Activity: Amundsen's Path

Prof. Jordan C. Hanson

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1 Memory Bank

- One nautical mile corresponds to 1/60th of one degree, or 1.852 kilometers.
- $W = \mu mg\Delta x$ ... Work done against friction.
- 1 kcal is 4184 Joules.
- Food energy densities: 9 kcal per gram (fats), 4 kcal per gram (protein), 4 kcal per gram (carbohydrate).
- $W = mg\Delta y$ ... Energy required to climb a height Δy.

2 Amundsen's Path

Attached is page 464 of *Last Place on Earth*. Let's examine the following calculations below regarding the trek from The Bay of Whales and Roosevelt Island by Amundsen and crew to the South Pole, and back.

1. Estimate the number of (horizontal) nautical miles corresponding to the round trip of Roald Amundsen and crew from start to finish. What fraction of this takes them to the mountains, from the mountains to pole, and pole to mountains, and mountains to base?

2. What is the total distance in kilometers? Convert each distance to kilometers.

3. As a simple correction to add the vertical 10,000 feet of the mountains, convert 10,000 feet to meters and add twice that value to the total.

4. How much energy is required to pull 5 men, 52 dogs and 10^3 kg of food and gear *to the mountains*, assuming $\mu = 0.1$. Call this energy $E1$.

5. How much energy is required to lift 5 men, 17 dogs, and an additional 0.5×10^3 kg of food and gear up the mountains? Call this result $E2$.

6. How much energy is required to travel from pole back to the mountains, assuming it's now just 5 men and 17 dogs? Call this energy $E3$. (This energy is supplied by the depots laid by the men).

7. How much energy is required to travel from the mountains back to base, assuming it's now just 5 men and 15 dogs? Call this energy $E4$. What is the total energy required for the journey (sum the E's)? If it took 99 days, what was the average power output of the team?