gain a higher handhold in a dynamic movement that converts the push of his hands into a powerful upward pull directed in opposition to the push of his feet. Small downward-pointing flakes also can be used to create opposition.*

time, but you can also use continuous lieback technique to climb cracks in 90-degree corners or flakes on a wall. You climb lieback corners using your feet against one wall while your hands pull in the opposite direction to produce the counterforce, as shown in the photos at right. When the wall is smooth, your toe points directly up it, with the entire sole against the wall to maximize friction. Keep your feet as high as possible to prevent them from slipping off. This position strains fingers, hands, wrists, arms, shoulders, and back muscles and requires commitment to the technique, or you will fall off.

Falls most often occur in liebacking when your feet slip off because you lower them to lessen the stress on your arms and hands. Less frequently, your hands slip off a rounded edge that you are palming. Cracks with sharp edges afford a good grip and make liebacks easier. If there are positive edges or lower-angle spots to friction, then you can stand in a more upright position to relieve stress on your hands and arms. You can occasionally turn your foot at a right angle to insert your toe into a wide spot in the crack to give a foothold.

Because of the strenuous nature of liebacks, climbers usually inspect a lieback for potential rests before starting out. Then they move quickly along to a rest spot, such as a stemming position that has footholds on both sides of the





***Liebacking a Corner: A**—The climber pulls against the crack with a straight arm and pushes in the opposite direction with his feet against the flat wall. He needs to keep his feet high and close to his hands to generate enough counterforce to adhere to the rock. If he stands upright over his feet, they will slip off the rock and he will fall out of the lieback. Usually, liebacks fail when your feet slip as you attempt to relieve stress on your arms.*
***B**—The climber has moved his right foot upward onto a small edge that allows him to stand up a little straighter without having his feet slip off. This position reduces the counterforce strength that he must generate with his arms. Small positive toeholds allow you to lessen your effort before continuing, but you must still lean back and cannot stay in this position for long before continuing.*

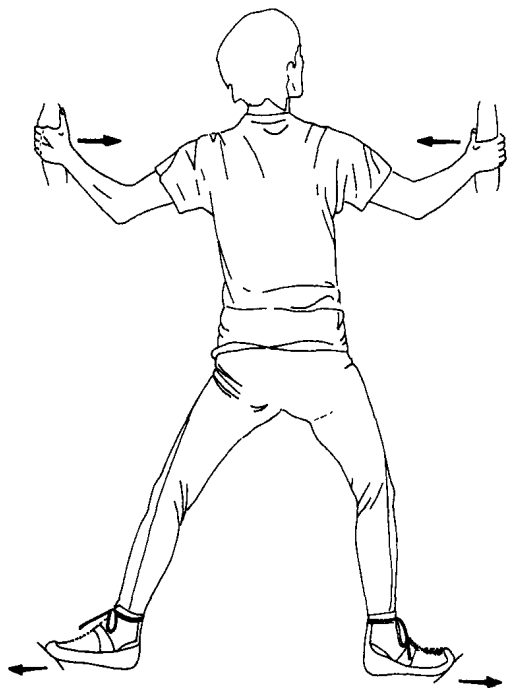


Figure 1-6. Stemming on a Steep Face Using Counterforces

corner. The most difficult part of the lieback in a corner often occurs where the crack becomes less vertical. This difficulty arises because your feet are still on the steep wall, demanding a strong counterforce that you have difficulty providing because your hands no longer have as positive an edge to grip.

Liebacking is often mixed with face climbing, stemming, and jamming.

Stemming

Climbers often stem between flake edges on steep faces. The boulderer in figure 1-6 stands on flake edges using the inside balls of her feet to bring her center of gravity closer to the wall, placing most of her weight over her feet. She establishes and maintains upper-body balance by pinch-gripping rock flakes as she pulls her hands toward each other. The opposition forces created between her two hands counter another set of opposition forces created by her feet, as shown by the arrows.

The classic stem takes place in a right-angle corner where both walls have positive edges, smear, or friction holds (see photos at right). Stemming in a corner has an advantage over stemming on a face. On a face you can only move your legs so far apart before your hips hurt and you lose balance. In a corner you can increase your stem span by turning and rotating your hip. In doing this you "backfoot" the holds behind you to provide counterforce.

Stemming is a type of face climbing, since upward progress can depend on footwork combined with mantle-type moves, horizontal pull moves, or counterforce moves. In the photos at right the climber frictions with his foot on the left wall, "backfoots" the right wall using a smear foothold, and uses the crack to produce a lieback type of counterforce as he sequentially moves his feet and hands. Occasionally you can find a pull move for your hands to help stand over your feet. Beginners expecting abundant positive downward pull holds may have a very difficult time progressing, while an expert enjoys a relatively easy ascent.

Stemming can be useful even if the corners do not have walls at right angles. You can sometimes stem shallow grooves on steep faces. Rock climbers can ascend overhanging cracks more easily if there is any opportunity to stem on face holds on either side of the crack. Ice climbers can ascend overhanging shallow grooves in a relatively straightforward manner by stemming between walls with crampons. In all cases, stemming effectively brings your body position from leaning backward to vertical and allows you to get weight off your arms onto your feet.

Weight Shifts

Climbing on a face involves smoothly shifting your center of gravity from one position to another. The climber in figure 1-7 starts a traverse to the left by placing her leading foot onto a distant and slightly higher hold. At the end of this initial movement (A), her center of gravity is slightly left of her right foot, which supports most of her weight. She maintains balance by providing a counterforce off the distance