consequences. Harrison varied these experiments with fate. He jumped from a rock-ledge on to a snow-slope to glissade and started well. His hat blew off. Involuntarily he raised his hand from his axe to clutch it. With the brake off, his pace quickened. A big stone lay in his way. He jumped, cleared the stone, but lost his axe and his balance, then whirled round and round, faster and faster down the slope. By luck he got his feet foremost and pulled up close to the rocks at the bottom. Some bruises and a finger cut to the bone were light punishments for all this. We met again round the tea-things at 4 P.M.

In the strength of that tea we walked with pleasure three hours to Stein: three hours that might have been four and a weariness without tea.

As we crossed the Susten Pass, a gun-shot gave the official signal to a search-party of local guides to retire—they had found our tracks and watched the base of the mountain all day. A wire to Meiringen stopped the departure of a strong relief column: its labours were limited to drinking our health.

All visitors at the Stein Inn considerately refrained from leaving the dining-room, but the good landlady and her maids stood in line to welcome us: 'We thought you were dead! We knew you had nothing to eat. We thought you were dead.' Thanks to the tea, we were not even dead tired.

The route up is certainly interesting, and probably more direct than route 4 of the guide. Under good conditions the complete ascent of the N.W. buttress should be very attractive. The best route down is a question to consider. Our route was long and without much climbing interest.

Indoor Training for Climbers.

By R. P. COCKBURN, M.D.

(Read before the Alpine Club, April 9, 1912.)

BEFORE success can be attained in any of the several branches of athletics, a certain qualifying examination as it were, common to them all, has to be passed. The entrance examination requires a certain measure of health, a certain standard of general muscular development, a certain rapidity

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of co-ordination between the different organs and limbs, a certain degree of hardness, endurance, courage, and perseverance. These are necessary for all athletics. After passing this qualifying examination the student can train himself for any special subject, climbing, rowing, or what not. There is thus a General and Special Training to be considered.

It is difficult by indoor work alone to acquire the health and general development, etc., necessary to pass the qualifying examination, but certain of the special subjects can be well practised in one's bedroom or bathroom; that is to say, the muscles necessary for climbing work can be developed to a great extent indoors. Of course, there is nothing like practising the thing itself. There is no training for climbing like climbing. No one would train in his bathroom who could get to Cumberland, or practise golf strokes in a room if he could get out on to the links. Most men, however, are tied and bound by a chain of duties which compels them to exercise at home or not at all. Some men are so blessed by the gods that they require very little exercise to keep in good condition. Their muscles remain hard and they are able to undergo great exertions with comparatively short training. Others get soft easily. They cannot get into training quickly, and need prolonged preparation before going out to Switzerland. Advancing years, it is to be feared, tend to place all of us in this category. Everyone has a certain reserve of energy which he can draw upon in an emergency which enables him to perform quite unexpectedly surprising feats of agility and strength (under the stimulus, for instance, of a mad bull or a fire), and one is apt to be misled into overestimating one's capacities in consequence; it should therefore be noted that this reserve can only be tapped by strong emotions—that in the performance of his feats the individual may strain himself seriously—that he cannot execute unfamiliar movements with accuracy, and that this reserve is not easily replenished. Training, of course, enables us to enlarge this reserve of energy, to tap it and to replenish it easily and quickly and to prevent strain or undue fatigue while using it.

There are different sorts or qualities of energy. We may take as two examples that of the ox and that displayed by the tiger. The former has great strength, patience and endurance, but lacks quickness, and especially the power of making sudden or small movements and of getting into his stride rapidly.

The tiger has his energy stored up in the most explosive form available for instant use. The spring of a tiger—a standing jump—is a wonderful example of what can be done with nerve

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energy. Man can, with training, acquire some of the quickness of the felidae combined with oxlike endurance and strength. Extreme rapidity is seldom required by climbers, but when it is wanted it is needed very badly, and should therefore be practised during training.

Before going any further, in order to understand the rationale of training it is necessary to glance at the physiology of muscular action.

The ordinary view of a movement is that it is simply a question of muscles, but a muscle fibre left to itself is a poor thing. Separated from its nerve-cell it cannot move, but lies inert and soon degenerates. In speaking of a muscle, then, we really mean a nerve-muscle combination. The nerve-cells control all the activities of the body. They are for greater efficiency of working grouped together in variously shaped areas. On the surface of the brain, where lie the cells which have to do with muscular movements, they are arranged in groups known as 'centres.' One centre on the left side of the brain superintends the movements of the toes of the right foot, another those of the foot itself, another those of the leg and thigh. These centres placed close together, without any sharp line of demarcation between them, form the centre for the right leg. The arms, trunk, head, etc., are provided for in a similar way. The cells are equipped with numerous branching filaments or 'processes,' by one of which they communicate with their particular muscles (*i.e.* in the case of the muscle-controlling or 'motor' cells), by the others with their neighbours, and indirectly with all the other cells in the body. By this interlacing network of communications stimuli which affect primarily one cell may travel on to its neighbours and, if sufficiently powerful or prolonged, may spread to all the cells in the nervous system : a fact of the utmost importance. The irritation, for instance, of one point of the brain's surface may spread suddenly to the rest and cause a general convulsive fit. Again, fatigue of the tiny group of cells which have to do with the minute internal muscles of the eyeballs may in cases of severe eye-strain spread to the whole brain and incapacitate a man from using the full strength of, say, his legs. On the other hand, refreshment of one group may refresh all the others. The cells which have to do with the appreciation of music are stimulated by a band, and the dragging legs of the weary soldier step out with renewed vigour.

The nerve-cells tire sooner than the muscle fibres, so that when a muscle is worked to a standstill, its inability to do further

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work is due to the exhaustion of its guiding nerve-cell, not to exhaustion of the muscle itself. These are points of practical importance. A tired muscle can be refreshed only by rest, but tired nerve-cells can be refreshed in several ways, because many other things besides fatigue due to exertion tire them. Monotony, depressing thoughts, and a number of other factors impoverish these sensitive structures.

The muscles we have to do with particularly are those of the heart, the blood-vessels, and of the trunk and limbs, etc.

The heart accommodates its activities to the demands of the body for more or less blood. It responds to work as do all the other muscles, and grows stronger and more vigorous with exercises, provided that they are not too strenuous. It must be remarked that the heart may suffer serious or even permanent damage from exertions which are not felt to be excessive by the rest of the body.

In the walls of the blood-vessels are circular muscle fibres which control the calibre of the vessel. When more blood is sent to a part these muscles relax to allow of its passage contracting again when the stream becomes smaller. If they do not allow the vessel to expand quickly enough, unnecessary strain is thrown on the heart and the blood-pressure rises. A slight increase in blood-pressure acts as a stimulant, but too great a pressure is a serious disadvantage. Exposure to wind is also said to increase the blood-pressure, thus perhaps accounting for the invigorating effects produced by such exposure. The pressure is also raised temporarily by food. With increasing years the vessels become less elastic and slower in their response, so it is especially important for the no-longer-very-young climber to take things quietly after meals. If the demand for more blood is made gradually, the vessels accustom themselves to the necessary extent without causing temporary breathlessness.

The phenomenon known as 'Getting one's second wind' may, it has been suggested, be due to the temporary reluctance of the vessels to dilate, the result being great breathlessness. When they do expand a feeling of relief is experienced.

The 'Voluntary' muscles are attached to the skeleton, and are at first moved instinctively and unconsciously as in young infants. By degrees, with the growth of volition, they are or may be set in motion by the will consciously.

It is difficult to realise the complexity of apparently simple movements. If I wish, for instance, to raise my left knee, my will (how, we do not as yet know) sets in motion the motor

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centre for that leg. The muscles which elevate the knee contract, and the knee is raised. If these muscles alone were used the knee would come up with unnecessary violence; therefore the muscles which prevent the raising of the knee are also put into action less vigorously, but sufficiently to control the former. The balance of the body is disturbed by the movement of the leg, therefore the trunk, head, and perhaps arms are moved backwards and towards the opposite side. The other leg at the same time is braced up and held firmly to meet the increased strain on it. On this present occasion consciousness also plays a part, as I am conscious of raising my knee. Successfully to carry out even this simple manœuvre it is necessary that the *timing* of the successive muscular acts should be perfect. If the trunk is drawn back before the leg comes up, or is allowed to come forward too soon, or if the various groups of muscles involved act irregularly, the knee will not be raised quietly and a loss of balance will result.

Imperfect timing of the muscles concerned in speech has a great deal to do with stammering; inaccurate timing of the muscles of locomotion sometimes leads to curious sudden stumbles and trippings.

Consciousness may or may not be involved in the execution of movements. It is remarkable that any action should be possible without the direct personal supervision of the conscious intellect. It is made possible by the subdivision of the nerve centres into higher and lower. The workings of the higher ones are attended usually by consciousness, those of the lower usually are not. The lower carry on the purely automatic functions (breathing, digestion, etc.) instinctively, but can also be trained to execute almost any actions.

Consciousness and all it implies is a very wonderful thing, and I would not say a disparaging word of anything of which we are so justly proud, but it must be confessed that unconscious movements are much to be preferred to conscious ones. For the first training of the limbs in learning new combinations of movements attention is necessary, but, once learned and sufficiently practised, they can be carried out by the lower centres unconsciously, and more effectually thus:

The higher the centre, or the more highly developed the function of a cell, the sooner it tires. Prolonged consciousness of anything, of movements perhaps especially, leads quickly to fatigue, and fatigue, as we have said, tends to slowness and uncertainty of action. The greater the complexity of the movements the sooner does consciousness of them lead to exhaustion.

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Fatigue, again, is induced apart from exertion by depressing emotions such as shock, fright, or grief. A man who has seen a friend injured or perhaps killed, or who has all but precipitated a disaster himself, will exhibit symptoms of profound fatigue. His consciousness is occupied by what has just happened, and if he is called upon to do anything that he cannot do automatically he will most likely be unable to comply for a time at least. He might, however, be able to perform an automatic act, *i.e.* he might be able to manage a difficult bit of balancing if balancing came automatically, but not otherwise.

If the task is further complicated by one's having to do something besides 'passive balancing' (by that I mean standing or walking on a narrow ridge or walking in steps cut by someone else, and so on), if one has to cut steps oneself, or look about for hand-holds, etc., the difficulties in the way of conscious co-ordination grow so great that a breakdown is to be expected. If the balancing and the step-cutting can be done automatically, the principal factors in the production of fatigue and embarrassment under these conditions will have been removed. Now, there is only one way in which movements become automatic, and that is by being performed very frequently. Many men are a source of anxiety to their friends for perhaps half the time they are climbing, because they have not practised balancing till they get to the mountains, and do not pick it up quickly. They are uncertain and not to be depended upon in steps or in difficult places. My contention is that the most complicated acts involving balancing can be practised indoors.

The importance of familiarising oneself with balancing lies in the fact that a breakdown in this particular thing leads to very widespread disturbance of the whole body. A man who loses his balance throws himself into extraordinary attitudes. His face is contorted, his mouth opens, the eyes stare, he flings his arms about, twists his trunk and strains his legs in the desperate attempt to recover himself. Moreover, he experiences a great loss of confidence. Anything which can avert such a trying state of affairs is worth practising.

INDOOR EXERCISES:—(1) GENERAL; (2) SPECIAL.

One of the best indoor exercises is the 'Running Exercise.' It is really marking time at the double. Raise the knees alternately to the level of the hips at a walking pace at first, and then at a run. The toes should be pointed downwards as the knees are raised. Do this twenty or thirty times with

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each leg to begin with, gradually increasing the number to 400 or 500. I think that 500 times with each leg is about or a little more than equal to a half-mile run.

The 'Full Knees Bend' with arms raised is also a good one. With the heels together and the toes turned out, rise on the toes and bend the knees till the thighs touch the calves, raising the arms to the horizontal or above the head. The body should be kept erect the while. Jumping in the air while in this position improves the exercise. This should be done ten to thirty times without the jump, half or less than half that number with the jump.

Skipping is also a splendid exercise, but terribly destructive to ornaments and electric lights. It should be done about the same number of times as the 'Running Exercise.'

The Highland Fling is also a first-class exercise. A number of other general exercises will be found in any manual.

The following are some exercises particularly useful for climbers :—

FOR HAND-HOLDS.

Begin with 'Grips,' such as Sandow's grip dumb-bells, Terry's Grip, or Clements'. The latter is perhaps the most comfortable to use. Twenty to forty grips would be an average number of times to work up to.

Next in difficulty are 'Pull Ups' on a bar or trapeze. The 'over-grip' should be taken, *i.e.* with the backs of the hands towards the face. Five to twenty times is enough. Harder still is the same exercise performed on a door five to ten times. N.B.—Fix a wedge under the door to keep it from swinging and also to spare the hinges.

FOR CRACKS AND NARROW CHIMNEYS.

With the body at full length drop on to the hands and toes. Without moving the hands bring the knees together, up to the chest and back again ten to twenty times.

On the hands and toes as before, let the body sink between the arms till the nose nearly touches the floor and rise again.

Lying on the back raise the legs (alternately at first) till they are vertical. After a time both legs should be raised together.

Each of these last may be done ten to thirty times. So should the 'Sitting-up Exercise.' Lying on the back, come up slowly to a sitting posture, and lie down again slowly.

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Rise on the trapeze to the full length of the arms, sink slowly till the elbows, are level with the shoulders, and rise again five to twenty times.

I have spoken of a trapeze. It is quite easy to fix up a light trapeze in any room at the top of the house. If the weight is distributed over four joists, one is quite safe. The trapeze and fixing cost me one pound, and I had the apparatus in use for several years.

Plenty of useful exercises are to be found in any manual of Swedish Exercises; the ones I have alluded to are only samples. All-round development of the body should be aimed at, paying particular attention to the above.

BALANCING.

In practising exercises, *e.g.* with clubs or dumb-bells, in the usual way one stands with the toes turned out and with the feet apart, so that one's base is—sideways—some sixteen to twenty inches wide. Now this is an attitude seldom taken up on a mountain. The usual position in which one finds oneself is with the feet one more or less in front of the other. In traversing slopes the feet are often strictly behind one another. The base of support here is the width of the feet and often less. One should therefore do as many of one's exercises as possible in this position. Choose a line on the floor, place the feet on it one behind the other, and standing thus do the Swedish dumb-bell or other exercises in the ordinary way. Practise with the right and left feet in front alternately and resist the temptation to turn the toes out. Indian clubs test one's balance more perhaps than anything else. The use of them in this position is capital practice.

Still more useful will be found a little apparatus which I have devised to represent an ice slope. It consists of two boards three feet long by nine or ten inches wide, and about one inch thick, hinged together along one side and laid on the ground like an inverted V. To prevent the boards from collapsing adjustable straps are fixed to the ends. On one side are screwed four blocks of wood, two of them some seven inches long and three wide; the other two about four inches long by two wide. The former represent comfortable steps; the latter, steps quickly cut and more difficult to balance on.

Fix up the apparatus, stand on two of the blocks, and with an axe pretend to cut steps at, above, and below the level of the feet. Do this with the right and left feet alternately in front.

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Standing on the steps do the ordinary Swedish club and other exercises.

The other side of the apparatus is covered with a sheet of rubber and represents a hillside. Ordinary exercises practised on this slope strengthen the ankles wonderfully.

MORAINE EXERCISE.

This exercise I have devised, too, as a means of practising the loss and recovery of balance.

Procure about fourteen feet of 4 by 2 inch wood. Saw into pieces as follows :—Four pieces twelve inches long ; ten, eight inches long, and ten of four inches. Of the 12-inch pieces leave two untouched ; all the others divide diagonally. Stand the two undivided ones on their ends the length of an ice axe apart, and lay an axe on them. This gives something to jump over. Scatter the rest of the blocks on either side of the axe in different positions. Standing on the blocks on one side, jump over the axe on to those on the other. The longer blocks are fairly steady, the shorter ones ' tip up ' when one jumps on to them. The rule should be that when the balance is lost one should not touch the floor at all but should recover one's balance by stepping on to other blocks. Having recovered it, jump back again and repeat *ad lib.* The blocks represent to some extent the loose stones of a moraine. In conclusion, may I warn you against over-development of limited groups of muscles ? Such muscles are slow in action, prone to stiffness, and tend to undergo fatty degeneration.

THE BRENVA FACE OF MONT BLANC.

By J. P. FARRAR.

It may be interesting to record here all the ascents by the magnificent Brenva route, one of the greatest ice-climbs in the Alps, so far as I can trace them.

1. July 15, 1865.—F. Walker, Senr. (then aged 59), H. Walker, A. W. Moore, George Mathews. Guides—Melchior and Jakob Anderegg. Cf. ' A.J.' ii. 369 *seq.*, and ' The Alps in 1864,' 378 *seq.* (Kennedy's edition.) The account of the climb is by Mr. Moore. There are few Alpine narratives to compare to this. For accuracy of observation, topographical clearness, and general interest it is

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