SOME NOTES ON THE PHYSIOLOGY OF MOUNTAINEERING.

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Mountaineering is the noblest of sports; it is the most perfect of all recreations, admirably adapted for repairing and building up the much abused organs of the human frame. It appeals specially to the soot-begrimed dweller in cities, where, for the most part of the year, his poor body is cooped up in dingy factory or workshop, where his lungs are constantly filled with air that is none of the purest, and his whole system is continually kept under such a high strain that the least irregularity completely upsets the whole machinery. No wonder then that to the city youth who has once known the spring of the heather, or the highland lad whom business has called south, each successive holiday season, aye, even the short week-ends, only serve as a fresh stimulus to draw him back again and again, to the same old hills, the same quiet glens. Seldom indeed are nature's organs of locomotion called upon by the city man to do any degree of work at all; far handier is it for him to jump on a passing car, which for the merest trifle will land him at his door without entailing the least exertion.

The benefits derived from mountaineering are twofold, partly physical and partly mental. Physically, of course, the muscles play the most important part, since they are the instruments by which the body is raised from a lower to a higher level. In ascending a steep mountain side a great amount of extra work is thrown upon the muscles, principally those of the legs. This extra work demanded of these organs means that they will require a greater supply of nourishment, while at the same time, the waste materials that they throw off will also be increased. The first of these is supplied by the blood, and the second is passed into, and carried off by that same stream. The blood therefore will contain

a greater amount of impurities, is more venous, than normally, and this condition must be remedied.

Now there is a wonderful mechanism here called into play. Everyone knows that sudden and severe exercise makes us out of breath, due to the impure blood being thrown onwards to the heart and lungs more rapidly than these latter can at first transmit it. Hence, in order that the blood may get rid of its waste carbonic acid gas, and receive a fresh supply of oxygen, with such rapidity that the supply shall be equal to the demand, it is evident that the respirations must be increased; and this is exactly what happens. When the arterial blood that is deficient in oxygen reaches the brain, it so influences a particular part of it—the respiratory centre—that quicker and more powerful influences are sent out, along the particular nerves, and increase the respiratory movements, both in strength and in frequency.

As stated above, muscular exercise has an important bearing on the circulation. The hurrying movements of the blood with its increased waste are brought about by the action of the valves in the veins; these prevent the blood from being forced backwards by the pressure of the rapidly contracting muscles, and so this extra force is used in sending the impure blood faster to the heart, where, if the existing conditions were not altered, it would accumulate and cause a complete stoppage. But here, as elsewhere, we find that provision has been made for any such emergency, and just as fast as the blood reaches the heart, so fast that organ transmits it. Thus when a larger quantity of blood than usual finds its way to the heart, part of the inhibitory influence, the nerves that regulate, or keep in check, the beatings of the heart, is removed, and the unconstrained organ "thumps" vigorously against the chest wall as it pumps the impure blood outwards with increased speed to that great purifying centre, the lungs. Here the blood gives up most of its waste material—carbonic acid gas, from the hard-working muscles—and here it receives in return, part of its life-giving property—a fresh supply of oxygen—which it conveys to all parts of the body.

So we see that the troublesome "peching" and increased

thudding of the heart, with which we are all more or less afflicted, according to our "fitness," when ascending a steep slope, is, after all, simply nature's method of renewing the impoverished blood, and thereby enabling us to continue the exertion. At the same time, this is one of the best possible lung exercises, for just as oft-repeated exercise of any muscle increases it in size and power, so oft-repeated increased respirations also cause an increase both in the size and capacity, not only of the lungs, but of the thoracic cavity as well. Thus we get a broadening and deepening of the chest, and a strengthening of the lung tissue, both most beneficial means of warding off disease, especially pulmonary consumption. Now, in man at least, as most of the breathing is of the abdominal type—the thoracic cavity being increased in size by the descent of the diaphragm, or muscular partition between the chest and abdomen—it is plain that every time we take a full inspiration, the abdominal organs—stomach, intestines, etc.,—are pushed out of place, evidenced by the swelling of the belly ; with expiration, however, they return to their normal position. Can it be doubted that this increase in the churning motions of these organs has a decided, a beneficial effect upon digestion? I think not.

We have seen that an additional amount of nutriment—in this case, the free and unpolluted air (oxygen) of the mountains—is pumped into the blood stream, and as the blood is the vehicle by which nourishment is carried to the tissues and waste material taken from them, it follows I think, that the whole body will be greatly benefited thereby. Besides oxygen, the blood also supplies the tissues with all the other elements necessary for their support and vital activity, and these, of course, are derived primarily from the food.

I think it is a generally accepted fact among mountaineers that the muscles of mastication are also greatly benefited by a day on the hills, at least judging from the size of ruck-sack which some members of the climbing fraternity hawk about with them. No doubt it is the keenness of the mountain air, together with the extra strain thrown upon the different organs of the body, that largely accounts for this "mountain appetite."

There is another important function brought about by the hard working muscles. It is well known that the blood issuing from a rapidly contracting muscle is much warmer than that which enters it. How is this accounted for? It is the result of the chemical change—oxidation, or the union of the oxygen brought by the blood with the tissue elements—that goes on in a living muscle; and as the temperature of the body cannot be raised much above the normal without producing injurious effects, it is evident that this additional amount of heat must be got rid of. The skin with its numerous sweat glands is the principal medium by which the body throws off its extra warmth. The secretion of sweat is constantly going on, but the amount is so small that it is at once evaporated, and goes off into the atmosphere without our ever being aware of its presence. But if we are in a very warm atmosphere, or doing great muscular work, the blood-vessels immediately beneath the skin get flushed with blood, and we feel intolerably warm. As a result of this great blood supply to the skin there is an increase in the functional activity of the sweat glands, showing itself by profuse perspiration which bathes the surface of the body; and it is principally by the rapid evaporation of this sweat that the body gets rid of its extra heat, a little no doubt being removed by other means—radiation, the lungs, etc. Of course our sensations of heat and cold are based only on the cutaneous blood supply; if there is a large supply of blood to the skin, we feel warm; and this sense of warmth is due to the action of this warm blood on the sensory nerve-endings in the skin. But on the other hand, if the capillaries on the surface of the body are contracted, and nearly empty, we have a feeling of cold, caused by the action of the external air on these same peripheral nerve-endings. Thus our "feeling" is no real guide to the body temperature, which in health is always about the same, no matter how hot or how cold we "feel."

Now from the foregoing, I think we can adduce some points of practical interest. First of all we have the beneficial effect on the glands themselves, stimulating them to action;

then there is the mechanical opening and cleansing of their ducts—the pores of the skin—by the increased secretion. We also find that the sweat carries with it many noxious excretions from the body, and if these were allowed to accumulate and dry on the surface, trouble would ultimately follow. But with every movement the clothes are rubbed against the skin, and so these impurities, along with the excess sweat, are constantly being absorbed and removed; and in addition, this gentle friction has a stimulating effect upon the cutaneous vessels and nerves. It is this which explains to a certain extent the pleasant glow that is felt after a good sweat followed by a vigorous rubbing with a coarse towel; and hence the benefit of wearing woollen articles next the skin.

Now when we consider the large amount of water—sweat being composed of 98 per cent of water—which the body throws off in this way, especially during active exercise, it is natural I think that we should ask ourselves whence comes all this fluid. A little of it, a very little indeed, is produced in the body by the metabolism of the tissues—the oxidation of the hydrogen in the food—but by far the greater part must be taken into the body as fluid, along with the food-stuffs.

The man who has climbed a steep hillside in July, knows what it is to sweat, just as much as the blacksmith does, and as a direct result of this great loss of fluid from the body, he experiences the sensation termed thirst. Thirst is a peculiar sensation referred to the back of the mouth and throat, and is simply the cry of the system for water—more water. No animal can live long without that precious fluid, yet we find individuals who ignore this demand altogether, and try to satisfy their shrivelled up tissues with acid drops, raisins, etc.; needless to say nature "has" them in the end, for we can't cheat nature.

As a proof that it is the system in general, and not simply the local area at the back of the mouth that is involved in severe thirst, we have only to notice the extreme degree of thirst experienced after any great withdrawal of fluid from the body, the wounded soldier for instance, whose sole cry is

for water, wherewith to replace that more precious fluid which he has lost. A more convincing proof than that even is the fact that in the relief of thirst it is not at all necessary that the liquid be taken by the mouth; the thirst can be equally well relieved by injection into the circulation direct —as is done after any great loss of blood, transfusion—or into the bowel, in which case it is absorbed into the blood. Of course the chronic thirst of the habitual toper is quite another matter, and one which does not concern us here; but we must say just a word as to the use of alcohol.

In the writer's humble opinion this is a quite unnecessary addition to the mountaineer's lunch bag, especially for the purpose for which it is usually carried—fatigue or cold. To give brandy to a person who is utterly tired out, is about the worst thing one can possibly do. What he wants is food, and that if possible warm; hot cocoa or beef-juice is admirable.

And now as to the climber who has got thoroughly soaked and stands shivering behind the cairn or in the lee of some friendly rock, sipping at the contents of his flask, in the vain endeavour to warm himself. In this we have an example of the very popular fallacy that the ingestion of spirits puts heat into the body. Why! it does the very opposite; it throws warmth out of the body, and that at a much faster rate than it can be manufactured.

One of the first effects of alcohol on the system, after it has entered the circulation, is to dilate the small blood-vessels of the skin, and so send more warm blood to the surface. This is the heating effect that the alcoholist speaks about; but let us look at the facts a little more closely.

It is well known that the blood in its passage through the capillaries of the skin gets considerably lowered in temperature, as the atmosphere, in this country at least, is generally at a lower degree than the blood; in fact, as we explained before, it is principally by this means that the regular body temperature is maintained. Now it is evident that when a healthy person is cold and shivering, the blood-vessels on the surface of his body will be contracted and contain very little blood, the organism simply doing its best to keep all the heat

it possibly can. What then will be the result if in these circumstances we dilate these superficial vessels and so allow the warm blood to flow to the surface, and be acted upon by the cold air? Plainly this, I think, the individual will have a feeling of great warmth, due to the hot blood circulating in his skin, but as we have seen, this is utterly fallacious, for from the very fact of his "feeling" warm he is actually cooling the whole volume of blood in his body. Under these circumstances again, the best thing is warm fluid nourishment, but as this will seldom be obtainable at the time, the next best thing is movement; keep on the move and so manufacture heat—by the contraction of the muscles—though it be only "marking time" or trotting round the cairn.

I think we have also good reason to believe that the direct rays of the sun exert a beneficial influence on the skin; contrast the rosy-cheeked children of the country who are constantly in the sunlight, with the sickly pale-skinned little ones from any of the back lanes or alleys of our crowded cities. There is no doubt, however, that a large part of this is due to the fresh air and more wholesome food, but it is equally true that the bright sunlight also plays a not small part.

It will thus be seen that the good to be obtained from these excursions among the hills would be very limited indeed were it not for the purity of the air, the slightly larger percentage of oxygen with its traces of ozone, and the entire absence of bacteria and all the foul and offensive gases with which the atmosphere of our towns is continually laden.

"Fresh air and sunlight, these are the great natural germicides, they provide a prevention which will do away with the need for the cure, now unhappily so often sought in vain, in an open air treatment."

"It is from the influence of the pure air and sunlight on the blood, and through it on all the other tissues of the body, and *chiefly the nervous*, that the good results in mountaineering are obtained."

Now as to the effects on the senses. There is not the least doubt but that the receptive organs of special sense—

the eye, the ear, and the nose—are beneficially affected during a sojourn among the mountains.

Taking the sense of sight first; the man who works all day at at a desk or in a confined space has his eyes constantly fixed on near objects, and so is continually using his mechanism of accommodation. Is it to be wondered at then that the small muscles and ligaments that preside over this apparatus soon get tired? Notice the relief experienced whenever the eyes are turned to distant objects. When an individual is on the hills or in the open his eyes are more or less constantly turned to distant scenes,

"The blue hills that are far away,"

and his optical apparatus enjoys a day of rest and relaxation.

The auditory organ is affected in much the same way. The silence of the hills in contrast to the noise and bustle of the busy street brings a much needed rest to another part of our brain. And here again it is that the mountaineer stands almost alone, for where can we find the same peace and quiet, the same calm and repose that is found on the mountain tops?

It is also true that the sense of smell is much more keen in the fresh and exhilarating air of the country, than in the stagnant and polluted media in which we live in towns. For here in the city our olfactory organs are considerably blunted in their function, owing to the continual breathing of a stale and stuffy atmosphere. This is well shown in persons in a crowded room, who may be quite oblivious to the foulness of the air, until they go out for "a breath of fresh air" and come in again; then, and only then do they notice the stuffiness. Now on the mountains we are far removed from all sources of pollution, nothing is here but the genuine article laden with the fragrance of the heath and brake, or the resinous odour of the pines, now so much sought after by people with pulmonary troubles.

To the active brain worker there is no more profitable occupation than a ramble among the mountains; here his thoughts are completely severed from all their ordinary every-day associations, and here he is brought face to face

with all the varied and wonderful works of nature: it may be the sight of a flower

"A wee modest crimson-tipped flower,"

the cry of a bird, the roar of a cataract, or the movements of a large herd of deer that attract the attention; but certain it is that every one of them supplies food for a line of thought that is far removed from the channels of everyday life, into which his tired and overwrought brain has been ploughed. And if the brain, the great governor of all, is benefited, surely it is but natural to expect that every other organ, every part of every organ, will also participate.

As a final proof of the general good to the economy from these excursions, I may mention the enormous, the almost incredible distances one may travel among these mountain fastnesses, without the least feeling of fatigue.

In conclusion, then, provided the individual is in a fair state of health, and not too much given over to laziness or luxury, I can boldly assert that there is nothing better than hill-climbing for bringing back the blush of health to the faded cheek; and if the person has a knowledge of any of the natural sciences—botany, geology, etc.—the pleasure derivable from such excursions will be added to tenfold.