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## Supplemental: Edwin Hubble

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### Edwin Hubble

#### Great Minds in Science

You might have heard of the Hubble Telescope. Who do you think it's named after? Me of course! I am Edwin Hubble and before I entered the field of astronomy, astronomers focused their research on either our solar system or our galaxy, the Milky Way. I was more interested extragalactic astronomy (i.e. what lay beyond our galaxy) and I made discoveries that made me famous. I was also interested in cosmology which is the study of the origins and evolution of the universe.

I was born on November 20<sup>th</sup>, 1889 and was one of 8 children. I was a jock in high school and excelled at almost all sports like baseball, football, basketball as well as track and field and won many athletic awards and distinctions. Though I was smart, I wasn't an exceptional student so I received more positive attention for my physical abilities than I did for my brain.

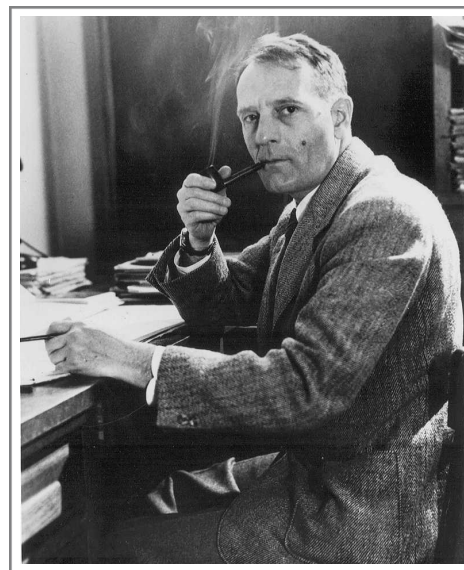
I had always been extremely interested in astronomy as a boy, but my father wanted me to become a lawyer, and I always wanted to please him so I began to study law at the University of Chicago and later at Oxford University. When I was 24, my father died and though I tried to practice law after that, I didn't have the heart for it. I ended up as a high school teacher and basketball coach for one year before I decided to pursue my dreams to become an astronomer. I went back to the University of Chicago and studied astronomy and graduated with my PhD in 1917.

By then, World War I had begun and the U.S. was at war with Germany. I suspended my academic career and immediately volunteered for military duty and rose to the rank of lieutenant colonel in the 86<sup>th</sup> division. I was stationed in France, but my unit was never sent off to combat during the war. When the war ended, I returned to my astronomical studies, this time at the University of Cambridge.

In 1919, I got a job at the Mount Wilson Observatory in California. This is where I would spend the rest of my career studying space. I was excited to be here because the observatory contained the newly completed Hooker telescope which was the largest and most advanced telescope in the world at the time. It was 2.5 meters in diameter.

At the time, it was accepted that our Sun was a star in the galaxy named The Milky Way, which made up the entire universe. At the Mount Wilson Observatory, I began taking thousands of photos of the night sky using the telescope. I was especially interested in the cloudy objects that were classified as nebulae. I had my suspicions that these nebulae were not contained within the Milky Way, and that they somehow existed beyond the Milky Way. Some of them might even be galaxies themselves. This meant that the size and scope of the universe was much larger than anyone had previously thought. This idea was ground breaking and it revolutionized the study of astronomy. I had disproved the idea of the "single galaxy universe".

How did I do this? It's quite complicated so I will give you a simplified version. I had begun analyzing a few stars called Cepheid variables. these stars pulsate at regular intervals meaning that they get larger (and brighter) and smaller (and dimmer) repeatedly over a given period of time. The frequency of pulsation is related to how luminous (bright) they are. The relationship between the frequency of pulsation and luminosity was discovered by Henrietta Swan Leavitt, a brilliant astronomer of the late 19<sup>th</sup> century. Knowing the luminosity of a Cepheid variable can be used to calculate its distance to another star. When I did all these calculations, I realized that the Cepheid variable I had been



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studying in the Andromeda nebula (now known as the Andromeda galaxy) and other Cepheid variables were extremely far away, so far that none of them could be found within the Milky way. When I studied more Cepheid variables, I was astounded to find out that they were even more distant than the ones I had been originally studying. The universe was BIG!

In my lifetime, astronomy was not one of the fields of science that could be awarded a Nobel Prize. I campaigned to get astronomy classified as a part of the field of physics so that astronomers would be eligible to win the Nobel Prize. Only shortly after my death did the Nobel Prize Committee agree that the astronomical sciences were a field of physics. However, it was too late for me. Many agree that if I was still alive, I would be awarded a Nobel Prize for my pioneering discoveries, but

Though I never won a Nobel Prize, I have been honored in various ways. The Hubble Space Telescope (HST) is of course, named after me. It launched into orbit outside of Earth's atmosphere in 1990. Having no interference from the distorting effects of Earth's atmosphere allows the HST to capture extremely high resolution images without the background lights that affect ground-based telescopes. The HST has recorded data that has allowed astronomers to see deeply into space (and time!) and even helped them calculate the rate of the universe's expansion. HST data has also helped scientists better understand the location and abundance of black holes.

## Questions:

1. What made him change his academic focus to astronomy?
2. How did getting a job at the Mount Wilson Observatory help Edwin Hubble in his research?
3. What was the view of the universe before Edwin Hubble's research and what was the view of it after?
4. Why wasn't Edwin Hubble ever awarded a Nobel Prize?
5. Describe two things that the Hubble Space Telescope has helped us better understand.