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A3_1 Can't Find Your Atlas?

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Abstract

In Greek Mythology the Titan Atlas was condemned by Zeus to bear the weight of the sky upon his shoulders as punishment for his rebellion. This paper explores just how titanic in stature a humanoid Atlas would have to be to perform such a task. Atlas was found to be 9.9 Earth radii in length and so would not have been able to support the sky on his shoulders.

Atlas

Atlas is one of the progeny of the first Titans in Greek mythology. With the arrival of the Olympians, the Titans were led into a ten year battle with the new Gods, by Atlas, to wrestle for supremacy. Having subsequently lost the war with the Olympians, the Titans were banished to Tartarus, however Atlas suffered a worse fate, to carry the sky upon his shoulders.

The Sky

To calculate the mass of the atmosphere, one must crudely assume that the atmospheric composition is 78% nitrogen and 21% oxygen [1]. The associated atomic masses are 2.34×10^{-26} kg and 2.67×10^{-26} kg respectively, with an average molecular mass of 4.84×10^{-26} kg [1]. Using the equation for the volume of a sphere, one can calculate the volume of the atmosphere

$$V = \frac{4}{3}\pi(R_E + R_A)^3 - \frac{4}{3}\pi R_E{}^3 , \qquad (1)$$

where R_E is the radius of the Earth and R_A is the height of the atmosphere relative to the surface of the Earth. Using the accepted value for the Earth's radius (6.4×10^6 m) and assuming that most of the mass of the atmosphere is confined at and below the troposphere [2] (14000m), the volume is given to be 7.22×10^{18} m^3 . The mass is calculated by finding the number of particles in the atmosphere via the ideal gas equation

$$\frac{PV}{kT} = N, \qquad (2)$$

where k is Boltzmann's constant ($1.3806503 \times 10^{-23}$ J/K), T is the average atmospheric temperature (293K) and N is the number of atmospheric particles. Using equation (2) the number of particles is found to be 1.75×10^{44} which when multiplied by the average particle mass, gives a total atmospheric mass of 8.47×10^{18} kg.

If it is assumed that the atmosphere is collected into a spherical shape (as often depicted when held by Atlas), then the most efficient way for Atlas to hold this mass is in the squat position, given that Atlas is human like in form, but just much larger. The height (m) of a human is related to the mass (kg) that they can lift in the squat position by [3];

$$\text{Height} = (\text{Mass Lifted}/120)^{(\frac{1}{2.16})} . \qquad (3)$$

Substituting the mass of the atmosphere into equation (3) gives the height of Atlas to be 63.1×10^6 m. This is equivalent to approximately 9.9 Earth radii, making it impossible for Atlas to dwell on the surface of the Earth. Instead he would be a celestial body whose own gravitational force would interact with the Sun and Earth. If one assumes that Atlas requires the intake of oxygen to survive, then the only plausible way to do so would be to siphon the terrestrial atmosphere via a large breathing apparatus (for a small period of time).

Conclusion

Assuming that Atlas’s form is that of a human male, it would seem that his feat of carrying the atmosphere is quite impossible. If Atlas were even capable of standing afoot the surface of the Earth, less than 1% of his body length would be submerged within the atmosphere (i.e. below the troposphere). This would make it impossible for him to carry the load on his back as is often depicted. Although Atlas’s vast height would prevent him from collapsing under his own weight (according to the square-cube law [4]) as the strength of the Earth’s gravitational potential would decrease significantly along his body length, this would also render him a celestial body in interplanetary space. If he were to assume a more spherical shape by tucking his legs beneath his arms and somehow acquired sufficient rotation to orbit the Sun, his orbit would inevitably alter that of the Earth (as long as he is close enough to use the Earth’s atmosphere to breathe). This coupled with a constant energy supply and some form of gargantuan space suit would make this feat seem even more implausible.

References

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