

**Homework Assignment 19: Due at the beginning of class 4/22/02.**

The mathematical content of this homework assignment consists of the application of the right triangle definitions of sine, cosine and tangent to calculate lengths and angles. This assignment is designed to be reasonably straight-forward, and many of the questions do not involve elaborate, lengthy calculations. Therefore, if you find that you can solve many of the problems with relative ease, then that's a good sign rather than an indication that you've missed some major point.

- Figure 1<sup>1</sup> shows a frame from the famous film shot by Roger Patterson on October 10, 1967 near Bluff Creek, CA. The image shows a hairy, ape-like subject walking along a dry creek bed in a wilderness area of Northern California. Figure 2 shows a frame from later in the film as the subject was about to disappear into the surrounding woods. Table 1 (below) lists a number of quantities shown in Figure 2<sup>2</sup> and Figure 3. Use a ruler and protractor to measure these quantities and record your results in Table 1.

Quantity	Measured value (give units)
Apparent length of left foot (Fig. 2)	
Apparent length of shin (knee to ground) (Fig. 2)	
Apparent length of thigh (waist to knee) (Fig 2.)	
Apparent height of upper body (waist to top of head) (Fig. 2)	
Angle between thigh and vertical (Fig. 3)	
Angle between upper body and vertical (Fig. 3)	

Table 1: Measure these quantities from Figures 2 and 3 and record your results here.

<sup>1</sup> Image source: <http://www.bfro.net/>

<sup>2</sup> Figures 2 and 3 were adapted from images obtained from: <http://www.bfro.net/>



Figure 1: Frame 352 (of 952) from the film taken by Roger Patterson on October 20, 1967, near Bluff Creek California.



Figure 2: Frame from Patterson film showing back of subject and sole of left foot.

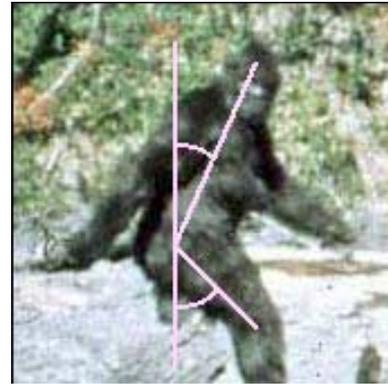


Figure 3: Frame 352 from Patterson film showing angle of back to vertical and angle of thigh to vertical.

- After making the film in 1967, Roger Patterson and his associate Robert Gimlin found tracks supposedly made by the creature that Patterson had filmed. The measured length of the left footprint was 14.5 inches<sup>3</sup>. Use this information and the results that you recorded in Table 1 to complete the entries in Table 2 (below).

Quantity	Value (inches)
Actual length of left foot	14.5
Actual length of shin (knee to ground)	
Actual length of thigh (waist to knee)	
Actual length of upper body (waist to top of head)	

Table 2: Actual dimensions for subject of Patterson film.

Based on the entries in Table 2, approximately how tall is the subject in the Patterson film?

- As shown in Figure 3, the subject of the Patterson film does not walk with an erect, upright posture as a human typically might. Instead, the subject of the film has its thighs bent and its upper body hunched over. Use the information that you recorded in Table 2 together with the angles that you recorded in Table 1 to determine how tall the subject of the Patterson film would be if it stood up straight?

<sup>3</sup> Source: G. Krantz. *Bigfoot. Sasquatch. Evidence.* Secodn Edition. Blaine, WA: Hancock House Publishers, 1999.

Figure 4<sup>4</sup> shows the photograph that won the 2001 Official Loch Ness Fan Club competition for the best picture of the Loch Ness monster. This photograph was made by Chris Rivett and Melissa Bavister of Northampton, England. The picture shows two dark regions or shapes on the surface of Loch Ness (see Figure 5 for close-up). According to Nessie enthusiasts, the large region is the body of the monster and the small region is the head of the monster.



Figure 4: Photograph of Loch Ness made by Chris Rivett and Mellissa Bavister. The objects have been circled to make them more clearly visible.

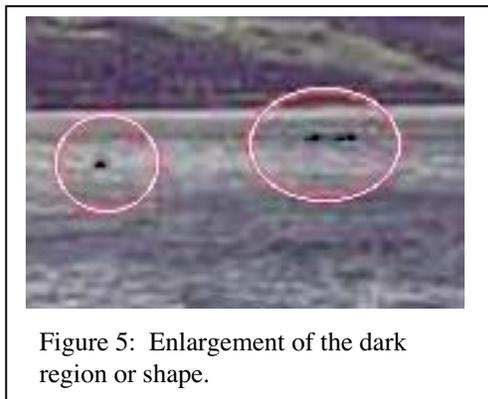


Figure 5: Enlargement of the dark region or shape.

As you can see in Figure 5, Mr. Rivett and Ms. Bavister included some of the scenery of Loch Ness in the back ground of their photograph. These details allowed Scottish naturalist and Loch Ness expert Adrian Shine<sup>6</sup> to locate the spot where the photograph was taken and measure some of the distances and angles that are involved. Mr. Shine's measurements are shown in Figure 6 (below).

4. Use the information shown in Figure 6 to calculate  $R$ , the distance on the surface of the Loch (in units of meters) between the photographer and the dark region or shape.

<sup>4</sup> The source of the images used in Figures 4 and 5 is: <http://www.lochness.co.uk/>

<sup>5</sup> Official Loch Ness fan Club, 9 Burnbrae Place, Inverness, Scotland IV1 2TA. The first prize in the competition is £1000 cash.

<sup>6</sup> Source: <http://www.lochnessinvestigation.org/>

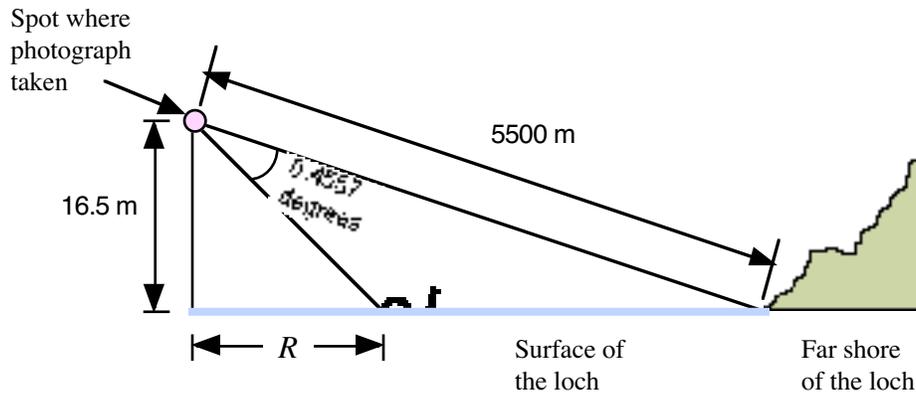


Figure 6: Diagram showing measurements made by Adrian Shine. The angle given is 0.4557 degrees.

5. Mr. Shine also determined that the angular width of the space occupied by the two dark shapes (see Figure 7) was equal to 0.0131 radians. Work out how wide (in units of meters) the space occupied by the two dark shapes actually was. In the opinion of Nessie enthusiasts, this width would be an estimate (in fact an under estimate) for the length of the Loch Ness Monster's body.

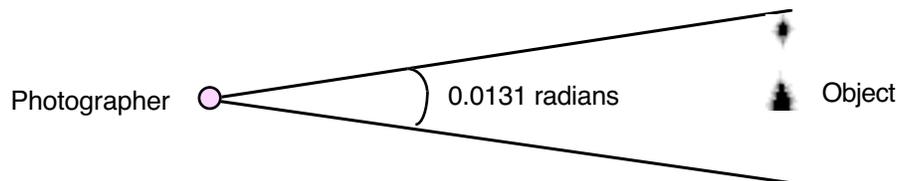


Figure 7: Overhead ("bird's eye") view of photographer and object on Loch.

### Extra Credit (up to 10 points available)

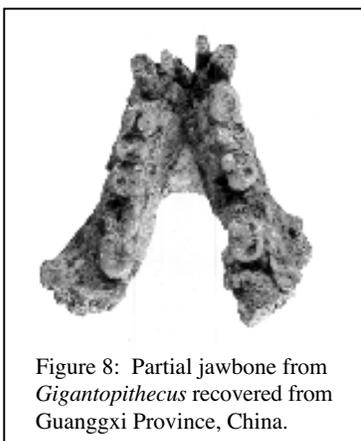


Figure 8: Partial jawbone from *Gigantopithecus* recovered from Guangxi Province, China.

(a) Some Bigfoot researchers (including retired Washington State University Professor of Anthropology Grover Krantz) have suggested the theory that (if the creature exists at all) Bigfoot may be related to the extinct giant ape *Gigantopithecus*. *Gigantopithecus* is believed to have lived between 1.3 million and 300,000 years ago. All scientific knowledge concerning *Gigantopithecus* is based on a few ancient and incomplete jawbones found near the town of Liucheng in Southern China (see Figure 8<sup>7</sup>). Figure 9<sup>8</sup> shows a sculpture of an adult *Gigantopithecus* that is based on the assumption that the ape closely

<sup>7</sup> Image source: <http://www.chineseprehistory.org/pics1.htm>

<sup>8</sup> Image source: <http://www.kandervision.com/homepix/giganto3-640c.jpg>

resembled giant gorilla. (The sculpture was made by artist Kevin M. Anderson and is located on the campus of Hartwick College in Oneonta.) Kevin Anderson is about six feet (72 inches) tall. If the sculpture is an accurate representation of a *Gigantopithecus*, how tall would this ape be when standing erect? How does this height compare with the height of the subject in the Patterson film?



Figure 9: Artist Kevin Anderson standing next to the *Gigantopithecus* statue. The statue is steel and bronze and is located on the campus of Hartwick college.

- (b) When you completed Homework 18, you found the amount of fish biomass in Loch Ness. You also found an equation relating body length to daily food consumption, and learned of an estimate that a population of 10-20 animals would be required for a viable breeding population. The contention of some Nessie enthusiasts is that the photograph in Figure 4 really does show a fish-eating, aquatic predator. How long would it take a breeding population of these creatures to devour all of the fish in the loch?