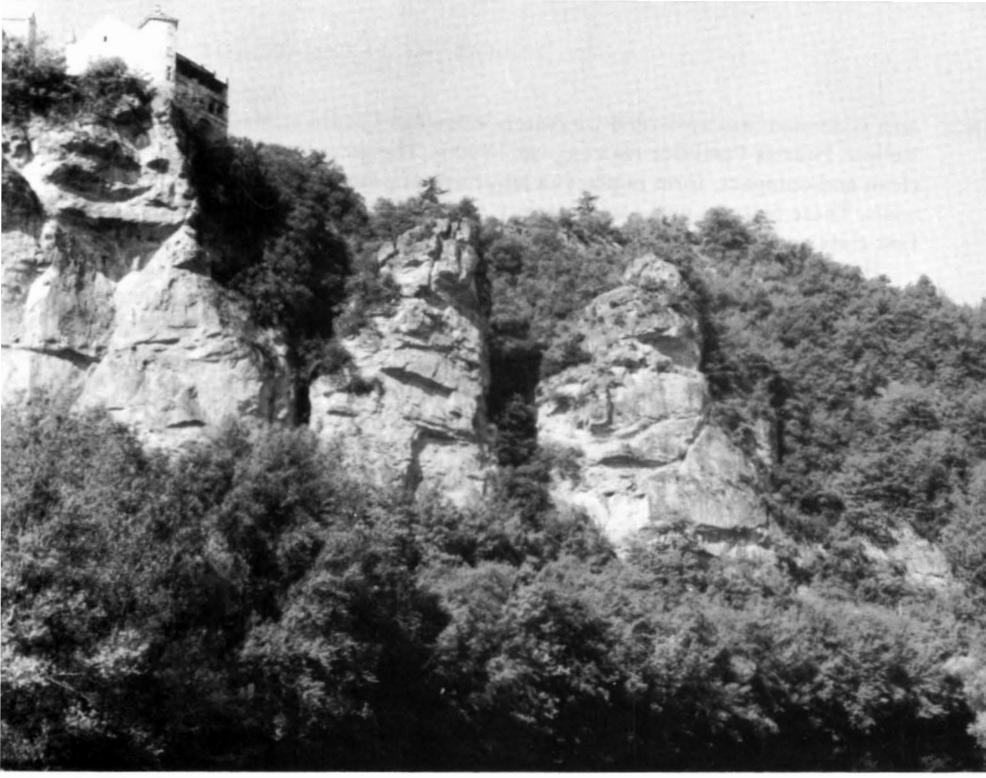


61 Les Trois Piliers de Bruniquel (Photo: T. Connor)

This outcrop is 100 to 120m high and provides routes of all difficulties. Visitors may have the luck to be entertained by the Montauban hang-gliding club which operates nearby.

The rock in the gorge is good in general, but will not withstand frequent driving in and removal of pitons.

Reference

Leaflet *Escalade* issued by Office Departemental du Tourisme de Tarn et Garonne, Rue de l'Hotel de Ville, 82000 Montauban. Further information from M. Patrick Puel, 10 rue Winston Churchill, 8200. Montauban.

The protection game

George Steele

Historical introduction

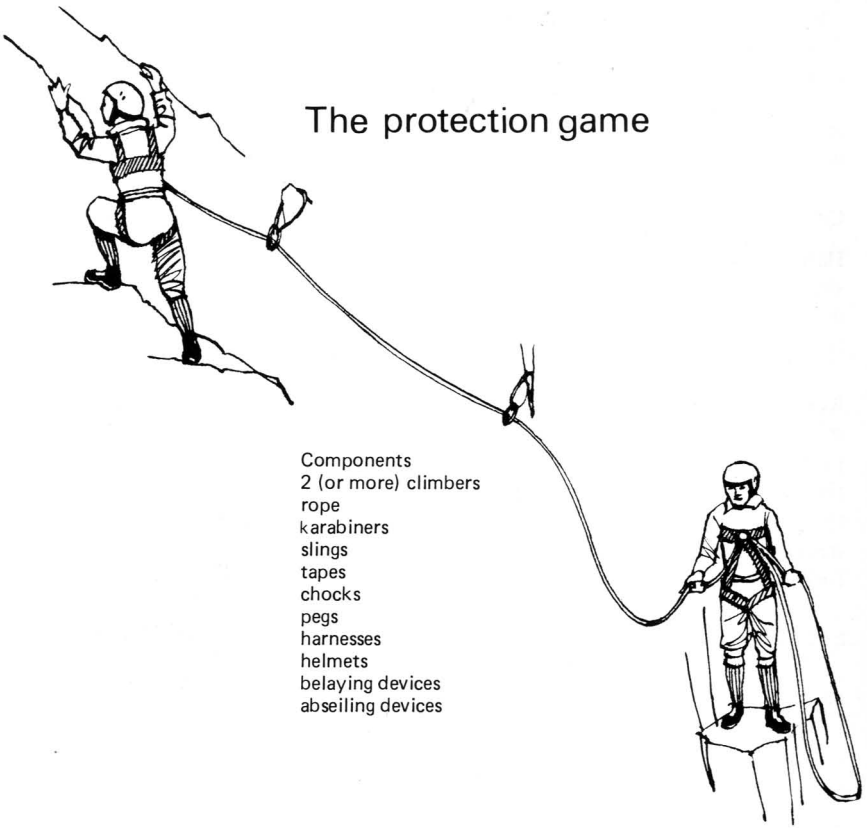
Except in the case of aid moves or artifical climbs, all that a climber needs IN ORDER TO CLIMB is his personal equipment (ie clothing, footwear, etc.). Over the century or so that men have been climbing rocks as a part of mountaineering they have additionally developed equipment and techniques for the *protection* of the leader and other members of his party. For many years the leader had to drag behind him a very heavy rope, mainly to protect those following him, because he himself could not rely on it in the event of a fall.

Belays (anchors) were either non-existent or, at best, very rudimentary. Their only remedy against disaster was the use of frequent stances thus giving very short pitches by modern standards. An early guide book *British Mountain Climbs* by George Abraham listed some 'Exceptionally Severe Climbs' for which the leader needed 200 feet of rope. A comment was added that 'the leader might be safer climbing without the rope'.

Between the World Wars karabiners began to appear on the continent and these used with pitons started the science of protection which we know today. Since World War II mountaineering equipment has undergone dramatic changes which are still continuing apace.

The performance of ropes and other items of equipment as they appeared, was always a subject for debate and doubt. Reputable manufacturers and retailers, often ex-climbers themselves, made valiant attempts to improve the performance and quality of their products. There was, however, no independent assessment of source of technical advice available.

Realising this problem the infant BMC established its Equipment Sub-Committee in the mid-1940's. Gradually other countries followed this example and much valuable work is now done in various parts of the world. A common forum for this work appeared when the UIAA set up first a Material Commission and later a Safety Methods Commission. These are now combined as the Safety Commission.



Present situation
Close liaison now exists both in this country and abroad between equipment manufacturers and national mountaineering associations. Unfortunately not all countries find it possible or worthwhile to maintain a strong technical team. Consequently feedback from climbers to manufacturers is uneven and often non-existent. The lack of consistency in the approach to this problem between different countries means that the level of monitoring or assessment of quality control at manufacturers' plants varies from good to very poor.

Mountaineering equipment is usually developed to meet a need (or a likely need). At the time of initial introduction it may not have been possible to test the item of equipment under all possible conditions of use. Consequently accidents have occurred which appear to stem from inadequacies in the equipment or from misuse of the equipment. Equipment designers and manufacturers should not be unduly criticized for this as imaginative climbers will always find ways of using equipment not previously considered. There have also been examples of equipment overdesigned from the safety aspect which have been rejected as impractical or unwieldy.

The role of UIAA and national mountaineering technologists
The current practice and future plans of such bodies as the UIAA Safety Commission, BMC Technical Committee, DAV Sicherheitskreis, etc, is to offer technical advice to manufacturers and users of equipment as requested. Additionally, projects are initiated on specific items such as ropes, karabiners and harnesses, or reviews of techniques such as belaying and abseiling. The outcome of these projects is usually the issue of standards for manufacture and performance tests, or recommendations as to the best techniques or ways of using equipment.

Current and proposed standards for equipment

Hawser laid ropes A British Standard, BS 3104 (1970) has been in existence since 1970. It defines the four sizes (Nos. 1–4) of hawser laid rope and lays down requirements with regard to materials, manufacture and performance tests.

Kernmantel ropes A UIAA Label Specification has been used since its inception in 1965 to provide a control over materials and manufacture but mainly a performance test which is required on only relatively few metres in many thousands. This performance test differs from that for hawser laid ropes in that it tests the ropes dynamically under pre-determined conditions to destruction (or attempts to) whereas BS 3104 (1970) specifies a static breaking force which must be exceeded without break.

An ISO (International Standards Organization) standard is being developed but its universal application is still a long way off.

This is probably a suitable point at which to explain the significant differences between the 3 types of standard mentioned above.

British Standards are controlled by the British Standards Institution which is an independent organization receiving some financial support from Central Government in the UK.

Standards are developed by Committees on which all interested parties, manufacturers, users, etc., may be represented. Once a Standard is agreed manufacturers may submit products for test and details of their plans for quality control. If the products satisfy the appropriate performance and other tests, manufacturers may claim that their product is to that BS. If the manufacturers' quality control arrangements are acceptable the products may also carry the BSI 'kite mark' but this would be subject to regular (usually annual) reviews.

ISO Standards are developed and controlled in a similar manner by the International Standards Organization whose headquarters is in Paris.

UIAA Label Standards on the other hand are produced and controlled in a very different way. These Standards are developed by a working group composed of delegates from different countries. The working group will present its proposed Standard for consideration and argument by the whole Safety Commission. Considerable power lies with the leader of such working groups. After ratification of the Standard it is up to individual national mountaineering Associations to administer the award and control of the UIAA Label on an item of equipment. As mentioned earlier inconsistencies often occur.

Helmets BS 4423 (1969) covers the materials, manufacture and testing of climbing helmets. Unfortunately only one manufacturer has followed the procedure through to the end and earned the 'Kite mark'. Several other manufacturers have submitted helmets for test with varying degrees of success. All have baulked at meeting the quality control requirements and have, therefore, not earned the 'Kite mark'. The only helmet meeting the full specification is rather heavy and has not proved popular. Until its competitors also meet the full requirements of the British Standard it seems unlikely that redesigning will take place which might produce a lighter, more acceptable helmet.

Karabiners The UIAA Label Standard for karabiners is probably the one which has created the greatest controversy about the value and validity of such standards. There seems to have been a misunderstanding between the BMC and the ÖAV in Austria. The BMC Equipment Sub-Committee had been the chief architects of the Standard and had rigidly imposed its requirements on the (at that time) sole UK manufacturer of karabiners. When chance tests on one model of Stubai karabiners showed a high rate of failures, requests were made to the ÖAV for copies of the original drawings, specifications and test results. Misunderstanding followed misunderstanding and spurious test results on materials were the only data produced. Metallurgical tests at the University of Nottingham finally demonstrated that the most likely problem was a simple one of quality control—the dies were not being kept clean between the forging operation on successive karabiners.

The Standard itself specifies static forces which must not break the karabiner and a dynamic impact test which although it destroys the karabiner gives an indication of its energy absorption capabilities in that minimum figures before destruction are specified. This last test is the one which has given the most trouble, especially as part of the test is carried out at $-30^{\circ}C$ where many aluminium alloys are extremely brittle.

Harnesses The UIAA Safety Methods Commission in 1974 set about studying the problem of attaching the climber to the rope. Subsequently a working group produced a Design Specification which took account of medical and climbers' evidence as to necessary requirements for both safety and value in use.

A UIAA Label Standard has now been prepared which should be ratified by the end of 1976. This lays down acceptable materials, methods of construction and design and includes a realistic performance test.

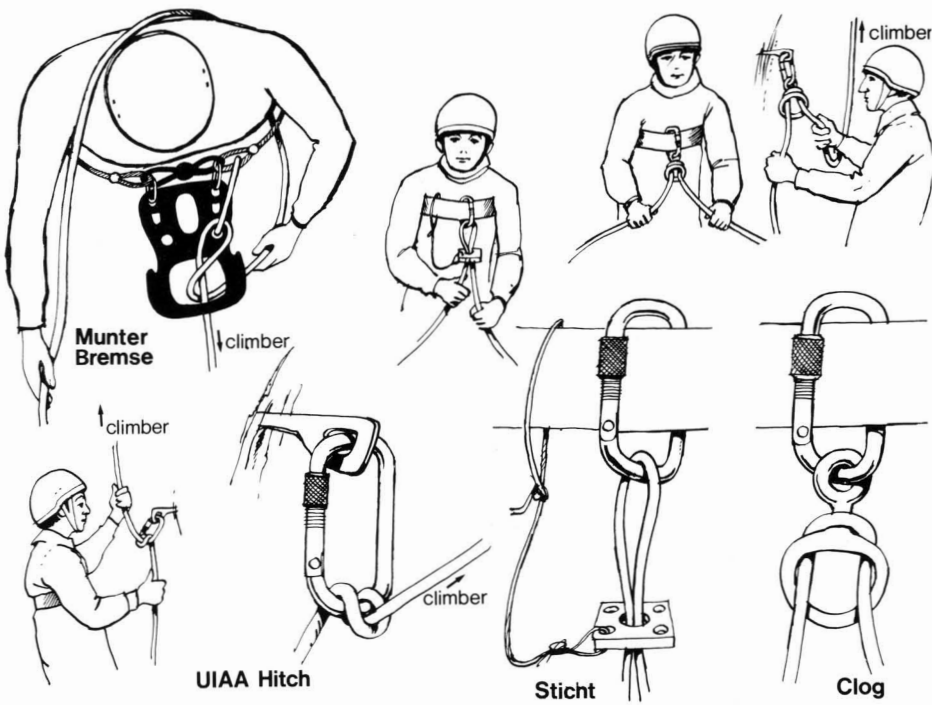
Recommendations for the use of equipment

The UIAA Safety Methods Commission has also in recent years studied and performed field trials on:

Methods of belaying on rock (1973)
Methods of belaying on snow and ice (1975)

Because of the unavoidable delays in arriving at international agreements the former recommendations were not available to the general public until 1975 and the latter report is still in preparation.

The recommended methods for belaying on rock were 3 in number. Two involve friction devices (Munter Bremse and Sticht Plate) and the third is a rope-on-rope friction knot—the UIAA Hitch. Body belay methods have been demonstrated in several trials to be inadequate for holding leader falls, despite many occasions when seconds have done this successfully.



The protection game—how to play

So far we have considered the development of the 'game' and examined some of the recommended pieces with which one plays. It would be all too easy to say that one should only play with these pieces—such is, however, not my intention!

When preparing standards or methods for recommendation it is necessary to make assumptions with regard to methods of use. These assumptions may not be valid for all climbing or mountaineering situations. First, I will discuss the assumptions made and then offer my own suggestions for different situations.

Assumptions made in the development of standards and recommendations

Rope Mountaineering ropes are designed to absorb the sort of energy which is generated if a leader fall is held, without dynamic belaying techniques and with a fall factor of the order of 2 (the maximum value).[1] The forces generated in such a situation would probably injure the human body. In practice with dynamic belaying techniques (even of the worst kind!) energy is absorbed and the forces in the system are reduced to a tolerable level. The use of running belays (runners) reduces the fall factor which in turn reduces still further the forces in the system. It can therefore be seen that many mountaineering situations occur where although the rope will be necessary it will only be expected to perform well within its capabilities.

Helmets Differences exist between most European Alpine countries and the UK on this subject. The greater danger in the Alps is that of stonefall which on many of the harder routes is accepted as a normal hazard. This hazard is fortunately fairly rare in the UK so that our accident statistics paint a different picture. Consequently the BSI specification for helmets envisaged protecting the head against injury in the 'falling climber' situation. This more stringent requirement is probably part of the reason why so many helmets fail to meet BSI requirements.

Karabiners The greatest forces in the system are generated when holding falls of fall factor 2. The worst situation for a karabiner occurs when it is on a runner. The forces on the runner (karabiner, sling and anchor) can rise to double the force in the rest of the system. Whatever the force in the systems it is felt equally by belayer and belayed. The runner of course has to hold BOTH of these forces. However, as soon as a runner is introduced into the system the fall factor cannot rise as high as 2.

In the UIAA specification for karabiners static tests are carried out applying a force of 2200 kgf which the karabiner must successfully sustain if it is to pass. In a fall situation using dynamic belaying and runners the forces in the rope are unlikely to exceed 700–800 kgf. It can therefore be seen that there is an adequate margin of safety in the karabiners.

[1] *N.B.* Fall factor = $\frac{\text{length of fall}}{\text{length of rope absorbing energy of fall}}$

Harnesses The harness specification has been drawn up assuming that UIAA approved ropes and recommended belaying methods will be used. Medical advice to the working party stated 2 points—that most injuries in falls happen *during* the fall—by impact with the rock rather than at the end of the fall; and, the strongest muscle in the body (behind the upper thigh) is the one best able to absorb the forces created in stopping a fall.

The first point meant that a climber was likely to arrive at the end of his fall in an injured or possibly unconscious state. As he might be hanging clear or against vertical rock it was considered essential for him to be in an upright and reasonably comfortable position. Thus the UIAA harness specification will insist on either a full body harness or a suitable combination of chest and sit harness.

Belaying methods on rock Only the most severe situations were envisaged in the assessment of belaying methods for use on rock. It was considered that any methods suitable in such instances would also be suitable in situations of less severity whereas the converse would certainly not apply. A list of requirements was drawn up and divided into 'essential' and 'desirable'. It was decided to assess each 'method' against each 'requirement' using a ''Which' type assessment, ie, –, 0, 00 or 000.

The more '0's the better! It was also agreed that to meet the requirements of a recommended method not less than 00 should be awarded against all the essential requirements. Extracts from the results are shown in Table I. From this one can clearly see how the recommended methods fared against individual requirements as well as what other methods lacked.

Belaying methods on snow and ice This work is still progressing and so it is not possible to give detailed comments yet. The method of assessment will probably be on a similar basis to that used for belaying methods on rock.

Possible concessions to recommended equipment and methods
As will be clear from the last section many situations exist where the dangers assumed in the development of standards and recommendations are relatively remote or at least considerably reduced. In such situations it is obvious that concessions can be allowed but the question is, 'to what extent?'

Here one must tread a tight rope between safety on the one hand and danger on the other. Ultimately the quality of any decision will be a function of the quality of judgement. If in doubt play safe—if confident then proceed. The important thing is to appreciate the possible dangers and to consider what, if anything, one should do about them. Climbers who still wish to persist with nominally unsafe techniques or equipment will then at least have made a conscious decision to do so in full knowledge of the facts—a far happier situation than continuing bad habits in ignorance of the potential dangers.

Ropes If all UIAA recommendations are followed (including belaying methods) then hawser laid ropes will be excluded. Mechanical belaying devices do not perform satisfactorily or consistently on such ropes. If, however, belaying methods are ignored for the moment Table 2 will give an indication of which

Table 1 Assessment of Belaying Methods on Rock

Requirements	Munter	Sticht	UIAA Hitch	Clog
Essential				
1. The method should not cause injury to the belayer whilst holding a fall	000	000	000	000
2. The method should limit the force applied in arresting a falling climber	000	000	000	000
3. The method should be simple and quick to apply and should be as proof as possible against misuse	00	000	00	000
4. The method should be equally suitable for single or double ropes, for ropes of different diameters and for paying out or taking in of ropes as well as holding a fall	000	000	00	000
N.B. This is not to imply that one single device should accommodate single or double ropes of any diameter		(1)	(2)	
5. The method should allow good control over the braking of a fall and must not allow excessive slip when arresting a fall	000	000	000	000
6. The method should work satisfactorily irrespective of the direction of the pull	000	000	000	000
7. The method should work on all falls even when the fall factor equals 2	000	000	000	0
8. The method should work adequately on dry, wet or icy ropes	000	000	000	000
9. It should be possible to 'lock' the device after holding a fall, and afterwards the belayer should be able to detach himself from the belay chain.	000	00	00	000
Desirable				
10. The method should not require the use of gloves	00	0	0	–
11. The device should have other uses: eg Abseiling, rescue, etc	000 (3)	00	0	00
12. The method should use standard equipment as much as possible	00	00	000 (4)	00

Notes (1) Special versions for different diameters and for double ropes
(2) Two karabiners necessary for double ropes
(3) Very many other uses
(4) Needs only a large screwgate karabiner (two for double ropes)

Table 2 Recommended Rope Use

Type of Climbing	Possible rope (or ropes)
Easy scrambling or ground requiring occasional use of rope	7mm Kernmantel No. 2 Hawser
Easy angled rock	11mm Kernmantel No. 4 Hawser
Steep rock	11mm Kernmantel No. 4 Hawser 2 X 9mm Kernmantel 2 X No. 3 Hawser
Very steep or overhanging rock	11mm Kernmantel No. 4 Hawser 2 X 9mm Kernmantel 2 X No. 3 Hawser
Easy snow slopes and gullies	11mm Kernmantel No. 4 Hawser 9mm Kernmantel No. 3 Hawser
Steep slopes and steep straightforward gullies	11mm Kernmantel No. 4 Hawser
Steep complex routes and very steep or overhanging ground	11mm Kernmantel No. 4 Hawser 2 X 9mm Kernmantel 2 X No. 3 Hawser
Simple glaciers, snow slopes and ridges	9mm Kernmantel No. 3 Hawser No. 2 Hawser
Complex glaciers and ice falls	11mm Kernmantel No. 4 Hawser 2 X 9mm Kernmantel 2 X No. 3 Hawser 2 X No. 2 Hawser
Mixed rock/snow/ice	11mm Kernmantel No. 4 Hawser 2 X 9mm Kernmantel 2 X No. 3 Hawser
Stonefall or avalanche prone areas	11mm Kernmantel No. 4 Hawser 2 X 9mm Kernmantel 2 X No. 3 Hawser

N.B. In considering 'Type of Climbing' one should bear in mind the 'area' of the climb, not just the climb itself. A fall from an easy climb could leave one hanging in an area of very steep or overhanging rock

rope should be used and when. The column headed 'type of climbing' obviously requires careful judgement and if at all in doubt one should assume a greater degree of seriousness (i.e. steeper rock).

Helmets Helmets started to be used by British climbers on Alpine routes where stonefall was a danger. Several helmets are available which give fair to good

protection against stonefall alone. The BSI specification took a different view and endeavoured to provide protection in the case of the climber himself falling and striking his head. Success in this aim has been fairly limited. The only helmet allowed to use the 'Kite mark' is considered heavy and unwieldy. One thing, however, is very certain—the existence of this specification has led to an overall improvement in the design of British manufactured helmets.

It has been stated for some time that 'any helmet' is better than 'no helmet'. This is still true and, of course, with helmets of good design easily available a 'good helmet' is much better than a 'poor helmet'.

Karabiners Only one possible relaxation can be suggested with karabiners. They should be matched strength for strength with the slings, etc., with which they are used.

Obviously a karabiner should not be less in strength than its sling but there are no advantages in using a big strong karabiner with a tiny chock on wire or thin line. (Other than just to weigh it down!)

Harnesses The UIAA's philosophy on harnesses assumes a situation where after a serious fall the climber will be hanging conscious or unconscious either free or against steep rock. In such a position the harness will ensure an upright position. If, however, climbing on easy angled rocks (eg Idwal Slabs) a sit harness would be quite adequate as friction with the rock or landing on intermediate ledges would negate the advantages of the approved type of harness. Similar examples to those given for rope will obviously come to mind. Again, the 'general area' of the climb is to be considered, that is where one could finish after a fall. Also the situation of a second or third climber on a rope is not always the same as that of the leader. Even where it is advisable for the leader to wear a 'recommended' harness, a sit harness might be quite adequate for others on the rope.

Belaying methods As stated earlier the most severe fall situations were envisaged when drawing up recommendations for belaying methods. These were aimed at protecting a falling leader under such conditions. Protecting a second and others on the rope does not necessitate such methods. In many cases body belays and 'figure of eight' belays are quite adequate for such duties.

General Comments

It is important in every case to bear in mind the reasons why recommended equipment and methods are essential in certain situations or for certain duties. Only by fully understanding those reasons will one be in a position to judge the possibility or wisdom of allowing concessions to those recommendations.