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thermal waters, and those with less than 20 degrees cold springs. They contain the soluble substances of the percolated rocky strata. The greater the quantity of such substances and the longer the water has been in contact with them, the richer is the water in mineral constituents. These elements are chiefly calcium, potassium, sodium, lithium, magnesium, iron, silicium, aluminium, sulphur, phosphorus, borax, chloride, bromide, iodine, nitrate, carbonic acids, sulphuretted hydrogen and nitrogen. The bases and the acids can be disassociated from one another or compounded with salts. The most important of these are common or kitchen salt, carbonate of soda, magnesium and iron, sulphate of soda, sulphate of sodium, gypsum and sulphate of magnesium, iodine salts and arsenic compounds. The importance of borax and lithium has not yet been sufficiently investigated.

When the mineral waters come into contact with organic substances on the surface of the earth and slowly spread, they deposit a part of their salts; in this way mud and peat are formed, which are both used for baths and local applications.

The majority of the springs are radio-active, having emanations either in the water itself, in their sediments or in their gases. Radio-active springs contain but little mineral substance, and are connected with the deepest strata of the earth.

Mineral waters are classified in ten kinds, according to their degree of mineralization, predominant element and temperature. They are:

1. *Feebly mineralized* or simple cold waters, containing less than 0.5 gr. of solid constituents to one litre, and less than 1.0 gr. of carbonic acid. Switzerland has 40 such springs, of which the most important are Aigle, Disentis, Knutwil, Romanel and Weissbad.

2. *Akrato-Thermal* or simple thermal waters, "Wildbäder." They contain to the litre less than 0.5 gr. of solid constituents, and their temperature is above 20 degrees centigrade. Ragaz-Pfäfers features such a spring, which compares with Badenweil, Gastein, Wildbad and a number of other spas in foreign countries.

3. *Barthly Waters*, containing over 0.5 gr. of solid constituents to the litre. They are divided into carbonate and gypsum waters, according to the predominance of carbonic and sulphuric earth. Some of the most important watering places with these features are: Henniez-les-Bains Montreux, Meltingen, Sissach, Rheinfelden-Kapuziner and Magdener springs, Yverdon, Tenigerbad, Aandeer, Grimmelalp, Loeche-les-Bains and Vals-Platz. The springs in the two last resorts are thermal. This category of spas compares with such foreign watering places as Thonon, Vittel, Wildungen, etc.

4. *Alkaline waters*, containing to the litre more than 0.5 gr. of solid constituents. The predominant salt is carbonate of sodium. Several of these springs contain iron, bromide, iodine, borax and lithium. There are 9 springs in all, of which the most important are Tarasp-Schuls-Vulpera, Passugg and Oberberg. Neuenahr, Vichy, Ems, Franzensbad, Karlsbad, Marienbad, etc., are rivals of similar properties in foreign countries.

5. *Sulphur Waters*, containing sulphate of sodium, sulphate of calcium and sulphuretted hydrogen. Some are cold and others warm, and often contain chloride and sulphate. There are 68 such springs, 24 of which are warm. Among the most important of them are Baden, Schinznach, Lavey-les-Bains, Yverdon, Alvaneu, Bex-les-Bains, Gurnigel, Lenk, Lostorf, Heustrich and Schwefelberg Bad.

6. *Common Salt or Brine Baths*, containing over 1 gr. of common salt to the litre. Bromide, iodine and carbonic acid are often found in these springs. Switzerland has such saturated waters at Bex-les-Bains, Rheinfelden, Rheinfelden-Ryburg and Schweizerhall, which are used for extracting salt as well as for brine baths. They compare, for instance, with Baden-Baden, Biarritz, Homburg, Ischl, Kissingen, Nauheim, Wiesbaden in foreign lands.

7. *Iodine Waters*, containing at least 0.001 gr. of iodine salt to the litre. The iodine is mostly found compounded with chloride of sodium in common salt, alkaline and earthy waters. The most important of these springs are at Tarasp-Schuls-Vulpera, Rheinfelden, Passugg, Bex-les-Bains and Schinznach.

8. *Chalybeate or Iron Waters*, containing 0.01 gr. and more of ferruginous salts, in which the iron is the main curative agent. In Swiss springs the iron is found in the form of bicarbonate. They are classed as alkaline, earthy, muriatic, saline and carbonic waters, according to their predominating element. Iron waters are very numerous in Switzerland, especially in the Alpine regions, and particularly in the Grisons. The most important among these spas are St. Moritz.



THE PERILS OF MOUNTAINEERING.

By F. S. SMYTHE.

(*Strand Magazine*).

Mountaineering is an exact art calling for strength, determination, skill, and patience. Efficiency in it is gained only through a long and exacting apprenticeship. Its charm lies in its appeal to the physical, mental, and spiritual qualities of man.

The British hills provide an excellent training-ground which demands a special and intriguing rock-climbing technique, but the Alps still remain the cradle of the art, and it is to them that thousands of men and women escape annually to rediscover the spirit of adventure and to learn the value of simple things — food, warmth, shelter, and companionship.

The greater Alpine ranges lie in France and Switzerland. The Alps of Dauphiny are the most famous of French ranges. Then comes the range of Mont Blanc, of which the major portion is in France, the steepest side in Italy, and the eastern end in Switzerland. In Switzerland mountaineers gravitate principally to the Pennine Alps, the Bernese Oberland, the Bregaglia and Bernina ranges, though there are, of course, many less lofty ranges where the novice may graduate in mountaineering.

Mont Blanc was scaled a hundred and fifty years ago, but it is generally conceded that mountaineering as a pure sport was inaugurated in 1854 when Mr. Justice Wills scaled the Wetterhorn.

Alpine climbing has passed through a number of stages. At first, a peak such as the Matterhorn or the Meije was thought to be impossible of ascent; then it was climbed and became "the most difficult peak in the Alps." Finally, it became "an easy day for a lady." This last should not be taken as a reflection on the ability of lady climbers; of recent years many new and difficult routes have fallen to their hardihood and skill.

In these speedy, impatient days the popularity of mountaineering results in many calamities. The annual Alpine accident roll is no longer numbered in tens but in hundreds. Inexperienced persons, unable or unwilling to employ guides, venture upon the high mountains, frequently ill-provisioned and equipped, and meet with disaster. On Mont Blanc alone a score or more perish yearly.

Only through years of experience in the company of first-rate guides or skillful companions can most people learn to climb safely. And, even as regards easy ascents, the weather is an incalculable and often deadly factor. The ordinary way up Mont Blanc, which is little more than a snow walk, may become the snow grave of the incompetent when a blizzard stalks without warning over the vast and complicated snowfields.

Only last summer I witnessed a display of incompetence which in retrospect seems scarcely possible. It was on an easy mountain. A large party started down from the summit one and a half hours before we did. Yet, we overtook them within five minutes of leaving the summit! The weather was fine, but supposing a storm had broken? It is not difficult to imagine their plight.

Another type of accident has become common of recent years. It is limited for the most part to young Continental mountaineers, and is a remarkable indication of the fanatical desire to undertake the most desperate risks for fame. Two Germans attempted to scale direct the terrific north precipice of the Eiger, which is a familiar sight to visitors to the Bernese Oberland. Day after day they pushed their way upwards, driving pitons (ringed iron spikes) into the rocks every few feet regardless of threatening weather. Then the storm broke and nothing more was seen of them until some time later a searching aeroplane saw one of them frozen to death lashed by a rope to the face of the precipice. It is small wonder that Swiss and French mountaineers deplore such madness, for it often happens that their guides, men who are always ready to risk their lives to succour those in distress, are called upon to rescue the injured or recover the bodies of the fallen, exacting and often dangerous work.

To those prepared to undergo humbly the task of learning adequately the art of mountaineering in all its branches the mountains are generous in their rewards. To climb efficiently, to be master of the situation, is to know one of the greatest joys that life can bring, the communion of the high hills. Yet, though skill may conquer fear, it does not eliminate adventure. The mountaineer knows he is there on sufferance, a mere ant on the face of the precipice, and that his skill, unaided by the intervention of anything mechanical, alone stands between him and death. It is in testing that skill to the uttermost, yet never overstepping the boundary separating boldness from rashness, that he discovers the perfect adventure in mountaineering.

The great rock wall of the Aiguilles des Grands Charmoz and Grépon, which rises in a single tremendous sweep 3,000 feet out of the Mer de Glace is a challenge to the spirit of adventure.

Mr. G. Winthrop Young accepted this challenge in 1911 and the wall was scaled for the first time after a desperately difficult climb. On its granite facets, in its cracks and chimneys and the delicate spires and bold rock towers of the great ridge in which it culminates, all the thrills of rock climbing are communicated to the climber. To stand on an inch-wide ledge and gaze upwards at the lean slabs, alight and warm in the sun, and at the bold pinnacles wedging a stainless sky, and to know that strength and skill are just sufficient, but only just, for the task before one; to do these things is to understand the subtle thrill of a great mountain climb. And when at length the summit is reached and taut muscles are relaxed in delicious repose, there comes a moment when physical adventure links hands with the spiritual beauties of the Universe, and horizons wider than those visible are disclosed.

To climb ice and snow demands a very different technique from that required by rock climbing. Nothing in mountaineering is more exacting on mind and muscle than the ascent of a long and steep ice-slope in which every step must be cut with the ice-axe. In no situation is the mountaineer more dependent on the skill of his companions, for a slip on steep ice would in most cases be fatal to the whole party. It might

be queried whether the rope is not more dangerous than useful in such cases, but the answer is that its moral support is invaluable, and even on a steep ice-slope there is always a chance of holding the leader should he slip, though it is axiomatic in mountaineering that the leader simply must not slip.

The rope is seen to its best advantage when crossing a crevassed glacier or ascending an ice-fall, such as is depicted in the accompanying photographs, when there is a risk of snowbridges spanning crevasses collapsing beneath the party. It is a thrilling experience to balance along a thin edge of ice with the dark green throats of crevasses on either hand.

Considerable skill is often necessary on a glacier, and many have marvelled at the manner in which a guide picks out the route, through a labyrinth of huge crevasses and tottering seracs — ice pinnacles which are a feature of an ice-fall.

Every man to his taste: some prefer pure rock climbing, a few specialise in snow and ice work, but the great majority prefer a little of everything — snow, ice, and rock. A man cannot truthfully call himself a mountaineer until he has had experience in all these branches.

No Alpine rock climbing can excel that to be found on the Chamonix Aiguilles, though some prefer the fearsome cliffs of the Bregaglia and the Dolomites. The Oberland is noted for its snow and ice, so also is the Bernina. The Zermatt district is as good as any for all-round mountaineering. But the greatest Alpine climbs lie up the south face of Mont Blanc and the east face of Monte Rosa. Here the scale is almost Himalayan, and it is not uncommon for climbers ascending by a great route such as the Pétéret ridge of Mont Blanc to be forced to bivouac for one or two nights. Woe betide them should the weather break; an already difficult climb may be changed in a few minutes to a desperately dangerous and hazardous retreat towards the safety that is so many weary hours away.

It is impossible to close this article without some reference to the work of the Alpine guide. Mountaineering owes much to his sagacity and skill. Many of those about to attempt Mount Everest will have learnt how to climb safely behind a guide. Quiet and unassuming yet strong and purposeful, his margin of physical and moral strength enables him to cope with any emergency.

One instance of his devotion to duty may be given here. When a friend of mine was injured on the south side of Mont Blanc I descended to Courmayeur, leaving a third member of the party with the injured man. Within an hour of my arrival at a hamlet two miles from Courmayeur a rescue party, with a doctor and medical appliances, was ready to start. This promptitude enabled the injured man to be brought down by nightfall, and point of the utmost importance when succouring the injured.

Mountaineering brings forth the best qualities in men, and of these perhaps the greatest is comradeship. In these difficult days the League of Nations can take heart from at least one human enterprise that has its roots in good-fellowship and goodwill.