SAFE E E A

NEWS OF THE P.A.T.C. MOUNTAINEERING COMMITTEE 1916 Sunderland Place N. W. Washington 6, D. C.

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Number 1

COMING EVENTS

- May 29-31 Memorial Day Three day trip to Seneca Rocks Leader: 'Ted Schad. Champ, Nelson and/or Schoolhouse are also possibilities. Camp at Armentrouts' or at Mouth of Seneca Picnic Grounds. Commissary by cars.
- June 6 Cross country hike from great Falls, Va., to Chain Bridge. Leave Hot Shoppe promptly at 8:30, leave cars at Great Falls Amusement Park about 9:00 A.M. This trip should put you in condition for your summer mountaineering -- what sort of condition we won't venture to say. Map reference: U.S.G.3. Falls Church quad, 1/31680.

June 19 - Sugarloaf Mountain, Md.

The following actions were taken at the business meeting, May 14: 1. Jane Showacre was re-elected vice chairman.

- 2. It was decided not to elect a secretary.
- 3. Ted, as chairman, was authorized to look into the possibility of securing a small gas engine to hoist Oscar and to buy a suitable one if available.
- 4. It was decided that there was no longer any need for the Mountaineering Committee to have a separate treasury and collect separate dues since we also receive an annual budget allotment from the PATC treasury. Current expenses will be met from the Mountaineering Committee treasury until it is exhausted, and no further dues will be collected.

VACATION OPPORTUNITY for a girl with an itchy foot. Helen Baker and two friends are looking for a fourth to join them on a month's trip (July 24 to August 24, or thereabouts) this summer. Their proposed trip is as follows: through New York, Ontario, Michigan, Wisconsin, Minnescta, North Dakota, to Glacier Park, where they will rent a burro or two and do some packing; Yellowstone, the Black Hills with a visit to the Conns, and back to Washington. Estimated cost: \$120. Contact Helen if interested.

A FEW TECHNICAL NOTES ON ROCK CLIMBING

by Paul Bradt

Climbers of rocks are to such an extent technically minded that it is thought that a few arm-chair deductions on climbing might be of interest to them. For this purpose use will be made of vectors which are arrow shaped lines used by engineers to represent forces. For the uninitiated let me give a simple example. Figure 1 represents a climber standing in the mud (to the editor he looks a little more like a caver). Arrows w and w', which we shall call vectors, represent the forces to be considered. The direction of the vector w indicates the direction of the downward force due to his weight. Its length, at the scale of one inch = 100 lbs., indicates the magnitude of this force thrusting him downward into the mud is 160 lbs. this feet. The smile represents satisfaction with the realization that w' = w and is oppositely directed, and he has ceased to sink. (Just as I thought, a caver---he can sink no lower---ed.)

Forces have a way of occurring in pairs. In fact, whenever a climber presses against a rock in a given direction, the rock presses against the climber just as hard in exactly the opposite direction. This is noterealized by the ignorant





FIGURE 1

FIGURE 2

climber of figure 2. While standing on a slab at slightly less than the critical angle he became worried, and to steady himself, he leaned against the wall with a force f. The resulting thrust f' of the rock upon his hand necessarily caused him

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to slide down the slab. He was pushed from his footing just as truly as if someone else had done it.

Toward reducing our resemblance to this chap let's consider the forces operating when a man stands on a sloping rock. He exerts only one force, his weight, represented by the vector w, but for purposes of analysis it can be resolved into two vectors, p and s, as shown in figure 3. The vector p indicates the amount of pressure (in this case 100 lbs) pressing his shoes against the rock. The vector s is the force (90 lbs) tending to cause his shoes to slip down the rock face. Whether this slippage occurs or not depends upon the rock texture and the climber's shoe coles. 1/ It is seen that s/p = H/D, the slope of the rock. So long as the rock isn't too steep the pressure p is sufficient to prevent slippage due to s. At the critical slope, c, these two forces are just balanced. Steeper than that, this pressure isn't enough to hold.





FIGURE 3

FIGURE 4

The condition just referred to is shown in figure 4, wherein the angle of the rock, q, is greater than the critical angle,c. To find the force needed to prevent a climber from slipping under these conditions, resolve the weight vector w, as in figure 3 into a perpendicular, p, and a slippage force vector, PF. Also draw the critical angle, c, from p to intersect the slippage vector at R. The vector PR is the slippage force that cannot held by the pressure p. The rest of

This was emphasized in my carlier Up Rope paper "Some technical aspects of rock climbing" April 30, 1948 (reprinted in Up Rope vol. The notation and values of critical angles are from this earlier paper. This paper was reprinted in The Iowa Climber, vol 2, no.2, pg.82 ff.

had been standing on a smooth quartz slab at F_1 , fig. 5, when he noticed a leveler band at shoulder height. Leaning gently in that direction and carefully pressing straight down with his gloved hand, he was able to take much of his weight off of his feet. At the instant he slipped, the forces were as shown in Fig. 5. In that figure, the weight w2 taken on his hand, and w1 that on his feet, added together equal his weight. Based on these two vectors, I have made a construction similar to fig. 4 for both hand and feet. The critical angle $P_1C_1R_1$ for rubber on such rock is greater than the angle q_1 (equals angle $P_1C_1F_1$) of his footing.

Accordingly his fect resisted slippage with a force R_1F_1 and he certainly wouldn't have slipped if he hadn't touched his hand to the rock. However, he had dry cotton gloves on his hands and their critical angle $P_2C_2R_2$ was considerably less than the angle q_2 (equals $P_2C_2F_2$) of the handhold. The excess slippage force R_2F_2 on his hand exceeded the holding friction R_1F_1 of his feet and caused his descent. The principles of this incident should be given at least fleeting consideration before touching the wall with any part

of the body having less holding power than

the slippage force, RF (about 30 lbs as drawn) is the amount that must be held, as by the pull F'R' of the rope (shame!, shame!.) or by a handhold, to prevent him sliding down the slope.

But a word of caution concerning handholds is in order. In critical conditions the placing of a hand on the rock may be just the wrong thing to do. The climber



ones shoes.

A climber ordinarily doesn't reach up and get a hold on a rope as shown in fig. 4 The same pull F'R' could have been obtained from a handhold on the rock if one is available. In the center of figure 6, a climber is holding himself by applying that pull to a handhold. The handhold has to yield or pull upward on him with the requisite force F'R'. The thrust of the legs, CR', added vectorially to the pull of his hands, R'F', equals the weight vector w, indicating that his position is stable.

ones shoes.

However, it is rather difficult to exert the force F'R' parallel with the rock face. The climber above him is pulling on his handhold in the direction of his arm at FR'. This is the easiest direction to pull. Moreover, he doesn't have to pull as hard. Because he pulls up somewhat more on the rock with his hands, he necessarily bears down on it more with his feet as indicated with the longer arrow CR'. The resulting greater pressure p gives his shees the greater holding force P''R'. Again the log thrust CR" plus the arm pull R"F" equals the weight w.

The upper climbers of fig. 6 have placed their legs at the critical angle c from the perpendicular p to the rock face. The lowest figure is that of a novice occupying a position in which novices are often photographed. Rather than place the feet low, where he fears they may start slipping, they are placed higher toward the hands. This brings the leg thrust in the direction $CR^{""}$. The much greater thrust shown by this vector is necessary in order that the vector triangle with w can be closed by a pull $R^{""}F^{""}$ in the direction of the arms. Ordinarily the legs don't so

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much feel this extra thrust but the tremendous pull R" 'F" of the hands is unnecessarily tiring on the fingers and likely to pull off the handhold. How, the novico may ask, does one learn how to place the legs at the critical angle from perpendicular p? By experiment, of course. Each step on changing rock is an experiment to determine the local critical angle. On the climb just discussed, the climber guesses at the angle and places his foot accordingly with hic weight on his heel and the tee up slope toward the handhold. If he has over-estimated the permissable angle c; his foct will begin to slip. An almost instantaneous shift of the pressure toward the toes can close the effective angle by as much as 10 to 12 Togrees (see angle a, fig. 7). If his judgment has not erred more than this, the shift will stop the slippage. With this latitude available for experiment, one can experiment freely and arrive at a pretty fair judgment of critical angles for ones footwear. One gains no friction by placing the too up slope; only a safety margin if the handhold is that way. Even that isn't gained if the rock is dished somewhat. ;; With this introduction to the simple vector analysis of climbing forces, one can bettor understand many problems. short For example, there is a instruction climb on Old Rag Moun-Climb), tain (the "Finesse forced to use a whorein the climber is hold at F, fig. 8, nearly vertical footbulge at H as a and a small, wartlike climber has rubber handhold. If the foot will not slip scled shoos, his . if its pressure makes on the granite. 45 degrees with the peran angle of ... to the foothold surface. pendicular, p, tion CR is accordingly The direcdirection to thrust, with the best ... the foot. The hand pull on S Himust provide a vector from some point on CR to the end F of the weight vector w.; It might appear that theiclimber could choose to close his vector triangle by pressure at H represented by vectors HX, HY, HZ; or some other Phi such force. However, those who have tried this climb realize that it isn't that simple. 111. R We shall leave cur climber struggling while we consider a box of sand, fig. 9A, resting on the edges of two parallel angle-iron bars. To

figure how much weight rests on either bar, we con-

sider the bars ' positions relative to the central spd G

FIGURE 6

TT. TLA



FIGURE 7

called the center of gravity of the box. Of course the ccurse the two upward forces F_1 and F_2 of these bars must add together to equal the weight of the box. But there is another condition to be met, for which we drop a vertical line from the center of gravity G. The forces F1 and F2 rust have longths such as will make area A_1 equal area A_2 , where the A's are the areas of the parallelograms contained between the F's and the vertical line. This condition is quite general. In fig. 9B we see it applied to a box balanced on sloping props having oblique puches P1 and P2. In fig. 90 the box is supported by prop Po and pull chain P1. Again A1 equals Ap.

The forces applied to the box of fig. 90 are analogous to those applied to the climber of fig. 8. The forces he applies FIGURE 8 are their opposing counterparts. Accordingly we locate the conter of gravity of the climber in the position shown; draw the vertical line UD through G; and drop perpendiculars from the points of application of the forces onto the line UD. Now by measuring the perpendicular distances of H

D

A2

slope

uf fout-

~ nold



FIGURE 9

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and F from UD and the length of the weight vector w, one can solve the two equations: Downward pressure of hand + downward thrust of foot = w Downward pressure of hand x distance of hand from UD = downward thrust of foot x

Downward pressure of hand x distance of hand from UD = cownward thrust of foot x distance of foot from UD.

Taking the measurements mentioned from fig. 8, we find that the downward pressure of the hand is 10 lbs. and of the foot is 140 lbs. Accordingly, Pull HX is the only Possible hand pressure. The others require too much downward force. The corresponding foct pressure is CX. Due to the poor handhold at H, it would be to the climber's advantage to get his center of gravity closer to the rock, and accordingly closer to his hand. This would allow him to pull more in the direction HY, -- a direction in which the hold H is better suited to serve.

Clearly one could apply such analyses to varied and more complex situations but I think it is time to stop. The fundamental principles have been illustrated. Besides, consideration of these analyses occurred to me while trying to tell beginners how to make the step of Fig. 8, but the explanation of why was a little more than I could handle on the spot.

We just recoived Holubar's new catalogue. Anyone interested is welcome to borrow the editor's copy. The new Gerry catalogue lists a number of items of caving equipment which may be of interest to some of our underground friends---if they ever got out of the mud on page 2.

Leafing through the May 3 issue of THE YODLER (Sierra Club, SanFrancisco Bay chapter) recently we came upon a section in lurid pink entitled "Paddle Patter". Overcoming our first editorial reaction we read a little further and were rewarded with the following bits of useful information:

".....if you must hit an object, hit ait head on if you can....." (None of these half way measures for our California friends. Having just returned from a short junket to the land of sunshine ourselves we concluded that THE YODLER must have a tremendous circulation among motorists in the San Francisco area.)

".....a capsized cance weighs several thousand pounds. NEVER get on the downstream side of it. "

(We cogitated on that one for quite a while, but weren't able to figure out why a cance weighs any more upside down than it does rightside up. Anyhow, we concluded that the underside wouldn't be so good aither.)

".....When someone is bearing down on your tail, you have no room for backpaddling, hovering, or ferry gliding." (We tried this and found that our fairy gliding was a bit rusty, even without someone bearing down on our tail.)

Also in THE YODLER we came across a homey bit of philosophy from Harper's Magazine (May, 1954)

"If a mountain persists as a challenge to a man over 26, it is a bad sign. The passion to lick mountains and philosophize about it implies some psychic deficiency or sex frustration. No philosophy of mountain conquering makes the slightest sense whatever." Thes. H. Ferril

Not only that, its hell on pants. .

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In the May 13 issue of MUGELNOOS (Ski Mountaineering and Rock Climbing Sections of the Sierra Club) we note that...."126 neophytes and veterans opened the 1954 RCS climbing season (on April 25)....At the May 2 Mt. Pacifico practice climb, 129 sighed the register...."

And we don't blame it a bit.

THE EXPLORER (Explorer's Club of Pittsburgh) carries in the May issue a full page of photographs of various club activities, including many on Seneca. One that we noted particularly was taken at the base of Devils Tower with Herb and Jan Conn inconspicuously in the background.

We also read with interest the account of the April 24 trip on which "Ben Nelson demonstrated ropelling using a sling and D ring. Walt pointed out the use of an emergency ropel"

Could it be that repeal is the word the EXPLORER's correspondent is gropping for----vory useful in touchy politicall situations.

UP ROPE's worthy business manager is in the process of compiling a new list of subscribers with addresses and telephone numbers. If your's has changed recently, please notify Peg Keister. **********

