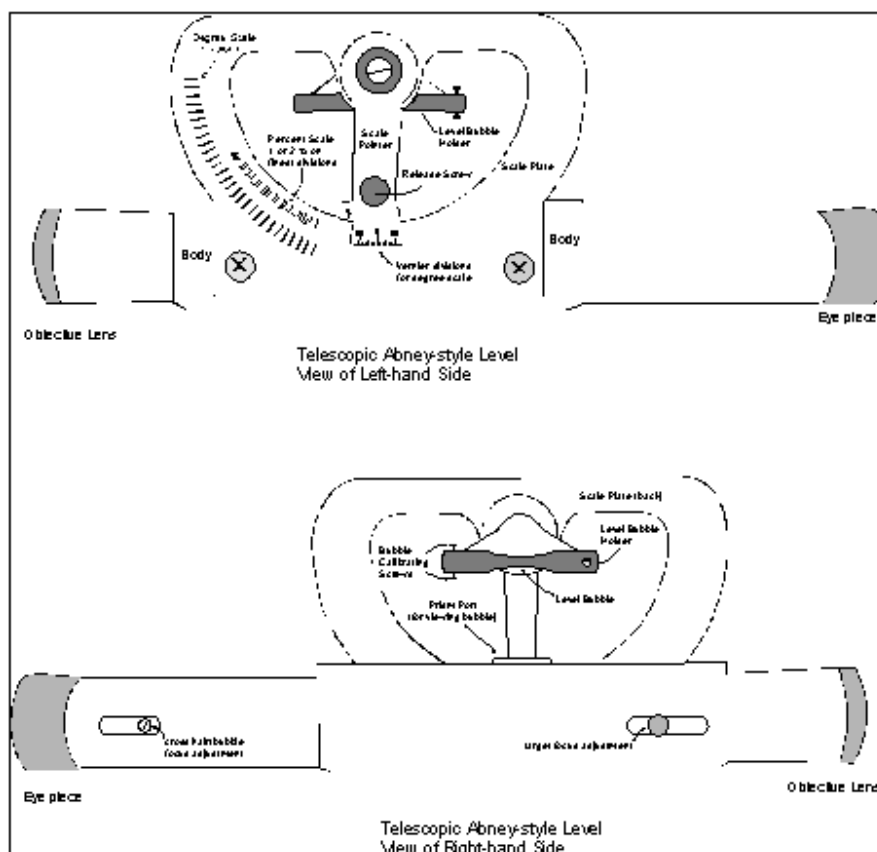


## Abney Level

Presented here is a short discussion of the instrument and on how to use it.

The **Abney Level** is a device that couples a protractor to a sighting tube. A bubble level is attached to an indicator (pointing) arm that moves around the arc of the protractor, and this level is visible through the top of the tube by means of a mirror prism. Half the field of view through the eyepiece shows the bubble, and the other half is the view of the target with stadia lines, and level line or cross hair.

In most Abney-style levels, the eyepiece is adjusted by sliding it forward or backward to focus the bubble image, the level line and the stadia lines. Some may have a threaded focusing mechanism, where turning the eyepiece lens moves it back or forward. The main body consists of a sighting tube that supports the lenses, prism, etc. The prism and the stadia and level line holder are located below the prism viewing port and are not visible. The scale plate (protractor) has both percent and degree scale graduations while the indicator or scale-pointing arm is provided with a Vernier scale. Like the eyepiece, the objective lens may be adjusted by sliding or by threaded focusing mechanism to focus the target. The bubble level on the main body is used to level the instrument.



### **USING THE INSTRUMENT:**

**Calibration:** Check the instrument to ensure that it is correctly calibrated. This is done by setting the scale pointer exactly at "0" ("0" is the same for both degrees and percent!). Then, using two pillars or posts of roughly the same height, at least 6 metres apart (preferably much more) and a bit over head height, tie a piece of flagging tape tightly around one post at eye height. The assistant takes another piece of flagging to the other post. Holding the level against the post, change the inclination of the level until the bubble shows as being exactly in the centre of the field of view on the "bubble" side. Keeping the bubble centered, focus on the other post. Get the assistant to move the tape up or down the pillar, until the middle of the three lines is centered on the tape. The assistant then ties the tape in place. The surveyor then sights back to the original tape from the second post. If, with the bubble still centered on the line, the centre line is centered on the tape, the instrument is calibrated correctly. If not, use the two small screws on the level bubble holder to re-calibrate. Loosen the screw on the side the bubble holder has to move, and then tighten up the opposite one. Check again on the tapes, moving one up or down as required. It may require several tries to get the instrument levelled properly. Some instruments may require the services of a professional instrument repairperson.

**Slope Readings:** Using this instrument for getting slope readings is simple.

- i. The user determines his/her eye height on another crewmember by using their shoulder, chin, mouth, nose tip, eyes, etc., as a "target".
- ii. The crewmember moves away and stands at the water edge (at the height of the stream at that point). The user also stands at the water's edge facing the crewmember.
- iii. Using the objective focusing, bring the crewmember serving as the height indicator into sharp focus. Orient the centre line on the crewmember so that it aligns with the "target". Then, level the bubble by moving the scale-pointing arm. When levelled, tighten the release screw.
- iv. The percent can be read off from the indicator located at the scales on the side plate. If the percent value is >10%, measurement can be made to the nearest 1%. If <10%, record the values more accurately.
- v. Use the degree scale to read the slope in degrees from the horizontal. If the "0" indicator is not on a degree line, use the Vernier scale to estimate the number of minutes (in increments of 10 minutes). For example, if the "0" indicator shows what appears to be an angle of 3.5 degrees (or 3 degrees and 30 minutes), note which line on the Vernier scale lines up to a degree scale mark. If the third mark of the Vernier is the closest of the Vernier scale markings to a degree scale mark, then the angle read is indeed 3 degrees 30 minutes (each increment is equivalent to 10 minutes). Using the conversion tables([Footnote 1](#)), the slope is determined to be 6.1 %.
- vi. Another way to take the sight is to tie a small piece of flagging tape to a branch or tree at eye height above water while going upstream or down. Then, when sighting back, use the small piece of tape to indicate eye height. It is good practice to do sights upstream and down, and average the readings.
- vii. If using a level rod, the stadia lines can be used to estimate distance from the user. The stadia are usually set for a 1:50 or 1:100 ratio.([Footnote 2](#))

## **Conversion Table**

| Degrees | Minutes | % slope | Degrees | Minutes | % slope |
|---------|---------|---------|---------|---------|---------|
| 0       | 0       | 0.0%    | 5       | 10      | 9.0%    |
| 0       | 10      | 0.3%    | 5       | 20      | 9.3%    |
| 0       | 20      | 0.6%    | 5       | 30      | 9.6%    |
| 0       | 30      | 0.9%    | 5       | 40      | 9.9%    |
| 0       | 40      | 1.2%    | 5       | 50      | 10.2%   |
| 0       | 50      | 1.5%    | 6       | 0       | 10.5%   |
| 1       | 0       | 1.7%    | 6       | 10      | 10.8%   |
| 1       | 10      | 2.0%    | 6       | 20      | 11.1%   |
| 1       | 20      | 2.3%    | 6       | 30      | 11.4%   |
| 1       | 30      | 2.6%    | 6       | 40      | 11.7%   |
| 1       | 40      | 2.9%    | 6       | 50      | 12.0%   |
| 1       | 50      | 3.2%    | 7       | 0       | 12.3%   |
| 2       | 0       | 3.5%    | 7       | 10      | 12.6%   |
| 2       | 10      | 3.8%    | 7       | 20      | 12.9%   |
| 2       | 20      | 4.1%    | 7       | 30      | 13.2%   |
| 2       | 30      | 4.4%    | 7       | 40      | 13.5%   |
| 2       | 40      | 4.7%    | 7       | 50      | 13.8%   |
| 2       | 50      | 4.9%    | 8       | 0       | 14.1%   |
| 3       | 0       | 5.2%    | 8       | 10      | 14.4%   |
| 3       | 10      | 5.5%    | 8       | 20      | 14.6%   |
| 3       | 20      | 5.8%    | 8       | 30      | 14.9%   |
| 3       | 30      | 6.1%    | 8       | 40      | 15.2%   |
| 3       | 40      | 6.4%    | 8       | 50      | 15.5%   |
| 3       | 50      | 6.7%    | 9       | 0       | 15.8%   |
| 4       | 0       | 7.0%    | 9       | 10      | 16.1%   |
| 4       | 10      | 7.3%    | 9       | 20      | 16.4%   |
| 4       | 20      | 7.6%    | 9       | 30      | 16.7%   |
| 4       | 30      | 7.9%    | 9       | 40      | 17.0%   |
| 4       | 40      | 8.2%    | 9       | 50      | 17.3%   |
| 4       | 50      | 8.5%    | 10      | 0       | 17.6%   |
| 5       | 0       | 8.7%    |         |         |         |

Tabular comparison: Abney to liquid-damped pendulum wheel clinometer:

|              | Abney-style |      |      | Clinometer |      |      | *Laser      |       |       |
|--------------|-------------|------|------|------------|------|------|-------------|-------|-------|
|              | Avg.        | Max. | Min. | Avg.       | Max. | Min. | Avg.        | Max.  | Min.  |
| "Reach"<br>1 | 3.1         | 3.3  | 2.9  | 2.2        | 3.4  | 1.0  | 3.75**      | 3.78  | 3.72  |
| "Reach"<br>2 | 12.9        | 13.2 | 12.6 | 13.9       | 15.5 | 13.0 | 13.19*<br>* | 13.21 | 13.17 |
| "Reach"<br>3 | 5.5         | 4.9  | 6.1  | 5.7        | 6.0  | 5.0  | 5.53**      | 5.57  | 5.47  |
| "Reach"<br>4 | 8.2         | 7.9  | 8.5  | 8.1        | 9.0  | 7.5  | 8.68**      | 8.72  | 8.64  |

\*These were not taken over exactly the same "reaches", as benchmark pins were not put in.

Clinometer readings ranged over 2.5% in some cases. The variations from the average using the clinometer were from almost the same as the Abney to six times that of the Abney.

When a difference of +/-2% can change the class of a stream, the telescopic Abney or Abney-style level is a better tool to use than a clinometer. If the gradient is well over 20%, a clinometer is likely the instrument of choice, since (for instance) if the gradient as measured by precise leveling is 42.5% and the clinometer reading is given as 44% or 40%, interpretations are not going to be changed. However, if the gradient is actually 19.2%, and it is read as 21%, the stream reach would be assigned to the wrong class.

From: <http://www.fisheries.gov.bc.ca/fishinv/tech5.htm>