and the Forecast

NEWS OF THE P.A.T.C. MOUNTAINEERING COMMITTEE

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FOUNDED BY JAN AND HERB CONN

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COMING EVENTS

April 11 - Carderock - Belay practice with Oscar.
April 18 - Bull Run Mountain, Va.
April 25 - Virginia side of Great Falls, opposite the Fish Ladder.
May 2 - Echo Cliffs.
May 8-9 - Old Rag (details to be furnished later).

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NO DALLY ALLEY

by John Christian

During the February 19-22 trip to Seneca Rocks a party consisting of Ed Worrell, Bill Hemphill and John Christian "discovered" a new chimney climbing area. "Discovered" seems to be appropriate, as only one Army piton was found inside and then only 5 ft. above the floor. The chimney is formed by the divorce of a large flake from the west side of the North Peak. The bottom of the chimney can be reached by traversing easy ledges from the Gunsight. At the south end the chimney is a maximum of 100 ft. or more in height. The width varies from 4 to 6 ft. over the 300 ft. depth or length. In the north half there is a large accumulation of chock stones near the floor. Traversing over these chock stones it was noted that the floor dropped sharply away to 20 or 30 feet below.

As time was short, a quick route up was desired. A ledge was discovered on the west wall, beginning at the chock stones, and sloping upward to the south. It ended in a widening of the ledge about 10 ft. below the top. John led up to this place and drove a piton. A vertical crack extended up to the top of the west flake. John continued the lead up this crack and then belayed Bill and Chuck.* up. The top of the west flake was graced by one well-bleached pine trunk. A walk along the narrow top to the north brought the party to a large chock stone suspended at the top of the chimney. From here the group descended by a series of ledges and "chimneying" to the north opening of the chimney.

The group named the chimney the "No Dally Alloy" and the lead climb the "One Stop" route. Also, the west flake was named the "Woiss Wand" for the whiteness of its west wall.

* Neatest trick of the week.

SOME TECHNICAL ASPECTS OF ROCK CLIMBING*

by Paul Bradt

Part 1 - Friction

Preparatory to making a few technical notes on climbing, I looked around for some data on the relative merits of different shoe soles. Along with the meagre handbook information one finds considerable caution given about variability of friction, as on different parts of the same rock. No climber needs to be told about such variations. He learns about them the hard way.

Two publications of the National Bureau of Standards, each obtainable from the Superintendent of Documents, Washington, D.C., for 10¢ (as of April, 1948), have merit. The one on "Relative Slipperiness of Floor and Deck Surfaces" (BMS-100) by Percy A. Sigler lists the data in my Table 2. The other, from the Journal of Research of the National Bureau of Standards, is by Frank L. Roth, Raymond Driscoll and Wm. L. Holt on the "Frictional Properties of Rubber" (RP-1463). It is a thorough treatment of the subject on which much of my discussion is based. The references left something to be desired in the way of diversity of data. I accordingly hinged a couple of timbers together (Fig. 1) to provide a tiltable surface. My procedure was to put on the shoes to be tested and stand on the surface of the sample while it was jacked up. When I began to slip the jack was stopped and the slope measured. These values are listed in Table 1. In that table the diagonal lines show the slope of the rock at the time of slipping, and the numbers give the value of the slope. Figure 2 explains how this number was obtained. In that figure, r is what the textbooks call the "greatest angle of repose." (Imagine-- repose!) The ratio of height, H, to the horizontal distance, D, I call the critical slope, H/D. This ratio is technically the "coefficient of friction," but I think my term is psychologically more appropriate for rock climbing.

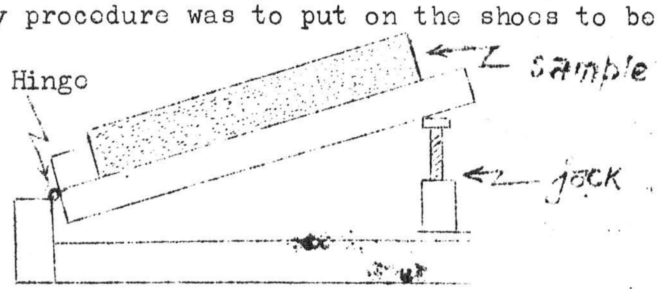

Fig. 1

Some experiments were performed by Sigler to determine the effect of dirt (a sprinkling of china clay) and water on floors. For these experiments actual shoes were not used but instead a sled runner-shaped "heel" of leather or smooth rubber was mounted on the bottom end of a pendulum. The pendulum was swung from a support with a hole in its flat bottom and was so placed that the heel, as it swung past its lowest point, would extent slightly through the hole and rub on any floor surface the apparatus was mounted on. The slipperiness was determined by the amount of speed lost by the pendulum during contact of the "heel" with the floor. To reduce the effect of "heel" wear on the results, the "heel" was spring mounted so that it could yield somewhat in the direction of pendulum length.

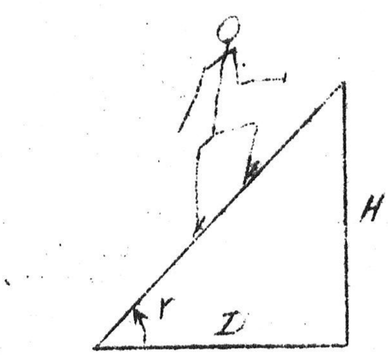

Fig. 2. Profile view showing CRITICAL SLOPE H/D. If it were any steeper, he'd slip.

This apparatus is particularly suited to determining the effects of moisture and dirt on a floor surface. However, an obvious defect is met in studying the holding power contributed by a roughness of surface. Roughness consists of adjacent high

Table 1.
Critical slopes for different foot gear on dry clean rocks.

	1	2	3	4	5	6	7	8
GLASS Commercial plate to simulate quartz or obsidian.	.17	.16	.25	.69	.45	.24	.69	1.3
SLATE split with a somewhat rough surface	.70	.59	.58	.62	.56	.55	.68	.96
LIMESTONE ledge rock packed with brachiopods and coral.	.92	.44	.47	.82	.69	.89	.89	.96
SANDSTONE bearing some mica. A rather soft smooth piece.	.87	.63	.73	.84	.84	.96	.92	1.05
GRANITE from stream bed About as smooth as an avalanche slope.	.69	.55	.67	.82	.72	.85	.89	1.0
CONGLOMERATE (?) A seasoned slab of concrete formed mostly of 1/4 inch pebbles.	.85	.84	.84	.89	.82	.92	.94	.77

Column
1. - Hard steel Tricouni nails, new.
2. - Soft iron nails.
3. - Clean dry sole leather.
4. - Bare foot.

Column
5. - Thin cotton socks.
6. - Italian hemp rope soled shoes.
7. - Cleated stiff rubber soles. (Now Bramanis)
8. - Sneakers with soft rubber soles worn thin.

The figure for Tricounis on glass is too high for them on quartz. They bit into the glass but couldn't scratch quartz.

Bare feet would have stood a higher angle on conglomerate if they or their wearer had been tougher.

The socks were slightly moist, and gave higher values for smooth surfaces than they would if dry.

On the soft stones the Tricounis bite in and are superior to soft iron nails. On the bare rough stones, the data are not decisive. After the Tricounis become worn smooth, they lose much of their virtue and are thought to be inferior to edge nails and soft iron hobs on surfaces like granite. The sharp hard crystals of such surfaces bite into the soft iron better than the steel.

The Tricouni nails, and to a lesser degree the edge nails and Bramani soles, are designed to hold on narrow ledges of hard rock. Their virtue in this is not brought out in this table. More will be said about this later.

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and low spots. In use, this apparatus then rests on the highest spots and the mean pressure on the "heel" is reduced by this lifting. As the result the critical slopes listed in Table 2 that apply to the roughest surfaces should be regarded as somewhat too low.

Dry dirt can become imbedded in the leather and increase its holding power.

Water, even though dirty, can escape sufficiently through the pores of leather to increase its holding power on a smooth impervious surface above that of smooth rubber. This property is even more conspicuous in rope soled shoes. Rubber's weakness in this matter is sometimes reduced by providing it with surface grooves through which the water can escape from between the surfaces. Note, however, that this problem occurs on only smooth impervious rock. On rough or porous rock the shoe need provide no egress for the water.

Rubber is generally superior to leather in holding power and it is never better than when dry and clean.

Rubber, by its fine performance, deserves special attention. I accordingly report some features noted by Roth et al.

	Dry & clean	Dry & dirty	Wet & clean	Wet & dirty	"Heel" composition
Vermont white marble polished (honed)	.37	.39	.26	.22	Leather
	.80	.39	.15	.13	Smooth Rubber
Minnesota white granite Honed and then roughened	.40	.44	.18	.18	Leather
	.62	.47	.47	.40	Smooth Rubber
Minnesota white granite rough sawed (4-cut)	.44	.47	.44	.40	Leather
	.77	.58	.62	.55	Smooth Rubber
Tennessee sandstone ground flat.	.46	.49	.53	.47	Leather
	.90	.51	.62	.55	Smooth Rubber

Table 2.
Friction on wet and dirty rock compared with dry. Critical slopes for sliding friction.

1) The virtue of rubber is largely lost upon surfaces that are dirty, covered with lichens, or sand, for in such cases the rubber does not get to touch the cliff structure.

2) Rubber will not start to slide on a rough, clean granite-like surface as readily as on a smooth one. In fact, the critical slope for starting to slide on a surface like rough granite is about .9 while that for a surface like smooth quartz may be as low as 0.45. Yet if you can allow a slow slippage you can stand on steeper slopes (as I did to get the figure of Table 1). The slow slippage of $2\frac{1}{2}$ inches a minute on granite gave Roth a slope of 1.1 and on quartz a slope of 2! Note that for both friction increases with slippage, but so much more for the smooth material that it becomes much the better footing.

3) The humidity of the day does not affect the critical slope on clean insoluble surfaces, at least until the humidity is above 80% and probably not until visible moisture is present on the surface.

4) If slippage exceeds certain speeds, oscillations are set up, as when a skidding tire squeals. For such rapid movement, the value of the critical slope (in this case the slope at which there would be no change in speed) drops to a value approximating that at which no slippage occurred. The figures in Table 2 were obtained at such speeds.

5) A very smooth rubber shoe sole has definitely greater holding power on a dry smooth surface than does a rough one. Reference is not made so much here to the presence or absence of a tread design as to the smoothness seen through a high power magnifying glass or microscope. Smooth rubber has been known to hold 30 or 40% better than slightly roughened rubber on a smooth surface. By the same token smooth

rubber will hold better for a given low slippage rate on a smooth surface than on a rough one. Critical slopes of $4\frac{1}{2}$ have been repeatedly observed in the laboratory with a slippage of about 3/8 inch a second.

6) A rubber sole that does not chance to conform exactly to the roughnesses of the rock will normally touch the surface of the rock at only three points without being deformed. The weight of the shoe will deform the rubber sufficiently to bring a considerable part of its area into contact with the rock. The wearer's weight will increase the contact area. However, if the rubber is heavily loaded with a stiffening filler, less of it is brought into contact with the rock for a given pressure. This reduced contact accounts for the somewhat poorer holding power of st stiff rubber soles when compared with soft ones.

When the slope exceeds a certain amount, the rubber molecules are unable to hold on; the rubber being relatively free, springs rubber-band-like to a relatively unstrained shape and then grabs hold again. The rapid repetition of this performance constitutes the oscillation such as you hear when auto tires squeal. Clearly, the momentum which is gained by the sliding climber during the free period couldn't be stopped by the brief siezure unless the slope be reduced. Hence the low critical slope for sliding friction.

This concept of contact area explains why rubber is the poorest footwear on conglomerate. The protruding pebbles hold most of the rubber away from the rock. This concept also leads one to suspect that a climber could probably get more performance than even the fantastic slope of $4\frac{1}{2}$ on smooth clean rock if he wore portable pancake-like rubber footholds and handholds on his feet and hands. The virtue of suction cups may have little to do with suction.

While discussing rubber, it may be well to mention some results reported by Conant, Dum and Cox to the rubber division of the American Chemical Society (on May 8, 1947) comparing synthetic and natural rubbers. They found that on wet roads synthetic tires had 16% greater holding power, but on ice covered ones natural rubber was 8% superior. Apparently the man with the synthetic soles should lead wet pitches.

Thesesdiscussions have all dealt with rock of a definite slope. If parts of the rock slope less than others, these parts are used as footholds. Suppose that the more gently sloping area is small, -- say, $\frac{1}{4}$ inch wide. Obviously nailed boots are well suited to such small footing (if even its slope doesn't exceed the critical value). However, rubber soles on such footing lose that part of their virtue which depends upon a large area of contact. It is the relatively poor performance of rubber on such footing and on smooth wet surfaces and on conglomerate-like surfaces that keeps nails from becoming obsolete.

* Reprinted from UP ROPE, Vol. IV, No. 15, April 30, 1948.

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From the Editor's Mail: a postcard from the Lembecks, saying:

"More callers, i.e. one more, on the L's. Bill Kemper gave us a pleasant evening of reminiscences between ski sessions on the hills to the north of us with mutual friends on the base. Who's next? We surely enjoy the casual and planned visits of the old gang. Art and Win."

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Some of you new PATC members want to do your share and show your stuff? Bob Hendricks, chairman of the Shelters Reservation committee, is looking for volunteers to help out on the reservation desk at HQ. on Tuesday or Thursday evenings. It's an interesting job with nice people and a fine chance to learn more about the workings of your club and to meet other members. You would not necessarily working every week; every other week would be very acceptable. How about lending a hand and having some fun?