exhausted. The Alps can never be exhausted: not by any individual member of this Club; not by the united efforts of all the members in all the years which have led to this year of jubilee; not by all the countless myriads who swell the ranks of this Club's god-children. It may be that men may more and more take that curious form of pleasure which consists in ascending the Jung Frau through a rabbit-hole, or the Wetterhorn by a rocket apparatus. Mr. Young may climb, if he has time, every perpendicular precipice in the Alps, and the Yorkshire Ramblers Club descend into every pot hole. We may find the old haunts desecrated, and we may have to abandon the Swiss side of the Matterhorn through the danger of falling sardine tins; but for all this, shall love and fellowship be dead or the full moon paler over Monte Rosa? Shut us off from the fashionable climbing centres, ticket every rib and every gully and catalogue every peak—the infinite vastness, the infinite variety of the Alps will remain unplumbed, unstaled, and for many years to come the middle-aged man and his children and his grand-children after him will seek among those heights, and will find, the peace, the freshness and the purer air of another world. Whether in the translucent mystery of the morning or 'the incomparable pomp of eve,' they stand for ever for us unchanged, unchanging, only transmuted in the alchemy of the affections through what our hearts distil of recollection and of love.

Mountaineering on Ski.

By E. RUSSELL CLARKE.

(Read before the Alpine Club, March 2nd, 1909.)

THE art of ski-ing, like the art of skating, has attained to something like finality. I am told that all the skating turns mathematically possible can now be done by a first-class skater. In Norway and Sweden a corresponding proficiency on ski is quite common, but the Englishmen who are first-class skiers in this sense can be numbered on the fingers of the hand.

Mountaineering on ski, however, is quite a new sport, and there has not been time for the technique to crystallise as it has done in the case of mountaineering on foot. I therefore propose to deal with the subject generally, without attempting to describe any particular expedition.

There is a very wide distinction between being able to ski and being competent to mountaineer on ski. The ability to

ski can be acquired by everybody—everybody, that is, who has been provided with a normal body and limbs, but a good deal more than this is needed for mountaineering.

The art of ski-ing is very like the art of skating, and to be a really pretty skier is as difficult as, or even more so than to be a good skater. The swings and turns can be learnt by diligent practising, and are undoubtedly useful when on tour, but they are not really essential to the mountaineer. What is essential to mountaineering on ski is a good physique, for the days being short the pace has generally to be rather fast; a capacity to stand up downhill when travelling at a good pace; and above all, a certain fear of snow and a knowledge of snow conditions.

The number of people who are able to ski is increasing very rapidly, and the bolder ones are anxious to try their new powers and go farther afield each year. I went to a certain well-known winter-resort four years ago, and although there was much ski-ing in the neighbourhood of the hotel, the only tracks on the mountains themselves were made by one party of climbers. This winter all was changed. Standing on the top of a mountain, one could notice ski-tracks in all directions.

The knowledge of mountaineering which is possessed by all the members of this Club is to my mind more essential than the capacity to ski gracefully. For this reason every member of the Club ought to ski. The most difficult part of the education has been achieved, and it merely remains to add a subsidiary accomplishment.

Real danger exists for those who undertake long winter expeditions on ski without the necessary mountaineering experience, and at the present moment the inexperienced are in the majority. Most people who have been to one of the Swiss mountain-resorts in winter will have noticed the courageous way in which the youthful skier starts for some peak with a number of totally inexperienced friends, and takes them up and down places which are often quite unsafe. Nor is it always wise to trust to the local guides, even when they have learnt the art of ski-ing. Of course I am not referring to the first-class guide, who knows all there is to know about snow, but to the guide who in summer shows the way up the more or less grass-covered mountains in the vicinity. He tries to follow the summer path, and this is often impracticable in winter.

The mountaineer learns at once to get about on ski. He will learn more about ski-ing in a week than the ordinary mortal in a month. A certain member of this Club went quite a long tour on his second day on ski. I should not like to estimate the number of times he fell or to describe the steady crescendo of

E Russell Clarke, Photo *Swan Electric Engraving Co Ltd*

AN UPHILL SKI TRACK.

Charles T. Owen, Photo. *Swan Electric Engraving Co Ltd*

GOING UPHILL.

his language, but he got home at last, firmly convinced that the method of progression was useful.

I want to say a word as to equipment. Boots are a necessity. By far the best are the genuine Norwegian boots called Lauparsko, because they are quite watertight and have a very flexible sole. It is best to have them unnailed, because nails diminish the flexibility of the sole, wear out the ski, and cause snow to ball under the feet. There is, however, one type of ski, called the Lilienfeld or Alpine ski, with which nailed boots can be worn, about which more anon.

The boots should be big enough to admit of wearing a pair of stockings and a thick pair of goatskin socks as well. Putties should also be worn to keep out the snow. People with a defective circulation find it useful to wear a pair of socks outside their boots.

As to ski, it is very important to choose a pair with a straight grain and free from knots, as a broken blade is an awkward occurrence if it happens far away and late in the afternoon. Personally I prefer a rather narrow blade, as this makes it easier to dig-in the edge of the ski on a steep crusted slope. It is possible to traverse a slope of great steepness, even when it is crusted, if the edges of the ski are sharp, and it is surprising how very little track is made. The ski edge may not penetrate the crust more than a sixteenth of an inch and yet give a secure hold. The ski should err slightly on the short side for mountaineering, as this makes the turns easier, especially the uphill turn.

As to the vexed question of bindings, the most important feature is a bent iron-plate which grips the sole of the boot near the toe. If this is really accurately adjusted it is possible to wear the toe-strap quite loose, which is an advantage, as anything tight is inclined to hinder the circulation. It will be seen that the toe of the boot must be nearly as broad as the blade of the ski for this adjustment to be properly made. The binding proper consists of means for keeping the toe well forced into the embrace of the bent iron-plate. The two main types are the Huitfeld and the Ellefsen. In the former the essential part is a strap passing round the heel and forcing the toe forward. The strap in most cases is provided with a toggle tightener, which saves much trouble when one's fingers are cold.

The Ellefsen is one of the types of ski which have a flexible piece of belting to which the heel is attached. For mountaineering it is not really so reliable as the Huitfeld, because it contains a light metal fitment which embraces the heel, and

when the temperature is much below zero this gets brittle and a very small shock may break it. The Huitfeld binding is without this objection.

There is still another type of binding, if such it can be called —namely, the one used on the Lilienfeld or Alpine ski. Many mountaineers prefer this to any other, but I am not one of them. The weight of the metal plate and spring hinge is excessive and leads to cutting down the weight of the blade, which is a very bad thing. Also the ski as sold do not contain a groove in the blade, which prevents them from travelling so steadily downhill. Moreover, the various capacities they have for adjustment to different sized boots are to my mind merely so many capacities for coming unadjusted at the wrong moment. One advantage is that a nailed boot can be worn. The other advantages of this type of ski have been most eloquently set forth by Mr. Rickmers in the 'Alpine Journal' for August 1903. My own favourite binding is a plain Norewgian one, and I generally carry a light pair of steigeisen or else a pair of heel crampons in case the ski have to be abandoned owing to meeting ice or rock.

However, it would be a great advantage if some binding could be found which would enable a lightly nailed boot to be worn without either wearing out the sole-plate of the ski or causing the snow to ball under the toe. I have on occasions carried a pair of climbing-boots in my sack when I knew that there was rock work to be done, and changed footgear at the base of the rocks. The change back in the afternoon is generally rather a painful operation, owing to the ski boots being frozen quite stiff. If someone would invent a light pair of steigeisen that answered the purposes of nails, and without spikes, it would be a great boon to skiers.

A stick of some kind is absolutely necessary, and it is as well to select something fairly strong. Two sticks with rings, converting into a single one without throwing away one of them, is a good thing, particularly when the ground is nearly level. An ice-axe is not a pleasant companion, but must be taken sometimes, as it is useful on crusted and icy ground.

As falls may happen even to the most experienced, it is best to have clothes made of a material to which the snow does not stick. I find a fine Bedford cord superior to the khaki-coloured gaberdines at present so much in vogue. It is essential that all pockets should have flaps. The best cap is a knitted cap, such as the crew of racing yachts sometimes wear, shaped like a jelly-bag.

If a camera is taken it should be a small one, and should be carried in the sack and not in the pocket. The warm moist

air of the pocket finds its way into the camera, and when the latter is brought out into the cold, condenses on the inside of the lens. I had a whole series of negatives ruined in this manner.

The portions of ski-ing technique which are most useful to the mountaineer are as follows :—

The art of ascending with the minimum of effort.
The art of running straight down.
The art of traversing downwards and turning.
The art of stopping.
The art of falling and getting up.

The art of ascending with the minimum of effort.—The mountaineer on ski will generally start at a fairly early hour, and therefore he will be at a considerable altitude before the sun attains any great power. On this account he is not likely to be troubled by the snow balling under his ski, as is often the case on expeditions which are carried out at a lower level. Consequently, unless he has purposely iced his ski to enable him to ascend without slipping back, they will remain clean and slippery all day. Icing is very easy to put on but very difficult to get off again, and I always try to avoid it myself. For this reason avoid getting the skis wet when crossing streams. Instead of icing, many skiers use attachments of one sort or another to assist in climbing upwards, and remove them before starting on the descent, but personally I am not in favour of these appliances. The best known of them are the skin, the net, and the wedge. The skin and the wedge are supposed to have a sort of ratchet action and to permit sliding forward while preventing sliding back. The net does not pretend to any such selective property. All of them cause the snow to adhere to the ski if there is any tendency to balling, and one's ski weigh enough by themselves without carrying an extra 10 lbs. of snow under each foot.

The question of adventitious aid to ascending is nearly as controversial as the question of bindings, and is a matter of individual taste. The reason why I do not personally advocate their use is that the angle at which it is possible to ascend on bare ski is about the angle of minimum fatigue. It is clearly no use making a horizontal track and it will soon be evident that it does not pay to make a vertical one, and the ideal angle appears to me to be the angle at which the bare ski naturally hold. The skier who uses the adventitious aid can make a steeper track, but he generally has to lift his ski at every step instead of sliding it along the snow surface. This is because his adventitious aid, especially if it be icing, causes the snow to adhere to the ski. Then he not only carries himself and his

ski to the top of the mountains but he is also continually transferring masses of snow from a lower to a higher level. Anyone who has ever tried to clear a skating rink of snow will know that this is a thankless and laborious task. There is a further disadvantage mentioned later—namely, that the aids to ascent prevent a rapid descending traverse from being executed, as a means of avoiding an avalanche.

The labour of making the uphill track is considerably greater for the leader than for the climbers who follow him, but it is also possible to ascend rather more steeply when leading than is comfortable for those following. Each successive skier makes the track more solid and more slippery. The leader should therefore aim at making a track slightly less steep than the steepest track possible for him. The track should be narrow, and it should be possible to follow it without perceptibly lifting the feet, with a kind of shuffling action. The action of the small errand-boy intent on wearing out his best boots is the action to imitate. The ideal track is the one that requires the minimum expenditure of energy for a given rise. A leader who insists on going up steeper than is consistent with a continuous track makes a series of parallel marks in the snow. The result is a most unprofessional looking track, which is very difficult to follow and requires much more exertion per foot rise. One is often asked whether the run down a mountain is worth the intolerable grind up. There is no intolerable grind up, as the members of the Club know full well. There is a peculiar joy in the rhythmic motion of the ski which requires no brain effort and allows free scope for watching the beauty of the wintry scene. A strong party of skiers can accomplish expeditions in a shorter time in winter than in summer. The uphill pace remains about the same, but the downhill pace is enormously accelerated. In good condition it is easy to maintain a pace of 1,000 ft. an hour going up and from 5,000 to 6,000 ft. an hour coming down.

So much for the technique of the ascent. *The art of running down with a narrow straight track* can be learnt fairly easily. The secret of success is to run with one ski slightly in advance of the other. Put the weight on the back ski, but with the heel raised so that the pressure is transmitted through the toe. This gives a spring between the ski and the body which greatly assists in the balance. The ski blades must touch along their entire length. As to the pace which can be attained in this way with safety, it is certainly very great. Prof. Hopkinson and I made some experiments on bad snow covered with old ski-tracks and on a very gentle slope. The pace attained was

about twenty miles an hour. This pace seemed quite slow, and much greater speeds can be attained when the conditions are favourable. If a fall happens when going fast, the skier gets buried very deeply in the snow but he never seems to hurt himself.

The art of turning is more difficult to learn. There is no doubt that we are all greatly indebted to Herr Zdarsky and Mr. Rickmers for elaborating the turn known as the Alpine turn. This is really the foundation of the descent from a mountain.

It is best learnt as a development of what I call the symmetrical stem. Thus, if the skier is descending a slope straight down with a narrow track and he suddenly forces his heels apart and edges the ski inwards, he will convert his ski into a kind of snow-plough, and instead of making a track 7 ins. broad it will be 3 ft. broad. This produces an incredibly strong braking action. In order to test the amount of this action I carried out some experiments with the help of Fritz Boron, who is one of the strongest and best Swiss skiers. We roped together and both started down a steep slope without any sticks. He was to try and pull me up with a symmetrical stem. When the pace had reached about 20 miles an hour, he pulled both himself and me up in a space of about 10 ft. and left a perfect track about 2 ft. wide with some 8 in. of snow piled up on each side. If the symmetrical stem is once learnt there is no difficulty about the Alpine turn. The only difficulty in the symmetrical stem is to prevent the skis crossing. If one ski is allowed to cross and the other got out of its way, so to speak, an Alpine turn is the result. The skier traversing a slope turns downwards into the symmetrical stemming position, thereby greatly reducing his pace, and then gets out of the symmetrical stem on to the new course.

The art of stopping is important. It is sometimes necessary to stop. The easiest and most natural way is to sit down, and for most of us in emergencies it is the way adopted. However, it is not really the ideal way. The sudden stop is wanted when ski-ing in a mist. No one who has not tried it knows the weirdness of the sensation of being unable to tell the gradients of the slope in front of him. On a cloudy day without any mist the slopes are very deceptive and the slightest mist makes it impossible to tell what lies ahead. Therefore to be able to stop is essential. If running straight down a slight slope, the telemark swing may be used. This gives a sudden stop, but if the slope is steep my telemark invariably ends in sitting down. The telemark swing is the

result of extending the wheelbase as much as possible by thrusting forward one foot—say the right one—and sinking on the left foot till the skier is nearly kneeling on his left ski. This is called the telemark position, and is useful for traversing small ditches and irregularities in the snow. The extended wheelbase combined with the lowered centre of gravity makes it easier to keep the balance over an obstacle. If the weight is now thrown on to the front foot suddenly, and the skier leans inward, a very sudden stop is the result. The Christiania swing is another method of stopping.

Some skiers can jump clear of the snow and turn in the air at right angles to their previous direction. On coming to earth again a fall or a stop of some kind invariably happens.

The art of falling and getting up is important. When coming down, the skier generally finds himself after a fall with his head pointing down the slope. The first thing to remember is to avoid falling directly forward on to the ski. If this happens, the ski point may make a nasty hole in the skier's face. To get up, it is necessary first to extricate the ski from the snow and then to roll over on one's back till the ski are below one. The stick is then laid horizontally on the snow and grasped by the middle. There is then no difficulty in gaining a vertical position.

The climber ascends his mountain by a series of traverses often executed on very steep slopes and varied by crabbing up some snow gulley where the width does not permit of zigzagging.

The steepness of the snow slopes which can be crossed on ski is very surprising. I have traversed a snow slope with perfect confidence where the stick had to be driven into the snow horizontally up to the hilt at the level of the shoulder, though the snow must be in good condition for such an attempt. The steepest snow slope I have ever been on is the north face of the Ecrins, which I once descended in summer direct from the summit. I think that, given suitable conditions, this face could be traversed on ski. I have occasionally thought that certain places, even with the snow in good condition, would be safer if the ski were removed. I am referring to places where there is room for the ski horizontally, but the vertical angle appeared to be somewhat dangerously pronounced. However, after trying the same place with and without ski, I have always felt much safer with the ski on. This, I think, is due to two causes. Firstly, the climber does not sink into the snow on ski and therefore he has more control over his movements and does not have to lift his knees

E. Russell Clarke, Photo. *Swan Electric Engraving Co Ltd*

ON THE COL DU BONVIN.

up to his chin every step he takes; and secondly, the snow is much less disturbed, so that there is less danger of starting an avalanche.

The danger of starting an avalanche appears to me to be less than the danger of being caught in one. Before there is any danger of starting an avalanche, one's ski give one warning by the increased side-slip of the snow under the ski when going up. If an avalanche is started going down, the skier would probably not be carried with it. Like an aeroplane, he is constantly changing on to a fresh surface. No one of course should attempt to mountaineer in winter immediately after a heavy fall of snow, especially if the weather preceding the fall had been hot, or windy, so that the surface of the old snow was crusted and slippery. Two or three days, however, soon consolidate the snow and cause it to adhere and freeze on to the substratum. A curious experience once happened to me on a rather steep snow-slope. The weather had previously been hot and windy, and all the slopes were as crusted as could be. A heavy fall of snow followed, and was succeeded by two blazing hot days. Consequently a crust formed on the new snow before it had properly joined on to the old snow. Without any warning and without a sound I discovered myself standing in my tracks and tobogganing down the slope on an unbroken biscuit of snow about 20 ft. in diameter. Luckily the biscuit soon ceased to slide. It had left the smooth icy surface of the old snow quite bare above it. The most difficult snow to negotiate is the exceedingly crusted and wind-swept snow that is sometimes met with. Its surface feels like ice under the ski. The skier is led on to it unconsciously, because the change from good snow to this crusted kind is generally gradual and he finds himself well on it before he is aware of the fact. His obvious course is to turn round and go back on to the good snow, but this is not always so easy as might be supposed.

Turning on a steep icy slope is an operation that requires the greatest care. It is sometimes necessary to take off the inside ski and then the outside one and continue on foot till a better place is reached. A careful look-out for such places should be kept on the way down, as it is quite easy to be taken unawares, especially in a mist, and a fatal accident may result.

If the rope is required for traversing a glacier in summer, it is a hundred times more necessary in winter. In summer there is often a slight difference in colour between the snow covering a crevasse and that resting on solid ice. In winter it is absolutely impossible to tell whether one is standing over a crevasse or not. All the surface irregularities of the glacier

have disappeared in the deep mantle of winter snow. The crevasses, however, are not filled up as is often supposed; they are merely bridged over by a more or less precarious and powdery snow. It is so impossible to tell whether one is in the neighbourhood of a crevasse that those parts of a glacier with really large crevasses ought to be avoided even by a party of four on a rope. All may tread on the bridge at once and may all disappear at the same time. On a long glacier expedition in winter it is, I should say, the exception for no one to have broken into a crevasse. Hence the absolute necessity for roping. There is no difficulty about roping on the level or on the ascent, but on the descent things are apt to get rather complicated.

A party of four coming down a long slope of fast snow on a rope is generally a very amusing sight, and ought to be exhibited at the Palace Theatre on a cinematograph. The difficulty, however, disappears with practice; four good skiers can run down without much risk of falling as long as they are describing a straight course. It is the turns that provide the amusement. The leader sees a likely place in which to execute an artistic alpine turn and shouts out, 'Hi! I am going to turn!' His pace is checked and the rope between him and the next man slackens and No. 2 promptly skies on to the rope and plunges head first into the snow No. 3 then does a violent turn to avoid running his ski into the prostrate form of No. 2, and No. 4 falls over the rope of No. 3. It is generally better when running several on a rope not to proceed in one track—that is, in single file—but rather to advance more or less in line, each making separate tracks. The whole party, if its members turn simultaneously, can generally execute the manœuvre successfully. This formation is often preferable for another reason, because the skier on a steepish slope generally descends it by a traverse which is more or less the direction the crevasses take. If the skiers are traversing in line and not in file, they are less likely to be all over a given crevasse at once.

Running down on a rope is the combined figure of ski-ing and corresponds to skating round an orange. A well-executed combined turn gives the performers great satisfaction, nearly as much probably as is felt by figure-skaters who have successfully performed some difficult cull. Many a man now habitually neglects the steel blade because of the delights afforded by the wooden one, and each time he looks down from some sunny height on to the hotel below and sees the skaters on the tiny rink aimlessly darting about for all the

E. Russell Carter, Photo. *Swan Electric Engraving Co. Ltd.*

SUNRISE, LOOKING ACROSS THE RHONE VALLEY.

world like motile micrococci in the field of a microscope, he knows that he has chosen the better part.

Before ending my paper I should like to say a few words about the wonderful attraction which the Alps possess in winter, for, although they are beautiful enough in the summer-time, they are even more so during the winter months. Then they have a charm which does not exist during the summer. There is a more transparent beauty in the air, and at times it has a sort of opalescent look never seen at other seasons. I think it is due to the air being charged with extremely minute snow-crystals. This effect may be seen best just after sunrise, when the climber is more than 9,000 ft. up. When very pronounced, it produces a most beautiful optical effect. Below the sun is seen a vertical ray of great brilliance, possibly due to reflection from the myriads of snow crystals in the air. This effect can generally be observed if the weather is cold enough and the altitude be sufficient, but I have never seen any mention of it in any alpine publication. A photograph of the effect taken just after sunrise, looking across the Rhône valley towards the Dent Blanche, is found on the opposite page.

Thus the climber nears his summit—sometimes on ski, sometimes on foot. If the peak is to be traversed and the ground is unskiable, the ski must be carried on the back. Then comes the scramble along the arête, and finally the peak is reached. Snow peaks are everywhere around him, emerging from valleys full of yellow mist. While pipes are being smoked, care should be taken not to let the under-surface of the ski thaw in the sun, as this would cause them to be iced. If the snow is falling, it may be necessary to grease the ski.

Then comes the joy of the descent. The ski are given a final polish in the snow, and off the skier goes. A long traverse and an alpine turn brings him back below the summit but 1,000 ft. nearer the valley. Another turn, and swishing through the air he is on the glacier at the mountain foot. Now the rope is put on and the party traverse the glacier from side to side. The alpine turns are a source of satisfaction if successful, and of laughter if someone falls, as is generally the case. Then there is a sudden jerk on the rope which pulls everyone over. The last man has disappeared into a crevasse, with only his head and shoulders visible. The rope is pulled on gently and the point of a ski emerges and is placed in position by one of the party across the crevasse. This gives a point d'appui and the skier emerges rolling away from the crevasse with his

ski waving in the air. Perhaps a gentle slope leads up to some col where the rope can be taken off, and then comes the descent to the valley. Ten feet below the snow lies the summer path. What pity one feels for the summer climber who could at best run down the path on his mere feet!

A traverse keeping just above the tracks of the ascent, a rapid breathless turn which intersects them, places the skier on a counter-traverse which may take him thousands of yards before he need turn again. Then the slope eases off and for a while the straight run can be taken. Feet together, still and upright, he shoots down to the little plain below on which perchance is visible the roof of the highest hut. The little plain floats up to meet him, and with a swing he comes to rest, feeling that life is well worth living.

Climbing on Lliwedd.

By A. W. Andrews.

(Read before the Alpine Club April 6, 1909.)

FOR many years rock climbers in the British Isles were looked upon with much the same favour as that bestowed by the Church in the Middle Ages on the supposed possessors of heretical knowledge. Fortunately, however, for them, the mildness of modern manners prevented the employment of disciplinary repression.

I find it difficult to shake off the feeling that I am on my trial before a stern tribunal, but I have recently derived great encouragement from the fact that at a recent meeting of this club no less I think than seven members confessed, not merely that they climbed without guides, but that they belonged to climbing combinations which often went two on a rope on snow-covered glaciers.

The excuse offered for this heinous offence, that they could not get a suitable third man, seemed hardly convincing, but no storm of rebuke fell on their devoted heads; mainly, I expect, because those qualified to criticise had done the like themselves. At any rate, guideless climbers are not now outside the pale, and they certainly require no defence from me.

British rock climbers are merely guideless climbers, absorbed in trying to learn something of that part of the technique of mountaineering which has as its province the climbing of rocks. As such they are obviously harmless and necessary.

Many of us may rightly deplore the increasing habit of younger