COG SQUEAKS

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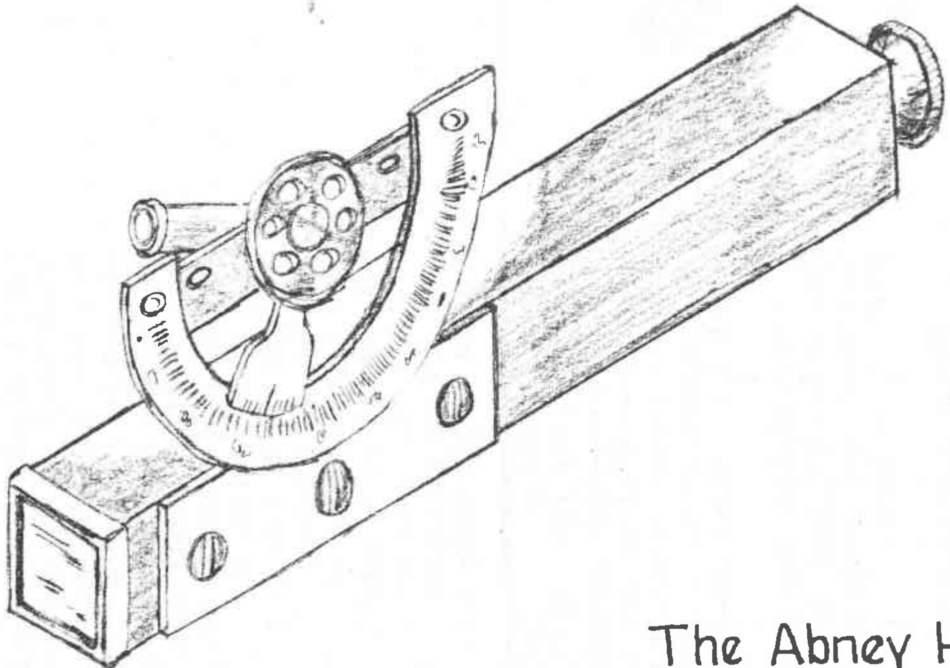

The Abney Hand Level

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National Speleological Society

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* MEETING NOTICE *
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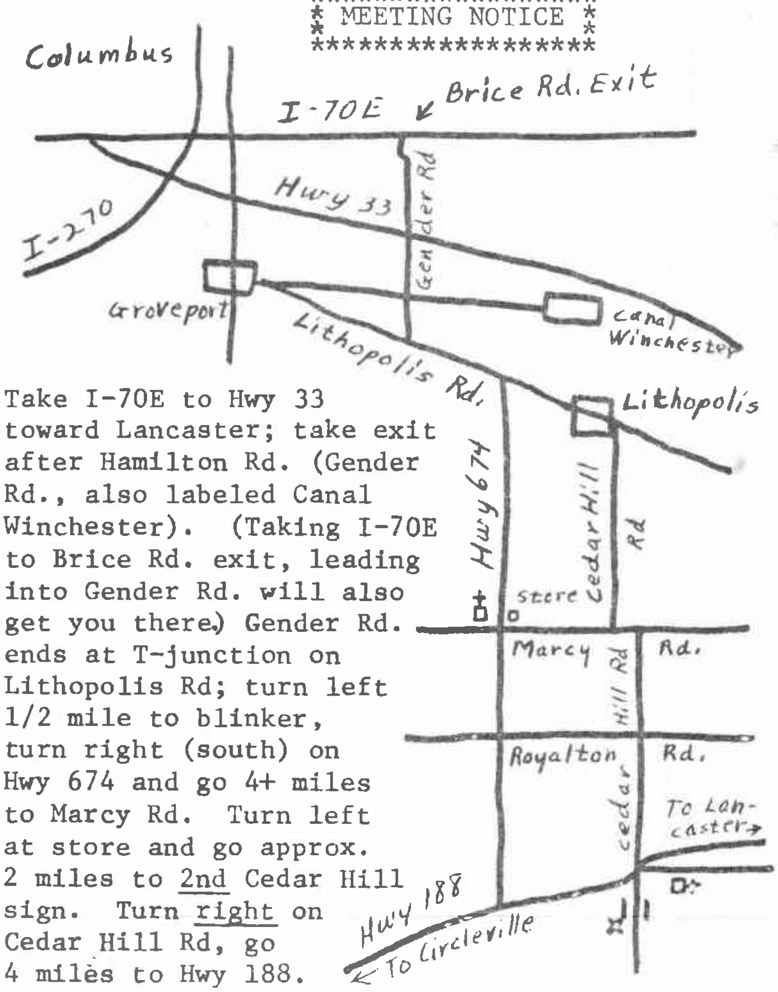

Take I-70E to Hwy 33 toward Lancaster; take exit after Hamilton Rd. (Gender Rd., also labeled Canal Winchester). (Taking I-70E to Brice Rd. exit, leading into Gender Rd. will also get you there.) Gender Rd. ends at T-junction on Lithopolis Rd; turn left 1/2 mile to blinker, turn right (south) on Hwy 674 and go 4+ miles to Marcy Rd. Turn left at store and go approx. 2 miles to 2nd Cedar Hill sign. Turn right on Cedar Hill Rd, go 4 miles to Hwy 188. Cross intersection carefully (poor visibility) and go down hill to left of store building with red doors. Redshaws are at bottom of hill, across bridge. Additional parking in church lot. Phone 969-4009 if all else fails.

This meeting features our annual preview of the NSS Photo Salon. This is a real treat, and everyone should make an effort to be there.

Please note that the date of the meeting is JULY 15; this is the THIRD FRIDAY of the month rather than the usual second Friday. Problems with Salon judging have forced us to reschedule. The usual time of 8:30 p.m. still applies.

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CAVE CREEK SYSTEM MAPS: THE 1976 REVISION

by Lou Simpson

A map of this cave system in Pulaski County, Kentucky was published in the COG Squeaks Vol. 18, No. 4, April, 1975, along with a comprehensive article detailing the exploration and cartography. Passages involving sixteen entrances were finally integrated into a system of 74,738 feet by February 1975. Several caves to the north of the integrated system remain separate, probably because of the artificially raised water table of Lake Cumberland. Prior to inundation in 1953 a large entrance on the Cumberland River at what is now the Cave Creek boat dock was well known locally. Information from the rare old edition of the Hail geological quadrangle records that this entrance had a stream coming out of it, was large in cross-section, and had many stalactites.

Prominent additions to the south part of the revised map include the connections of Goldson and Humongous Caves to Firestone Cave. The connection of Humongous and Firestone involved considerable new passage and the discovery of a new entrance by excavation of a point on the surface above a rat's nest. The Cloaca passage in Firestone was resurveyed when lake levels reached below 684 feet above sea level, but there still remain levels and leads which were yet flooded. Lower sub-lake levels in the north part of Firestone also appear on this map for the first time. A new addition to Goldson Cave is notorious 196-Shove Crawl, which frustrated all attempts for a Goldson-Hyden connection, despite sump-pushing and bolt-climbing. Near the Humongous Pit entrance is the now-defunct Great Humongous Dig and Railway, another abortive connection attempt. Wood was laboriously hauled in and assembled into rails for a dirt cart. A total of 110 horizontal feet was excavated. Then a connection between Humongous and Firestone Caves was found elsewhere. The rails rot.

The north map includes much-expanded Campground Cave Number Two and an unrelated cave system, Hargis Peter Cave. The map and description of Hargis Peter Cave was published in John House News Vol. 2, No. 9, September, 1973. The Campground Caves were described in COG Squeaks Vol. 19 Number 12, December, 1976. The inundated Cave Creek resurgence (at the boat dock) would be about 2000 feet west of the campground entrances. It seems reasonable to postulate a flooded connection between this resurgence and Campground No. 2, Smith Recluse, Barnett's and Firestone Caves.

About half a mile total new survey has been added to the system and associated caves in each of the years 1975 and 1976. It might be wise, therefore, to list briefly here any outstanding leads and projects that come to mind, lest they be forgotten:

Firestone Cave
1. Levels flooded yet at 682 feet above sea level: North Lake Room, North Lower Level, North Cloaca, Goldson connection area, pit near Red Room. There is probably a lower parallel passage running along the north side of the Cloaca.

Hyden Cave
1. Miscellaneous clean-up between Windy Way Maze and Anderson Entrance.
2. Loops in Sahara Room.
3. Push near-sump (warm water!) upstream Sahara Room.
4. Extend Outhouse Crawl.

Barnett's Cave
1. Walter's Folly level lead near connection (bolts, belay).
2. Leads below lake 682': survey Raft Route, leads to west downstream.

Smith Recluse and Campgound No. 2
S.R. - downstream lake level sump.
C.2 - deep sublake lead (marked 684').

Fred's Cave
When this cave was surveyed the sump was open and a long bellycrawl continued. A subsequent attempt found a sump in the crawl. The cave floods, which makes the project less appealing (death-trap).

As can be readily discerned from the above list, Cave Creek is surveyed. If Lake Cumberland should drop below elevation 680, say to 675, it might be profitable to reexamine the low levels, which will be full of mud of course. An attempt to do the bolt lead in Walter's Folly was again thwarted by the threat of severe thunderstorms April 2, 1977. (Continued on page 46)

USE OF THE ABNEY LEVEL CLINOMETER IN CAVE SURVEYING

by Lou Simpson

I recently obtained a catalog from Surplus Center in Lincoln, Nebraska, just to see whether they still sell the Abney Level clinometer. They do, and it costs $14.65 plus a dollar for postage. The order number is #812:

Surplus Center
P.O. Box 82209
Lincoln, NE 68501

Several years ago, before the current inflation, the cost was $8.95.

It is useful to attach a string to the clinometer while using it in a cave. Clinometers are easily lost. Many cavers prefer not to carry a clinometer in its case because it is time-consuming to take it out at each station. However, this would be a good idea under poor surveying conditions.

These levels have no designation of positive or negative slope, so it is a good idea to etch a plus and a minus at appropriate ends of the scale. A vernier is present for reading to the nearest ten minutes of arc, but I haven't tried to use it. I prefer to estimate to tenths of a degree by eye. Since the method of sighting involves centering a relatively large bubble on the dimly lit hairline, accuracy to ten minutes is probably unwarranted anyway. I usually remove and discard the little knob on the movable pointer because it interferes with reading the scale and also it is on the left side and I prefer to do the leveling with my right hand. Perhaps this is why these clinometers are surplus: they're left-handed instruments.

A small difference in inclination results in an appreciable change in vertical measurement for survey shots that are nearly level. This happens because the vertical component of the tape is the product of the tape and the sine of the inclination, and sines of small angles change more rapidly than sines of angles more nearly vertical. Therefore, it is essential that the level be calibrated regularly. Abney levels can easily get out of adjustment because the pointer can turn with respect to the bubble capsule if it is slightly loose. Perhaps a higher quality and more expensive instrument would not have this defect.

Calibration can consist of sighting at a target known to be level with the sighting position. Such a standard exists at the Pulaski County fieldhouse in Sloan's Valley where there are white paint marks on the front basement wall of the house and on the chimney in the yard. Such reference marks can be established anywhere, even using an uncalibrated clinometer. I believe the directions for doing this come with the clinometer. Briefly, this consists of marking a level on the wall while sighting from that mark at another wall. Mark a point on the other wall that the uncalibrated clinometer set at 0 indicates. Then sight from this second mark back toward the original target area and mark the level which the uncalibrated clinometer indicates is 0. The level midway between the two marks on the first wall will be level with the mark on the second wall. It takes two people to do this calibration. See Fig. 1. Now adjust the screws to change the clinometer until it indicates 0 when sighted between the two standard marks. This is a process of trial and error.

Since many cavers in the Central Ohio Grotto use the Silva Ranger (15T) compass for surveying, the choice of survey station points is most convenient when the instrument reader can sit or stand on or under them. This is great for marking stations on a horizontal surface, but how can a clinometer be read from this horizontal surface? We have been using additional parameters called HF (height from) and HT (height to), which are defined as in Figure 2. These parameters, which can be any value including negative, are recorded in the data book. In analysis of the data, the elevation of station 2 relative to station 1 is obtained by the calculation:

$$\Delta Z = T \sin I + HF - HT$$

The length of the horizontal component of the tape is obtained by multiplying the tape (T) by the cosine of the inclination (I). If HF and HT are equal, their difference is zero, and neither need be used in analysis since they cancel out.

If, after a survey has been made, a clinometer is found to be out of adjustment, the data can be adjusted by adding or subtracting the angular error. However, the data analysis may take place so much later that the instrument is no longer available

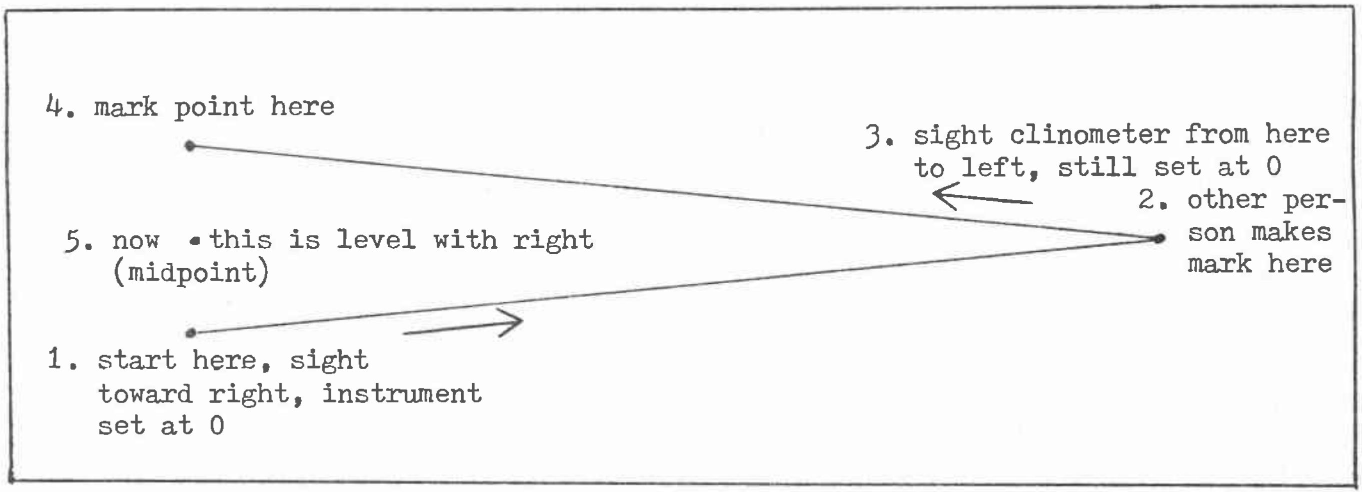

Figure 1. Calibration of Abney Level.

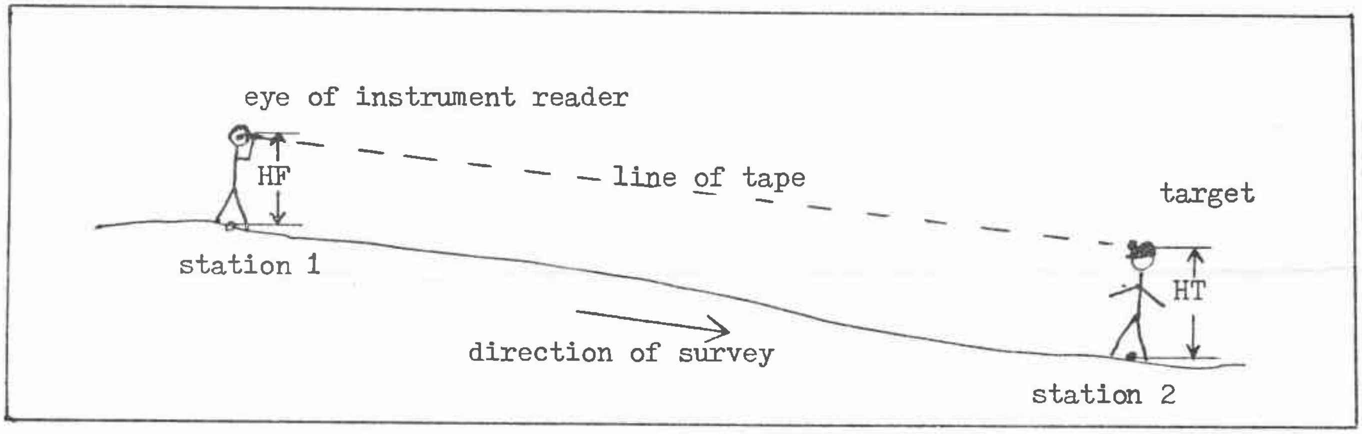

Figure 2. Use of Abney Level and definition of HF and HT.

and calibration at this late date might be irrelevant due to further disturbance. I recently analyzed some five-year-old data and found a ten-foot vertical error in a five station loop. I was able to calculate the angular error in the clinometer by the following lengthy but extremely useful derivation:

r_i = tape to station i from station i - 1 θ = angular clinometer error

I_i = inclination from station i - 1 to station i

Z_i = vertical change from station i - 1 to station i

Z_i = vertical change = $r_i \sin(I_i - \theta) + HF_i - HT_i$

ΣZ_i in a closure loop = $0 = \sum_{i=1}^{n}(r_i \sin(I_i - \theta) + HF_i - HT_i)$.

Since $\sin(I_i - \theta) = \sin I_i \cos\theta - \cos I_i \sin\theta$,

$$0 = \cos\theta \sum_{i=1}^{n} r_i \sin I_i - \sin\theta \sum_{i=1}^{n} r_i \cos I_i + \sum_{i=1}^{n}(HF_i - HT_i)$$

Let $A = \sum_{i=1}^{n} r_i \sin I_i$, which happens to be the sum of the horizontal components, and $B = \sum_{i=1}^{n} r_i \cos I_i$, the sum of the vertical components.

(continued on page 48)

BAT CAVE CLEANUP

by John Barnes

Jake Elberfeld had been trying to arrange a cave-cleanup trip for some time. He finally arranged with John Tierney, Park Naturalist of Carter Caves State Park, for a group to clean up Bat Cave the weekend of May 14. John Barnes of Lexington, KY, and Jake Elberfeld, Bob Kukla, Phyllis Redshaw, Ken Smith, Bill Svekric, and Bruce Warthman of the Central Ohio area participated. We got the key to the cave gate from Mr. Tierney, then walked to the entrance carrying wire brushes, plastic bags, hydrochloric acid, spray bottles, and rubber gloves in addition to our normal cave gear. We worked in the entrance area for awhile, picking up trash and broken bottles and cleaning graffiti from the walls. We entered the cave about 12:30 p.m. and locked the gate behind us. The area near the gate was almost solid with graffiti, some of which required standing in water to reach. We slowly worked back into the cave, cleaning as we went, and soundly cursing the vandals. Some areas could be cleaned just by scrubbing hard with a wire brush. Others required repeated spraying with acid and acrubbing. Some areas were impossible to clean. We left graffiti alone in a few areas -- one area dated 1881 and appearing authentic and places where bats were roosting. The ceilings were the most difficult to clean, often requiring a very awkward stance just to reach them. Bill and Phyllis left at 3 p.m., since they had to be back in Columbus by 7. We are grateful to them for coming down to help. The rest of us worked until 4:30, by which time we were getting hungry. (If he won't admit it, I will: and tired. Try scrubbing at arm's-length over your head for four hours!--Ed.) We left the cave, carrying out one bag of trash, and left the cleaning gear locked safely inside.

We drove to Olive Hill for supper, then Bruce too had to leave. Jake, Bob, Ken, and I returned to the campgrounds, where we had set up tents, then went for a two-hour hike. For our evening's entertainment we went to the amphitheatre and watched movies for three hours, then back to camp and to bed.

We returned to the cave the next day about 10 o'clock. We spent two and a-half hours cleaning graffiti to the back of the upper level of the cave, and headed out after using all the acid we had brought. We each received a Krowler W. Flaugher award for our contribution to the park.

We learned a number of lessons on this trip. We need a ladder for reaching the ceiling and higher portions of the wall. We should have some spray bottles (the trigger-type work best) with acid diluted about 1:3 (vol/vol, water;i.e. 1 part acid to 3 parts total vol.) and at least one bottle with full strength acid (20% HCl by weight). Rubber gloves with gauntlets work very well, since the acid drips off before reaching your clothing. Those who do not wear glasses (and those who do and don't want to replace them) should wear safety glasses. A tank sprayer (garden type) with water would also prove valuable. The final requirement is lots of elbow grease. Jake will try to arrange another such trip later this summer; come and join us -- you'll get a real feeling of accomplishment.

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CAVE CREEK MAPS CONT.

This is the fourth such cancellation.

The reader is invited to explore and extend this cave system.

We are grateful to Russ Dobos of Master Printing Co. in Cleveland, Ohio, for reproduction of these maps.

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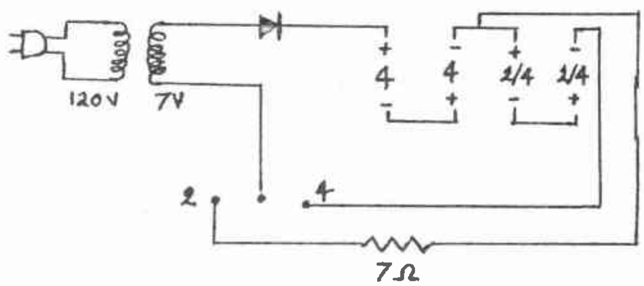
NiCad -- cont. from page 47

a separate unit is shown as an **integral part** of the circuit for convenience.



The 2's and 4's indicate either positions for batteries or the position of the DPST switch. Note also battery polarities.

A CHEAP BATTERY RECHARGER FOR AA NICADS

By Ken Smith for Bob Wood

When I was first looking for a strobe for in-cave use, I was uncertain for awhile whether I should buy the cheaper-at-the-time type, which required batteries, or put the extra money into a rechargable unit. I decided on the battery unit at that time for two reasons: 1) it would enable me to carry as much "juice" into the cave as I thought I would need on even the longest trips, and 2) I would have to use a lot of batteries before I would start saving any money by having bought the more expensive unit. I'm glad now that I decided the way I did. I can use the battery unit for practically nothing since Bob Wood (Equipmentis maximus) built me a recharging unit that allows me to use AA NiCads. The batteries are inexpensive enough even at the normal retail price of $2.00 each; this is especially true when one considers the cost of alkaline energizers (lead/acid and even heavy duty batteries are too short lived to even be considered). If you can get ahold of government surplus so much the better. The last batteries I got were on sale at Olson's for 99¢.

The recharging unit cost me about $2.50, and if you're a good scrounger you may get off for much less. Woody asks me to hasten to point out that this unit is "cheap and dirty:" much more sophisticated units are possible, but this works. Anyone who has a rudimentary knowledge of electronics (you'd be hard pressed to know much less than I) should be able to construct the unit in a few minutes from the information given here.

Now to the specifics. The unit is designed to operate from the recharging adaptor for a TI SR-50 and will take two or four batteries simultaneously. The TI recharger furnishes only the transformation of the power from 120 V to 7 V; it does not rectify the current. It should be possible to use a similar unit from another calculator, but be sure to compensate for any change in the number and internal resistance of the batteries the unit is designed to handle. The SR-50 contains 3 NiCads, each of which is equivalent in internal resistance to a AA NiCad; this explains the resistor added when only two batteries are being charged. This resistor (see diagram) is purposefully heavy to protect the batteries when they are left to charge for long periods. The same effect is achieved by the use of four batteries instead of the three the calculator unit is designed for. Jacks can be purchased to adapt the transformer to the rest of the circuitry. The support for the unit is anything you can make do: mine is an aluminum bowl of the type that "Spreadables" sandwich spreads come in. The plastic top (now the bottom) serves to keep the works dust-free but allow ready access to them.

The internal resistance of batteries, needed to calculate the required resistance, was determined empirically as follows:

E_{nl} = battery voltage with no load
E_l = battery voltage with load
I_l = current with load
r_i = internal resistance of battery

no load load

$$r_i = \frac{E_{nl} - E_l}{I_l}$$

Woody didn't have the specific data he had used to come up with 7 ohms any more, and when I tried to duplicate the procedure I got 0.4 ohm, but then I didn't have one of Uncle Sugar's digital readout meters. The difference in the loaded and unloaded voltages was only 0.05 volt for the resistor I used for the load, and my meter simply isn't accurate enough for such small differences. I trust his value.

In the circuit diagram below, the transformer, although actually (cont. on page 46)

Level Lecture Cont.

Let $C = \sum_{i=1}^{n}(HF_i - HT_i)$; then $0 = A \cos \theta - B \sin \theta + C$.

This can be solved for θ by substituting $x = \sin \theta$, $\sqrt{1 - x^2} = \cos \theta$,

and using the quadratic formula:

$$\theta = \sin^{-1}\left(\frac{BC + \sqrt{B^2C^2 + (B^2 + A^2)A^2}}{B^2 + A^2}\right)$$

If HF_i and HT_i are equal or are zero throughout the loop,

$$\theta = \sin^{-1}\left(\frac{A}{\sqrt{B^2 + A^2}}\right).$$

The above procedure was made necessary by the fact that there existed much more data surveyed the same day with this uncalibrated clinometer and this additional data was not part of a loop. I found an error in calibration of several degrees, which resulted in several tens of feet difference in vertical levels in the remote points of the survey. Of course it is possible to adjust a poorly closed loop by adding proportional parts of the error to each data point.

It might seem from the problems with the Abney Level that some other instrument might be preferable. I am unable to focus on the Suunto instruments and prefer not to invest in a Brunton. A water tube is combersome, I would think. A more expensive Abney-type level would not be justifiable on account of the risk of damage or loss. Perhaps the best procedure, but not the most convenient, would be to read the level both foresight and backsight on each station so calibration errors would subtract out. This could be done at least on easy main passage surveys. A second clinometer for backsight would be a check. Easier yet: calibrate.

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