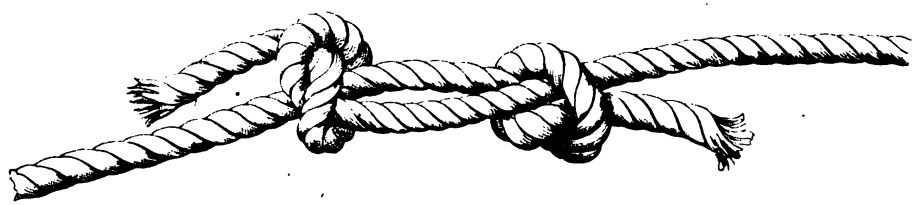
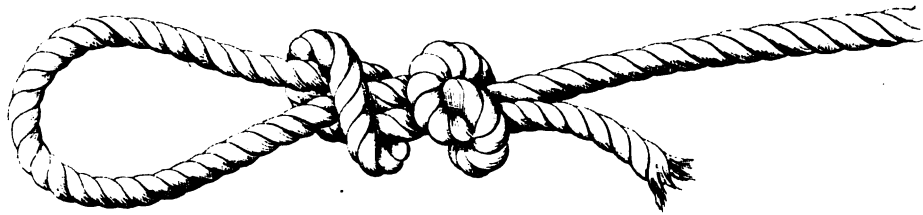


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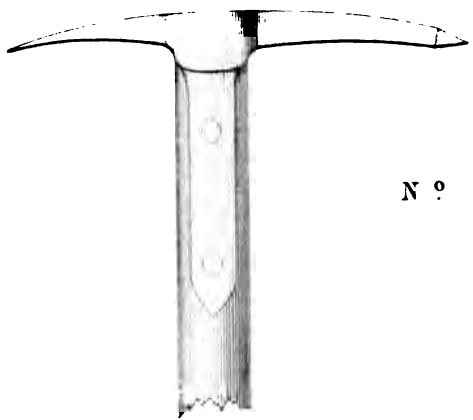


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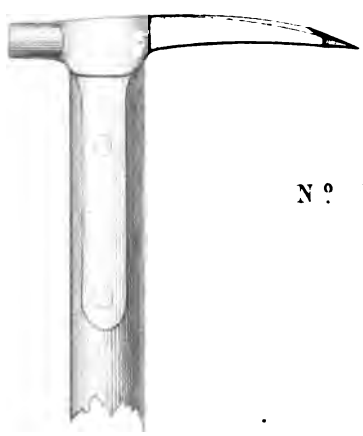


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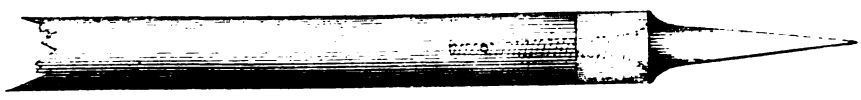
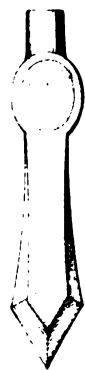




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Nº 1.



THE
ALPINE JOURNAL.

SEPTEMBER 1864.

REPORT OF THE SPECIAL COMMITTEE ON ROPES, AXES,
AND ALPENSTOCKS. Read before the Alpine Club on
July 5, 1864.

[*.* In May last the Committee of the Alpine Club invited the members to send to the Club-rooms for exhibition any specimens of axes and ropes which they might think worthy of notice. A large number of different axes being thus collected, opportunity was afforded of carefully comparing their various qualities. A committee was specially appointed to discover by experiment the kind of rope best suited for alpine purposes, and to consider in detail all the conditions to be fulfilled in the construction of an ice-axe. The report presented by this committee was adopted by the Club and ordered to be circulated among all its members, and we have thought it probable that most readers of the Alpine Journal would be to some extent interested in the questions discussed in it. This report has therefore been inserted in the present number, in the hope that the information contained in it may prove more widely useful than if it had remained in exclusively private circulation.]

MR. PRESIDENT AND GENTLEMEN,

In the REPORT which we now have the honour to present to the Club, we have endeavoured to state what kinds of ROPES, AXES, and ALPENSTOCKS will be found most safe and useful for mountain work.

It has seemed to us that it did not fall within our province to express an opinion as to the particular circumstances under which the rope should or should not be used; whether it is ever productive rather of danger than safety; and whether it is desirable that every traveller of a party should be provided with an axe.

We have simply attempted, therefore, to lay before the Club the result of our enquiries as to the material, mode of construction, and form of these important alpine accoutrements.

Ropes.

As to the facts which it was necessary to ascertain with regard to ropes, there can be, we presume, very little difference of opinion: we had only to determine what is the strongest kind of rope which is light enough to be carried about.

To solve, however, this problem, apparently so simple, we found it requisite to make a large number of experiments, the nature and result of which we propose now to state.

It appeared to us that we should best determine what sort of rope is most suited for mountain expeditions by finding out which would best sustain, not a steady and gradual, but a sudden and violent strain. Most of the good light rope sold in London will support a dead weight far greater than any which it is ever likely to have to sustain in the Alps; but in estimating its strength it is always assumed that the strain will be gradually applied. The alpine traveller's rope, on the contrary, if tried at all, will have to resist a sudden jerk, which may be a very violent one: and it is against this danger that the most careful precautions should be taken, as some lamentable accidents too clearly show.

We have therefore endeavoured to ascertain what ropes will best stand the sharp jerk which would be caused by a man falling suddenly into a crevasse, or down an ice-slope: and on this subject we can now lay before the Club the result of nearly a hundred experiments, made with various kinds of rope purchased of the best London makers.

We considered that the least weight with which it was practically useful to test ropes was twelve stone, as representing the average weight of a light man with his whole alpine equipment. In the preliminary experiments, therefore, all ropes were rejected which did not support the strain produced by twelve stone falling five feet. Under this trial, all those plaited ropes which are generally supposed to be so strong, and many most carefully-made twisted ropes, gave way in such a manner

as was very startling to some of our number, who had been in the habit of using these treacherous cords with perfect and most unfounded confidence.

Only four ropes passed successfully through this trial; these were all made by Messrs. Buckingham and Sons, of 33 Broad Street, Bloomsbury, and can be procured only of them.

We confined our further experiments to these ropes, one of which failed under severer tests, while the remaining three, made respectively of Manilla hemp, Italian hemp, and flax, proved so nearly equal in strength that it may fairly be doubted which is on the whole to be preferred.

Each of these three ropes will bear twelve stone falling ten feet, and fourteen stone falling eight feet; and it may be useful to say that the strain upon a rope loaded with a weight of fourteen stone, and suddenly checked after a fall of eight feet, is nearly equal to that which is caused by a dead weight of two tons. None of these ropes, however, will bear a weight of fourteen stone falling ten feet; and the result of our experiments is, that no rope can be made, whether of hemp, flax, or silk, which is strong enough to bear that strain, and yet light enough to be portable. We believe that these ropes, which weigh about three quarters of an ounce to the foot, are the heaviest which can be conveniently carried about in the Alps.

We append a statement of the respective merits of the three kinds, all of which are now made by Messrs. Buckingham expressly for the Club, and marked by a *red* worsted thread twisted in with the strands:—

No. 1. MANILLA HEMP.

Weight of 20 yards, 44 oz.

Advantages.

Is softer and more pliable than 2. Is more elastic than 2 and 3.

When wet, is far more pleasant to handle than 2 and 3.

Disadvantages.

Has a tendency to wear and fray at a knot.

No. 2. ITALIAN HEMP.

Weight of 20 yards, 43 oz.

Advantages.

Is less bulky than 1 and 3. Is harder, and will probably wear best, being least likely to cut against rocks.

Disadvantages.

Is much more stiff and difficult to untie than 1 and 3. When wet, is very disagreeable to handle, and is apt to kink.

No. 3. FLAX.

Weight of 20 yards, 44 oz.

Advantages.

When dry, is softer, more pliable, and easier to handle than 1 and 2, and will probably wear better than 1.

Disadvantages.

When wet, becomes decidedly somewhat weaker, and is nearly as disagreeable to handle as 2.

As it is a very desirable thing that ropes intended for the Alps should, if possible, be made waterproof, we enquired of several makers as to the possibility of covering or saturating the rope with a waterproof mixture. They all informed us that any kind of waterproofing is highly injurious to either flax or hemp. Silk, however, becomes stronger by being made waterproof in the ordinary way.

While we were making our experiments upon the strength of ropes, we took the opportunity of observing what effect was produced by different kinds of knots upon the rope, and how far they affected its strength and tenacity. In consequence of these observations, we made some special experiments upon knotted ropes, and we are inclined to believe that it may be useful to many Members to inform them of the results.

The results we have obtained from our experiments upon knots are not such as to enable us to make a detailed report, or to add any information to that already in the possession of any man who has been accustomed to handle ropes. We are only enabled to state, positively, one or two important facts, of which many travellers and guides appear to be strangely ignorant.

There can be no doubt that every knot in a rope weakens its power of resisting a sudden jerking strain. How great a loss of strength results from a knot we cannot undertake to estimate, but that the loss is a very serious one the following statement will show:—These ropes, which we report will resist the strain of fourteen stone falling eight feet, will *not* resist it if there is a knot in any one of them; or even if the knots used in attaching them to the point of support, or to the weights, be roughly or carelessly made. The rope in these cases breaks at the knot, for two reasons: partly because the folds, as they cross in the knot, are strained suddenly across each other, and one of them is cut through; and partly because the rope is so sharply bent that the outer side of each fold in the knot is much more stretched than the inner side, so that the strain comes almost entirely upon one side only of each fold.

For the first reason, we found it necessary to put a pad of some kind inside the knot—leather, linen, or a little tow or waste rope will do. For the second reason we preferred knots in which the folds are least sharply bent round each other; that is, in which the curves are large.

We therefore conclude that:

- 1st. No knot, which is not absolutely necessary, ought to be allowed to remain on the rope:
- 2nd. The tighter and harder a knot becomes, the worse it is:
- 3rd. The more loose and open a knot is made, the better it is:

and we append diagrams of those knots which we found by experiment to weaken the rope least. For alpine ropes, only three sorts of knots are ever required, and we suggest one of each kind.

No. 1 is for the purpose of joining two ends.

No. 2 is for the purpose of making a loop at one end.

No. 3 is for the purpose of making a loop in the middle when the ends are fastened.

No. 4 is a knot, of which we give a diagram in order that no one may imitate it. It is one of those which most weaken the

rope. The only one which seemed to be equally injurious, is the common single knot, of which no diagram is necessary.

As the ropes which we have recommended are very liable to become untwisted, unless the loose ends are secured, we advise travellers, in order to avoid knots, to have the ends of every piece of rope bound with waxed twine.

It should also be known that it is very unsafe to join two pieces of rope by looping one end through the other, so that, when the jerk comes, they will be strained across each other as two links of a chain are strained across each other. Unless a pad of some kind divides the loops, one will cut the other through.

Axes.

With regard to axes our task was less easy. There is no subject on which the Members of the Alpine Club seem to have such divergent opinions, and we proffer such suggestions as we have to make with considerable diffidence, trusting that nothing we say may be considered in any way to slight the inventors of those ingenious but not always intelligible instruments which have of late adorned the Club rooms.

It is unfortunately true, as stated by Mr. Stephen and Mr. Ball, that the authorities are by no means agreed as to the best form of ice-axe; and it may be added, that not even are any two men who ever climbed a mountain agreed on the subject at all, as there is no case on record of anyone having met in Switzerland two Members of the Alpine Club armed with the same kind of weapon.

As, however, we recommend three kinds of axes, we trust that we may be considered to have done our best to harmonise the considerable diversity of opinion which exists on the subject.

The axes made in England for the purpose of being taken out to Switzerland, may be divided into two classes, namely: travellers' axes, intended to be used for chipping a few occasional steps, for enlarging and clearing out those imperfectly made, and for holding on to a snow-slope,—and guides' axes, which are the heavier implements required for making long staircases in hard blue ice.

We have had three models prepared, of which diagrams are

appended; the first two represent the lighter axe, or what we have termed the travellers' axe; and the third, the heavier instrument required for guides' work. Diagram No. 1 represents a light axe or pick, of a kind somewhat similar to that recommended by Mr. Stephen, in a paper published in the fifth number of the Journal. It has, in the first place, the great advantage of lightness and handiness, while its single blade, to some extent, combines the step-cutting qualities possessed by the two cutters of the ordinary double-headed axe, though the latter instrument is on the whole decidedly superior. The small hammer-head at the back is added in order to balance the pick, and in some degree to improve the hold when the axe-head comes to be used as a crutch handle.

This form, it should be understood, we recommend on account of its lightness and of its convenient shape. Diagram No. 2 represents a travellers' axe, slightly heavier than the first; and as this is the shape which appears to us the best adapted for mountain work of all kinds, we desire shortly to state our reasons for recommending it to Members of the Club.

In the first place it is absolutely necessary that one of the cutters should be made in the form of a pick, as this is by far the best instrument for hacking into hard ice, and is also extremely convenient for holding on to a snow-slope, or hooking into crannies, or on to ledges of rock.

For the other cutter we recommend an adze-shaped blade, and we are convinced that this is the form which will be found most generally useful, as being best suited for all the varieties of step-cutting. The hatchet-shaped blade used by the Chamouni guides is no doubt a better implement for making a staircase diagonally up a slope, but on the other hand, it is exceedingly difficult to cut steps downwards with a blade set on in this manner; and as mountaineers rarely come down the way by which they went up, if they can help it, it is obvious that this objection to the Chamouni form of axe is conclusive.

We recommend that the edge of the blade should be angular instead of circular, although the latter shape is more common, because it is clear that the angular edge cuts into frozen snow more quickly and easily.

The curve, which is the same in all the axes, approaches to coincidence with the curve described by the axe in making the stroke. A curve is, in our opinion, desirable, in order to bring the point more nearly opposite the centre of percussion, and to make the head more useful for holding on to rocks or a slope.

The axe shown in diagram No. 2, though slightly heavier than No. 1, is not of sufficient weight or strength for cutting a series of steps in hard ice. To those gentlemen, therefore, who do not object to carrying weight, but who desire to have an axe fit for any kind of work, we recommend No. 3. As this is exactly similar in shape to No. 2, differing from it only in size, we have not thought it necessary to give a separate diagram of No. 3.

As to the mode of fastening, which is the same in all the three axes, we should have felt some diffidence in giving an opinion had we not been fortunate enough to obtain the advice of an experienced metal-worker, by whom we were strongly recommended to adopt the fastening shown in the diagrams, as being the method generally considered best in the trade for attaching the heads of hatchets, or large hammers likely to be subjected to very violent strains. It will be seen that the axe-head and fastening are forged in one solid piece, the fastening consisting of two strong braces or straps of steel, which are pressed into the wood about one-eighth of an inch, and are secured by two rivets, passed through the wood and clenched on each side. The braces are put at the side, instead of in front of and behind the axe, because, by this means, the strain which falls on the axe acts against the whole breadth of the steel fastenings, and not against their thickness merely.

We believe that this is the firmest method of fastening which can be adopted, and that, so long as the wood is sound, it is scarcely possible for the head of the axe to get loose or to come off: and it has the further advantage of strengthening the wood instead of weakening it, and of distributing the strain produced by step-cutting over a large bearing. It should be added that these axe-heads and fastenings ought to be made entirely of steel. These models have been manufactured by

Mr. Leaver, metal-worker, of Maidenhead, who has the plans and scale.*

The dimensions of the axe-heads are as follow :—

No. 1.

Length of blade measured from the wood	4½ inches
Breadth of blade at widest part . . .	1½ ”
Weight, including the braces . . .	13¼ oz.

No. 2.

Length of blade measured from the wood	3½ inches
Length of pick ” ” ”	4½ ”
Breadth of blade at widest part . . .	1¾ ”
Breadth of pick ” . . .	0½ ”
Weight, including the braces . . .	15¼ oz.

No. 3.

Length of blade measured from the wood	4 inches
Length of pick ” ” ”	5 ”
Breadth of blade at widest part . . .	2¼ ”
Breadth of pick ” . . .	0⅞ ”
Weight, including the braces . . .	21¼ oz.

We much desired to recommend to the Club some means by which the axe-head might be made movable, so as to be capable of being put on and taken off the handle quickly and easily. We regret to say, however, that we were unable to discover any plan by which this can be effectually done. We examined very carefully the numerous and formidable weapons which have been sent in by Members for exhibition, most of which had elaborate contrivances for fastening on the axe-head. These were all, however, liable to very serious objections. Some were evidently insecure; with others it was necessary that the axe-head should be surmounted by a huge knob, which would

* Mr. Leaver will manufacture the axes, complete, at the following prices :—

No. 1	£1 1 0
No. 2	1 2 6
No. 3	1 5 0

prove a most serious impediment in step-cutting; while in the best and firmest which we found, the axe-head was attached to the pole by means of nuts and screws projecting at the side or over the top of the axe. This latter method of fastening seems to us awkward and possibly dangerous, as the nuts, from their position, are very likely to become loose or to get broken off, and cannot, except when dangerously loose, be fastened or unfastened without a key or wrench—a troublesome article, certain to be lost on the first expedition.

The Handle of the Axe

should, we think, be made of ash. We recommend this wood, in preference to deal, which is lighter and nearly as strong, because in choosing a piece of ash it is easier to select with certainty thoroughly sound and well-seasoned wood; and in preference to hickory and lance-wood, which are stronger, because those woods are extremely heavy.

The handle should, we believe, be of a very slightly oval form, as it is then more convenient to the grasp than if round. As to the thickness of the wood, we are satisfied it ought nowhere to be less than $1\frac{3}{8}$ inches, since a pole of that diameter, made of ordinarily good ash, is the smallest which cannot be permanently bent by a heavy man's most violent effort; although we have seen some pieces of unusually strong ash of a less thickness which proved inflexible.

We recommend, then, that the oval section of the handle should have a shorter diameter of $1\frac{3}{8}$ inches, and a longer diameter of $1\frac{1}{2}$ inches, and that the thickness should be the same from one end to the other. The length of the handles for Nos. 1 and 2 should be such that they will reach to just under the arm at the shoulder. The handle for No. 3, which is intended to be used exclusively as an axe, should be between $3\frac{1}{2}$ and 4 feet long. The lower end of the handle should be strengthened in the usual way by a ferule, and armed with a spike.

The spike should be from $3\frac{1}{2}$ to 4 inches long, clear of the end of the handle, and should have a shank of the same length to be screwed into the wood. The screw should be prevented from moving by a slight rivet passed through it near the upper

end after it is fastened in. The exact form of the spike and ferule are represented in the diagram.

We have further to recommend for axe-handles an addition which is liable to suspicion as an entire innovation, but which, we are confident, will be found valuable at those critical moments when the axe is required to hold up two or three men. It has happened that when the axe has been struck into the snow a man has been unable to keep his hold of the handle, which slips out of his hand, and leaves him perfectly helpless. To guard against this mischance, we propose to fasten a band of leather round the handle, at a distance of a foot from the ferule at the lower end. This leather should be about an eighth of an inch thick, and will be quite sufficient to check the hand when it is sliding down the handle. It should be lashed round the wood and strained tight when wet.

Alpenstocks.

What we have said about the handle of the axe applies in all respects to the alpenstock, except that the length of the latter should be different, and that the leathern ring would of course not be required. It is generally thought most convenient that the alpenstock should be high enough to touch the chin of its owner as he stands upright; but this is a matter on which it is scarcely possible, and, were it possible, scarcely necessary, to lay down an absolute rule.

We have now laid before the Club the result of our enquiries upon the subject which we were appointed to consider, and we hope that it may not be too late for some of our suggestions to prove useful to Members during the present season.

E. S. KENNEDY (*Chairman*)

F. C. GROVE (*Secretary*)

J. J. COWELL

H. B. GEORGE

W. E. HALL

R. C. NICHOLS.