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JAN AND HERB CONN

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CARDEROCK ACCIDENT REPORT EXCERPTS

Arnold Wexler, Paul Bradt, and Andy Kauffman served as a committee to investigate the climbing accident at Carderock on December 26, 1954 to determine the causes and to recommend measures to prevent or reduce the probability of similar accidents reoccurring. Excerpts from the committee's report, which "found nothing remiss on the part of the individuals involved," are presented here so that our experiences may serve to further safer climbing practices with our own and other groups.

The situation:

Three climbers, all of whom had had belaying instruction and practice were making the Cris-Wex-Don Traverse. The leader was an expert climber and experienced leader, the second man was superficially acquainted with team climbing and inexperienced in belaying a leader from an exposed position, and the third man was a novice. (A fourth member of the team had given up the climb earlier, been belayed to safety, and untied. This left a double rope distance of 75-80 feet existing between the second and third man.) At the time of the accident, the leader was established in an excellent belay position on the cedar tree shelf. The third man was being lowered through a carabiner in a sleeve type expansion bolt, located 24 feet above the ground and one foot above the overhang over the sloping ledge, halfway between the small inside corner and the cedar tree shelf (near the intersection with Arnold's Arduous Ascent, the place where Oscar hung out in his pre-arbor days). The hole for the bolt had been drilled and the sleeve placed in March 1954. The leader of the team had screwed a bolt into the sleeve, tightened it mildly with a carabiner, and partially tested it (downward pull without his full weight). The second man had part of his weight in the rope tying him into the bolt as he belayed with both hands on the rope (see sketch on p.#). As the third man leaned out from the cliff and into the rope, the bolt gave way with a loud crack. The third man fell head up, feet down for 15-20 feet. The belay rope ripped out of the second man's hands with little or no snubbing. The third man landed in soft ground and apparently struck his foot on a loose rock. His left knee was cut on a sharp edge of the cliff during the fall and on landing he broke his right heel and right fibula. The second man swung to his right (either because he was insufficiently balanced by failure of the bolt or by a jerk of the rope) and was caught, unharmed, by the leader. A doctor with the

group was summoned and quickly administered first aid. The leader and second continued to the top of the cliff and then joined those assisting the injured man. Dead poles, in lieu of an ax for chopping green ones, proved inadequate support for a coat stretcher so a rope stretcher was made. Eight men carried the injured man to the towpath from where he was transported in a jeep wagon to the nearest hospital. (The jeep was granted access to the towpath through Model Basin property.) The injured man was hospitalized for 16 days, and his foot remained in a cast for 36 days. The prognosis was generally favorable.

An examination of the rock where the bolt had been showed that the rock had spawled or crumbled around the bolt, leaving a hollow depression about 5/8 to 3/4 inch deep and about 2-3 inches in diameter at the face (see sketch on page 3).

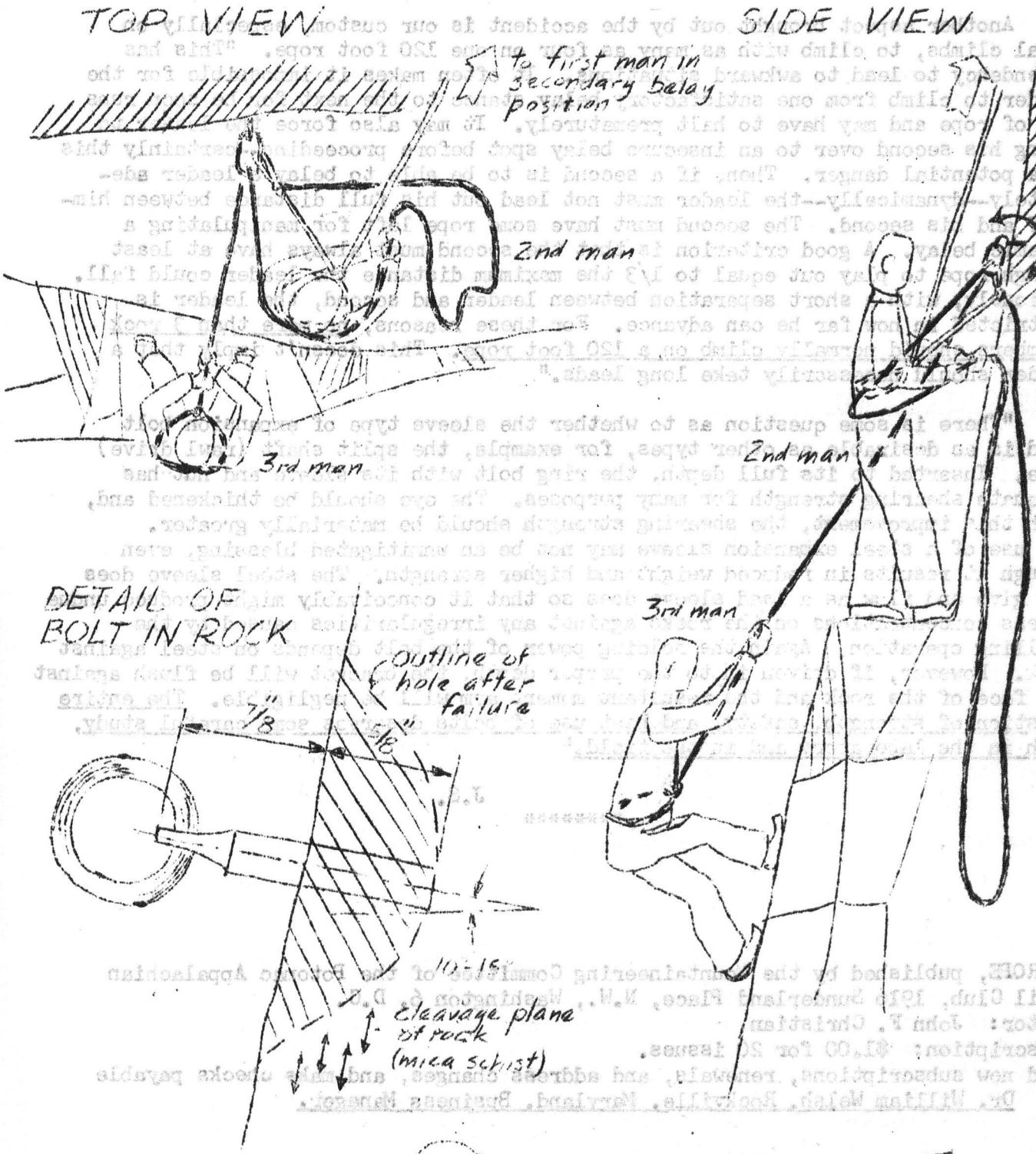
From tests made later, including those with another bolt under corresponding conditions (in sleeve placed in similar rock, also in March 1954), it was estimated that the force on the accident bolt was about 400-450 lbs -- about 1½ - 2 times the weight of the 3rd man plus 1/2 to 3/4 the weight of the 2nd man. Examination and tests further indicated that failure was not due to weakness caused by weathering.

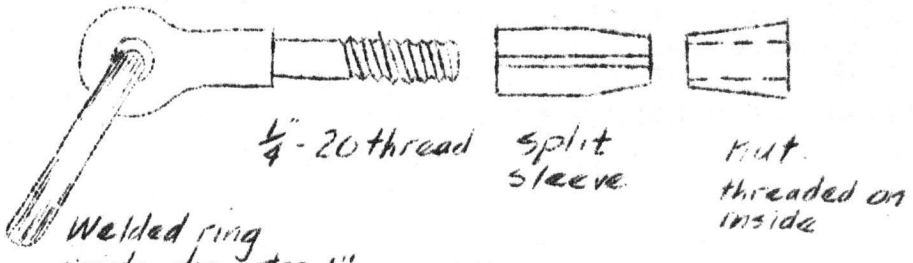
"From these tests it may be concluded that failure is associated with the short length of the bolt in the rock and the long moment arm. It does not take much force to cause the inadequately driven bolt to bend.....Bending tends to produce high compressive stress es in the rock. This type of mica schist is weak on a microscopic basis so that it crumbles very easily....hence the bending of the bolt crushes the rock beneath it; this permits the bolt to rotate and crush the rock on top. In general, spawling then follows, the rock crumbles and the bolt pops out."

Considerations:

Expansion bolts of the sleeve type such as failed in the accident (see sketch) should be inserted in holes deep enough to hold "not only the sleeve, but which permit the shoulder of the bolt to be inserted up to the eye so that little or no moment arm remains. Used in this fashion, this type of expansion bolt should be adequate for about an 1800 lb. load in shear."

Regarding a belay stance in which the belay rope from the third to second man runs from the bolt in front of the second man (belayer) to his right side, over the rope to the leader, then around the belayer's hips to the left, with the left hand then serving as the snubbing hand, the report says: "This type of belay has a superficial advantage in that a pull on the rope tends to rotate the belayer into the cliff and hence into a more secure position. However, this would have only been a momentary advantage, for without the tie support, the belayer would have been immediately jerked from his stance. Whether a highly skilled and experienced belayer....using dynamic techniques could have partially arrested the fall is completely speculative.....what would have been desirable--and this should be considered by leaders setting up a climb--is a separate piton or bolt for climber and belayer. Thus if one inadvertantly fails, the other will still be available....."





SLEEVE TYPE EXPANSION BOLT
(All parts are steel, manufactured by Gerry Cunningham)

Another aspect brought out by the accident is our custom, especially on local climbs, to climb with as many as four on one 120 foot rope. "This has a tendency to lead to awkward situations. It often makes it impossible for the leader to climb from one satisfactory belay stance to the next for he soon runs out of rope and may have to halt prematurely. It may also force the leader to bring his second over to an insecure belay spot before proceeding--certainly this is a potential danger. Then, if a second is to be able to belay a leader adequately--dynamically--the leader must not lead out his full distance between himself and his second. The second must have some rope left for manipulating a dynamic belay. A good criterion is that the second must always have at least enough rope to play out equal to 1/3 the maximum distance the leader could fall. Obviously, with a short separation between leader and second, the leader is restricted in how far he can advance. For these reasons, no more than 3 rock climbers should normally climb on a 120 foot rope. This doesn't imply that a leader should necessarily take long leads."

"There is some question as to whether the sleeve type of expansion bolt used is as desirable as other types, for example, the split shaft (rawl drive) type. Inserted to its full depth, the ring bolt with its sleeve and nut has adequate shearing strength for many purposes. The eye should be thickened and, with this improvement, the shearing strength should be materially greater. The use of a steel expansion sleeve may not be an unmitigated blessing, even though it results in reduced weight and higher strength. The steel sleeve does not give and flow as a lead sleeve does so that it conceivably might produce undue stress concentrations on the rocks against any irregularities caused by the drilling operation. Again the holding power of the bolt depends on steel against rock. However, if driven in to the proper depth, the bracket will be flush against the face of the rock and the resultant moment arm will be negligible. The entire question of strength, safety, and best use of bolts deserves some careful study, both in the laboratory and in the field."

J.S.

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