Equipment and technique

MacInnes—Peck ice tools *New ice-axes and Terrordactyls* A new all-metal ice-axe has been developed by Hamish MacInnes which uses the same well-tried Hiduminium shaft of the earlier models which have proved almost indestructible.

The new head design of the axe uses pressing techniques, which allow a light metal steel (as used on spacecraft) to be used. The pick is dropped at an angle of 78° which has been found to be the optimum angle for cutting and holding and the adze is made from the same material giving a uniform thickness throughout. Both the pick and the adze have very high cutting power.

The weight of the new axe is lighter than most light wooden models at present on the market. A special tapered ferrule also has a hole in it for belaying etc.

The Terrordactyl Together with the new ice-axes these have been exhaustively tested during last winter and during the summer in various parts of the world. The general impression of the hammer and adze terrordactyl is that it is the greatest aid to ice climbing since the crampon.

With the deep section blade of only $\frac{1}{16}$ in approx. thick they can be driven into the ice or snow in a down-pulling motion and in firm snow, white ice, frozen turf etc. their holding power is amazing. Etriers can be used through the ferrule hole for artificial techniques on ice.

The advantage of the Terrordactyl is not necessarily on the extreme routes, but for moving fast and safely on any steep climb. These new tools should allow a new standard of ice climbing to emerge. The Terrordactyl got its name from the late Ian Clough as the head of the prototype (used on the new Scots route on the Eiger, 1970) looked like that prehistoric monster.

Radio on Annapurna The successful assault on the South face of Annapurna, was achieved with the aid of the robust and reliable Racal TRA.906 'Squadcal' h.f., s.s.b. manpack. 'Squadcal' was used throughout the duration of the expedition to maintain communications between members of the advance parties of the expedition, their base camp and with Kathmandu, over 100 miles away. It was also used to achieve regular communication with the army expedition which was on the other side of the peak.

The members of the expedition always used voice for the regularly scheduled transmissions between stations. Operating conditions simultaneously encountered during transmissions varied from heavy snow and high winds to

113 *Terrordactyls in use on the North face of the Eiger.* Photo: L. Dickinson

pre-monsoon humidity with extreme heat. Even under these extreme climatic conditions the sets maintained regular and reliable communications.

A low-cost lightweight, h.f., s.s.b. packset, the TRA.906 'SQUADCAL' provides twenty-nine crystal controlled channels located anywhere in the 2 to 7 MHz frequency range. Fully transistorised, the TRA.906 has a power output of 5 watts p.e.p. and can operate over 10 to better than 25 miles in open country, or over 4 to 10 miles in jungle. Simple to operate, only one control is used to change frequency, 'SQUADCAL' has an inbuilt a.t.u. designed to tune 2·4 m (8 ft) whip, dipole or end-fed long wire antennas. In addition to s.s.b. telephony, facilities are provided for s.s.b., key-toned telegraphy and compatible a.m. telephony.

The equipment is completely sealed and waterproof, but batteries can be changed without breaking the main equipment seal. **Racal Ltd**

Outdoor ski-ing all year round Sno-lene Tracking and Sno-lene Underlay are new woven white fabrics specially developed to help skiers train and practise all year round.

Sno-lene Tracking has a very low coefficient of friction to simulate the effect of wet snow and is specially useful for teaching the various techniques required for cross-country ski-ing.

Artificial alpine ski slopes are increasing for recreational and training use but when these slopes are used outdoors it is possible for dirt and mud to migrate onto the ski-ing surface causing wear to the skis and surface. Sno-lene Underlay has been developed to help combat this problem by allowing rainwater to pass through it but controlling the mud, dirt and grit underneath.

It can be used on the side of the slope for climbing and as a run-out at the bottom thereby saving additional wear on the ski-ing surface.

British Ropes Ltd (Doncaster)

Published notes on equipment and technique Both our bi-monthly climbing journals include frequent notes on the latest developments in equipment and technique. Attention is drawn to the following material which appeared during 1970:

Body Harnesses for Rock Climbing (Rocksport 6/7). These provide methods of attaching the climber's body to the climbing rope, alternative to the waist loop, the dangers of which to the suspended climber have long been known. Waist-belts, waist-loops, chest harness, sit-slings, thigh harness and body harness are described, with advantages and disadvantages and names of suppliers. The author concludes that 'the climber will turn towards body harnesses in the seventies in much the same way as he turned to helmets in the sixties'.

Karabiner Brakes (Rocksport 10/11). This note draws attention to the versatility of karabiners.

114 *Sno-lene Tracking in North Wales.* Photo: British Ropes Ltd.

115 *Whillans Box on Annapurna*. Photo: Annapurna South Face Exp.

The Whillans Box (Mountain No. 12). A picture of one of these in use on the Annapurna South Face Expedition is included here. The inner tent of the box is to be replaced in future by a waterproof false roof. Closed-cell foam mattresses are used as groundsheet and as bedding.

Paper sleeping bags Reed Medway Sacks Ltd were showing a new paper sleeping bag at Colex this year. This is shower-proof and can be dried out; it is layered for heat insulation, is disposable, weighs about $1\frac{1}{2}$ lb and costs 45p. The development is interesting and some application to mountaineering or expeditions may emerge in due course.

An early application of the Etrier Principle (1857) Occasion: The festival which accompanied the 'Scouring of the White Horse' on White Horse Hill, Berkshire in September 1857.

Object: The ascent of a greased pole surmounted by a leg of mutton. Reporter: Tom Hughes

'When I got up to it, I saw a heavy-looking fellow, standing some five feet up the pole, with one foot in a noose of cord depending from a large gimlet, and the other leg hooked round the pole. He held in his right hand another large gimlet, which he was preparing to screw into the pole to support a second noose, and gazed stolidly down at a Committee-man, who was objecting "that this wasn't fair climbing—that if gimlets and nooses were to be allowed, he could get up himself." I thought he was right; but public feeling seemed to side with the climber.'

An early account of ski-ing in Scotland (1892) For the sake of any uninitiated, it may be explained that skis (pron. 'shes') are wooden snow-skates, 7 feet long and 3 to 4 inches wide, largely used throughout the northern parts of Europe and Asia (see Dr Nansen's *Across Greenland*). The best are made of ash or plane, and cost, with fastenings, about £1, but a light serviceable pair of pine can be had for a few shillings by writing to Messrs Hagen & Co., Bergen. On 12th March, shortly after a considerable fall of snow, M. T. G. and W. W. N. climbed the Campsies behind Milton, and followed the crest of the ridge for two miles to the Meikle Bin. From that commanding point, after a snow shower had passed, a grand view was obtained of the Highland mountains all dressed in white, the Ochils, Firth of Forth, tops of Arran hills, &c., &c. On the return journey the same route was followed. The skis were not of much use when ascending, but upon level ground, and especially where the snow was soft, better progress was made with their aid than without them, while a very slight gradient was sufficient to get up tremendous speed during the descent. When the angle was too steep to risk, the skis were slipped off and turned into an improvised toboggan. At one long slope, some 300 yards in length, and inclined at a general angle of 15°, an hour was enjoyably spent, the snow being in perfect order for ski-ing—firm underneath, with a powdering of drifted snow on the surface. This snowbed was crossed by one or two small ridges which imparted a switchback element to the sport, somewhat puzzling to inexperienced amateurs. Of course the party came to grief several times, but they returned home well pleased with their experiment. Skis might often be employed with advantage in winter ascents in Scotland, or rather descents—for although Norsemen skate up as well as down hills, few men in this country are likely to acquire such facility as to use them when going up hill, but they can be easily towed up, as they weigh only a few pounds. In the Alps it is not unlikely that the sport may eventually become popular, particularly with the blasé climber who has "done" everything in the ordinary way, and the individual ambitious of beating all previous "times" in the descent of easy mountains, such as the Breithorn, Cimi di Jazzi, or even Mont Blanc. In the event of the rope proving impracticable, a slight acquaintance with a glacier would reduce the risk from hidden crevasses to a minimum; and for a gaping bergschrund, an expert would simply fly over it. It is probably no exaggeration to say that a good man on skis could descend safely from the top of the Breithorn to the end of the Theodule Glacier in half an hour. **W. W. Naismith**

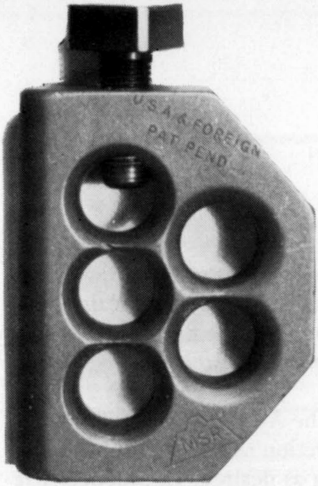
(From the *Scottish Mountaineering Club Journal*, May 1892.)

Early step-cutting on Ben Nevis (1848) 'As we approached the head of the glen, we got only glimpses of snow fields and rocks above us; and at length we were immersed in the fog, which fortunately was not very deep. We kept on the rock as long as we could, and at length found that there only intervened between use and the ridge a short steep ascent of drifted snow, most truly Alpine. It was too late to think of receding, and it was not far; so assuming my new mahogany tripod as an Alpine stock, I proceeded foremost to make steps in the most approved Swiss fashion, to the no small edification of my companion, who had never seen such an operation before. The upper few yards were so steep that I actually could not get one foot stuck into the snow before the other, and had to get along sideways.' **Prof J. D. Forbes (1848)**

Auto-Belayer, model 4 The MSR Auto-Belayer is a small friction device used to attach a climber to the climbing rope, see pl. 116. If he falls, the reserve portion of the rope, which he carries, feeds frictionally through the Auto-Belayer converting part of the energy of his fall to heat, and limiting the peak force which is exerted on the body of the climber and on the anchors. The Auto-Belayer is used by the leading climber, not by his belayer.

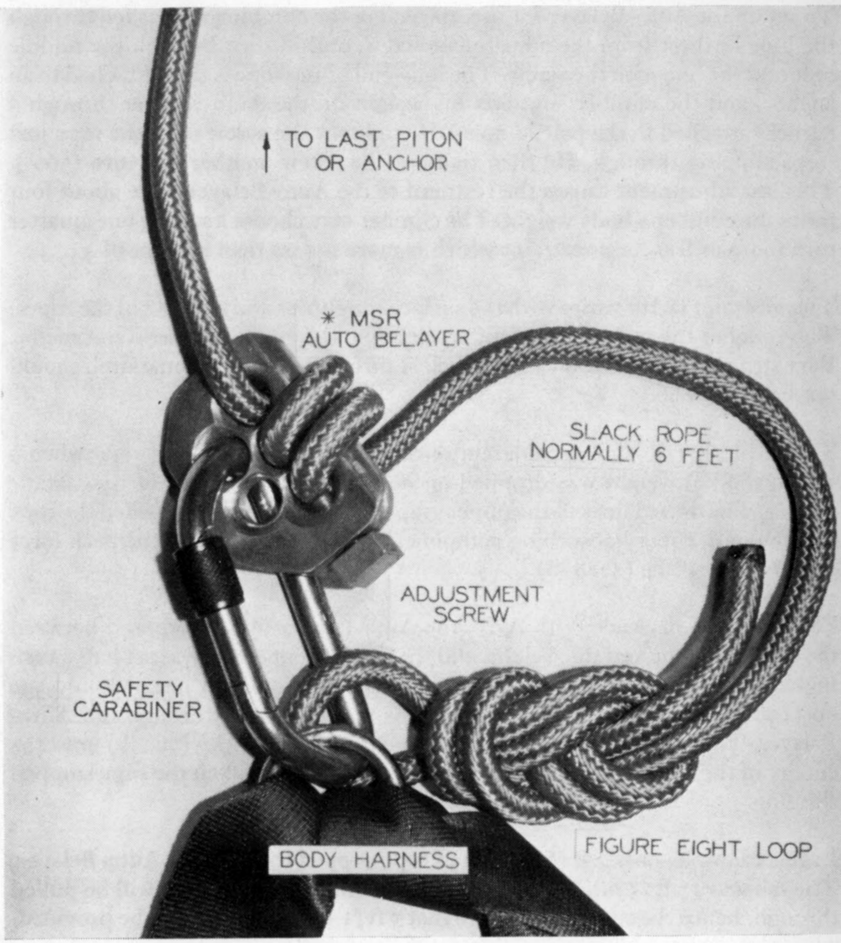
Background The basic idea of absorbing part of the energy of a fall by some method carried by the lead climber was suggested by K. Tarbuck in his booklet *Nylon Ropes and Climbing Safety*. Experimenting with the Tarbuck knot, the writer was unable to get consistent results. Sometimes the restraining force was too high and sometimes too low. The writer's first attempt at improvement was the substitution of a longitudinal bar of aluminum with holes for the knot. This worked consistently, but was somewhat cumbersome and was not suited to passing through carabiners.

The next attempt employed a transverse bar with a separate friction rope. This model got around the carabiner problem, but worked inconsistently. The actual value of the climbing rope restraint depended on the extraneous restraint of stripping the friction rope from the pocket in which it was carried.



116 *The Auto-Belayer.* This and next two illustrations: Mountain Safety Research Inc.

117 *Attachment of the Auto-Belayer to rope and harness*



In another model, the latter problem was solved by installing adjustment screws in the last holes to restrain the rope there with a force much greater than the force required to pull the rope from the pocket. But the finite length, and hence limited capacity, of the friction rope remained as a problem.

Model 4 The arrangement for using Model 4 of the Auto-Belayer is shown in pl. 117. The climbing rope itself is used as the friction rope. Accordingly, the length of reserve (slack) rope can be made as long as desired. In practice, 5 ft (1·6 m) would be a reasonable choice.

To set up the Auto-Belayer for use, the end of the climbing rope is fed through the hole farthest from the adjustment screw, and in turn through the middle hole and the one with the screw. The long end of the rope is then attached to an anchor, and the climber supports his weight on the Auto-Belayer through a harness attached to the pair of holes. He tightens the screw until the rope just stops slipping through. He then tightens the screw another full turn (360°). This last adjustment causes the restraint of the Auto-Belayer to be about four times the climber's body weight. The climber may choose a setting one-quarter turn more or less for a restraint which is more or less than a factor of 4.

This restraint factor varies with the surface roughness and stiffness of the ropes. The rougher the rope and the stiffer the rope, the greater the restraint factor. Very stiff ropes, those which will not close on a $\frac{1}{2}$-in (12·5 mm) mandrel, should not be used at all.

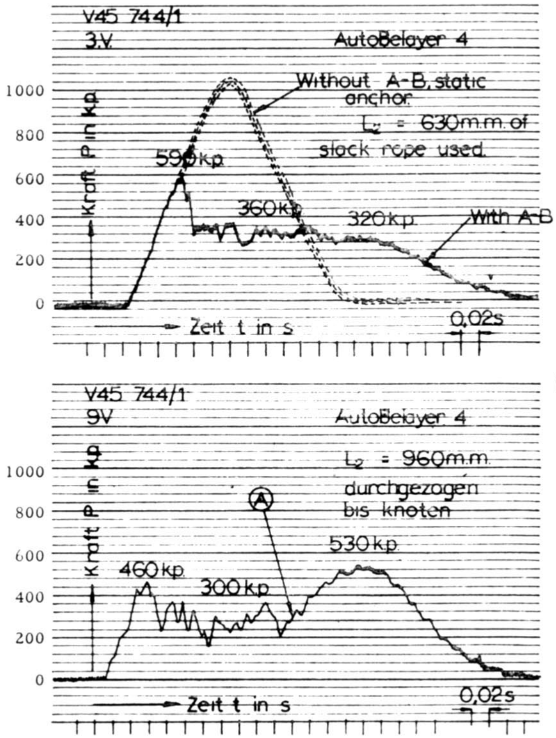
Shown in pl. 118 is an oscillogram of the force in the climbing rope when a 176-lb (80 kg) weight was dropped on it, 5 m of fall on 2.5 m of rope, static anchor. The dotted lines of the upper graph show the force curve when the rope was the only energy-absorbing component. It can be seen that the peak force was about 1040 kp (2288 lb).

For the curve marked 'With A-B', the Auto-Belayer was interposed between the climbing rope and the weight, and the adjustment screw was set half a turn higher than normal. The force started to rise as before, but reached only 590 kp (1298 pounds). At this point the rope started to slip through the Auto-Belayer. The restraining force then dropped to abour 360 kp (792 lb) until the energy of the fall was used up (converted to heat), after which the rope stopped slipping.

In this example, only 2 ft (630 mm) of rope slipped through the Auto-Belayer. The fall was 17 ft (5 m). If a higher fall is taken, more slack rope will be pulled through, hence the suggestion above that 5 ft (1·6 m) of slack rope be provided.

Tests performed by Technische Versuchs-und Forschungsanstalt.
der Technischen Hochschule in Wien.
Vorstand: Prof. Dr. R. Slattenschek.

2-3-1970



AutoBelayer 4
normal

(A) The length of the loop of slack rope was not sufficient, and pulled tight on the knot at time (A) The security knot then took over the load.

AutoBelayer 4

The AutoBelayer is a development of Mountain Safety Research, Inc.
631 South 96th St., Seattle, Wash. 98108 — U.S.A.
Patent applied for by Larry Penberthy.

What happens to the heat? The energy of a 17 ft (5 m) fall of the weight is enough to raise 1 oz (28 g) of water from room temperature to boiling. Part of the heat goes into the Auto-Belayer, raising its temperature to, say, 49°C, and part of the heat goes into the skin of the rope where it does no harm because of the low temperature. (Note: nylon is not hurt by temperatures up to 120°C.)

What happens when the fall is much greater, say 120 ft (37 m)? The temperature of the Auto-Belayer rises to, say, 70°C, and the extra heat is carried away by the climbing rope as it passes through. In making this test, the Auto-Belayer was set for 1200 lb (545 kp), and 17·6 ft (5·3 m) of rope was pulled through by an electric puller.

What happens when the slack rope is not long enough, and is used up before the energy is fully absorbed? In pl. 117 it can be seen that the end of the climbing rope is knotted with a figure-of-eight loop, which is snapped into a carabiner attached to the body harness. When the slack rope is used up, the load is carried directly to the harness, and the climber is subjected to forces which depend on the energy absorbing properties of the rope, carabiners and human belayer. But if the Auto-Belayer is set according to directions, the situation of the falling climber can only be improved by its presence. This is shown in the lower graph of pl. 118. The Auto-Belayer was set at a more-normal restraining force, 460 kp (1012 lbs) and the length of slack rope was limited to 3 ft (0·96 m). The slack rope pulled up tight, as anticipated, at point A on the graph. The climbing rope then began to absorb the force, with a curve similar to the dotted lines in the upper graph. The peak force reached only 530 kp (1166 lbs) instead of 1040 kp (2288 lbs) because part of the energy had already been dissipated by the Auto-Belayer.

What can the Auto-Belayer do for the falling climber that a good belayer cannot do? It can limit the peak force to be sustained in a fall to a reasonably low figure, regardless of the number of zig-zags of the rope through intermediate carabiners. This is useful for guarding against pulling out pitons, as well as for the 'comfort' of the falling climber. Even a good belayer will have trouble assessing how much hand and waist friction to apply as the number of such carabiners changes. Further, the Auto-Belayer will do its work even though the belayer's end of the rope jams. In fact, the belayer might well anchor his end of the rope solidly when an Auto-Belayer is being used.

Disadvantages? The presence of an extra 'thing' at the waist has been considered a disadvantage. The slack rope has to be carried somewhere. One solution is to put it in a light cloth bag suspended from the waist belt at the back, out of the way. Also, the spacing of the climber's body from the rock is increased, which wall climbers do not encourage. This spacing can be reduced to 1 in by threading the harness through the pair of holes, instead of interposing a carabiner.

The possibility of inadvertent alteration of the setting of the screw has been a concern to some. This point has been dealt with by jamming a bit of polyethylene (polythene) sheet in the threads to retard rotation of the screw.

In summary, the Auto-Belayer has the ability to limit peak forces in climbing ropes, and may well have a useful place in the safety-conscious climber's equipment.

Larry Penberthy *Mountain Safety Research*