

## Discussion Questions

### Oral Histories of Women Astronomers

#### Henrietta Hill Swope

- 1. How did Swope develop an interest in astronomy?**
  - She loved to find constellations as a young girl. Then, when she was a teenager she heard a lecture from Dr. Shapley which convinced her astronomy was interesting.
  - After graduating college, she heard about an offer for women to work with Dr. Shapley, and said she would learn the astronomy to work there.
- 2. Who were her mentors?**
  - She took a class from the female astronomer Margaret Harwood.
  - She learned a lot from the observatory director, Dr. Shapley.
  - Cecilia Payne-Gaposchkin was at the Observatory at the same time as she was, and taught her many things.
- 3. How did her family's wealth and status benefit Swope's career?**
  - She was able to do what she wanted without having to worry about money.
  - She never had to look for work; people approached her with jobs.
- 4. What was Swope's relationship like with superiors, including Shapley and Baade?**
  - The superiors would tell her what they wanted, and she would then accomplish it independently.
  - If there were a particularly interesting star, the director would get involved so that they could publish on it instead.
  - She wrote up and published much of Baade's work under his name.
- 5. What was Swope's relationship like with other women in the observatories?**
  - She respected the women who had gotten advanced degrees and wanted to do their own research, such as Annie Jump Cannon and Antonia Maury.
  - There were many women who had worked for Pickering (Shapley's predecessor), that she felt weren't very ambitious.
- 6. What challenges did Swope face as a woman in astronomy?**
  - There were few women in respected positions, so her superiors weren't sure how to treat her.
  - Most women were "computers," a position that just did calculations. She had to insist that she should be called a "research assistant" because she was doing original research.

**7. What was the general attitude toward women in the observatory?**

- Women were not as respected because they could be paid very little.
- The Observatory was only able to run as it did because they paid women little, so many women felt they were being used.
- Some women really enjoyed the work, so that's part of the reason they would stay at the low pay.

**8. What sacrifices did Swope make for her career?**

- She was paid much less than she felt she was worth, so that she would continue in work she loved.
- She moved a couple times to follow the astronomical positions she received.
- (This is not explicitly stated, but students may infer it) - She never married or had children, devoting herself to astronomy.

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#### Cecilia Payne-Gaposchkin

- 1. What challenges did Cecilia Payne face as a woman studying physics in college?**
  - She was singled out and resented by Ernest Rutherford, her famous physics professor.
  - She was the only woman in most of her classes – the other women eventually dropped out.
- 2. How did she decide what she was going to study astronomy?**
  - She heard a lecture by Arthur Eddington, a famous astronomer, and decided she was going to study astronomy.
- 3. How did other scientists react to Payne’s presence?**
  - Some, like Rutherford, were very put off by her, and didn’t believe a woman could do scientific research.
  - Her boss, Dr. Shapley, respected her work, but also paid her less than others because she was a woman.
- 4. How did Payne learn how to do scientific research?**
  - She asked for a research problem from Eddington, and he told her to determine proper motions of a galactic cluster.
  - She taught herself advanced mathematics in order to do the problem.
  - She worked with large mechanical computing machine to do problems she had been given to solve.
- 5. How did Cecilia Payne feel about moving to and working at Harvard?**
  - She loved being able to work long into the night.
  - She found the Harvard atmosphere liberating and intoxicating.
- 6. How did other scientists react to Payne’s first book?**
  - They generally accepted her conclusions.
  - She was praised by Eddington, her role model.
- 7. She was the first person to suggest hydrogen and helium are the most abundant elements in stars. How was this idea presented? How did other scientists react to it?**
  - She presented it with an asterisk, saying that even though that’s what the observations said, it might be a mistake of some kind.

- Many scientists, including Eddington, were skeptical so much of the universe was those two elements.
- However, Gaposchkin herself became convinced of its truth very quickly.

**8. How did Payne-Gaposchkin work with Dr. Shapley on the second book she wrote?**

- She followed his orders as her boss to write the book, even though she was not excited about it.
- She was totally in an assistant role; it was not a collaborative effort between her and Shapley.
- It was well-received by some important people, but very quickly lost its relevance.

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#### Dorrit Hoffleit

- 1. What was Hoffleit's favorite subject in school?**
  - Mathematics, she particularly liked geometry.
- 2. What were Hoffleit's early interests and hobbies? How did she develop an interest in astronomy?**
  - She was very interested in the fine arts and things that were beautiful. She liked to admire the beauty of nature and the sky.
  - She developed an interest in astronomy from admiring the sky, but didn't think astronomy was something you could do as a job.
- 3. Did Hoffleit's family and teachers encourage or discourage her early scientific pursuits?**
  - Her mother was proud of her for working at Harvard and working in a field that Hoffleit's grandfather would approve of.
- 4. What career did Hoffleit plan to pursue after finishing her studies at Radcliffe?**
  - She planned on becoming a geometry teacher, but there were few jobs during the Great Depression.
- 5. What was Hoffleit's impression of Henrietta Swope? How does she perceive other women in her profession?**
  - She thought that Swope was not particularly brilliant or inquisitive. She did very good work that was assigned to her, but she wasn't an original thinker.
- 6. What was Hoffleit's relationship like with her superiors, specifically the Harvard College Observatory directors?**
  - She liked Shapley, but knew he was taking advantage of her by paying her much less than what she was worth. But for her the most important thing was the research.
  - She did not like Donald Menzel, Shapley's replacement.
- 7. What sacrifices did Hoffleit make to pursue fulfilling research? Would a man have been confronted with the same obstacles?**
  - She worked for very low pay, and didn't get raises, because she really loved the work.
  - She was specifically hired because she was a woman and would work for cheap pay.
- 8. Describe Hoffleit's level of confidence throughout her education and career.**

- She was uncertain about getting into college, but actually did very well in her undergraduate degree.
- She planned on becoming a teacher, but couldn't find a job, so she did a master's degree which she did well in.
- She enjoyed her work at the Observatory and did it very well.
- Hoffleit had very little confidence she could do a PhD, but was pushed into it by her advisors who recognized her talent.

**9. Did Hoffleit struggle with pay or advancement?**

- She was paid very little because the administrator knew she would do the work cheaply.
- She was not a supervisor, despite her expertise in the subject.

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#### Vera Rubin

**1. How did Rubin develop an interest in astronomy?**

- She would look out her window at night to watch the stars, and look for meteors.
- She joined an amateur astronomers club in Washington DC when she was a teenager.

**2. How did Rubin's family feel about her interest in astronomy?**

- Her father and mother supported her by buying her a telescope and encouraging her star pictures.
- However, her father pushed her to study math, a more practical field than astronomy.

**3. Why did Rubin decide to go to Vassar College?**

- She received a scholarship, and needed one to afford school.
- She knew Maria Mitchell, America's first female astronomer, had been a professor there.

**4. Why did Vera decide to study at Cornell? What did her professors think of her choice?**

- Donald Menzel, director of Harvard Observatory, assumed she was leaving astronomy by getting married and following her husband to his job.
- The main professor of astronomy told her she should study something else and was very unsupportive.
- The physics professors at Cornell were very good and taught her a lot.

**5. What were some of the challenges Vera Rubin faced as a woman in astronomy?**

- She was told to study something else by both high school and college professors.
- She wasn't allowed to go to some talks because spouses weren't allowed in them.
- She didn't work with others in many of her classes because she was the only woman and other students didn't work with her.

**6. How did Rubin decide to work on the rotation of galaxies? How did people react to her data that there must be more matter in galaxies than could be observed?**

- She was looking for a research problem she could do without access to observing time on a large telescope.
- She wanted a problem that few other people would be working on.
- She was very surprised by the results she received, but there were so many observations, that other scientists had to accept her results.

**7. What sacrifices did Rubin make for her career? For her family?**

- She attended Cornell, a poor school for astronomy, so that she could be with her husband.
- She often had people dismiss her abilities because she was a woman. For instance, Princeton wouldn't even send her a catalog because she was a woman.

**8. What does Vera Rubin think steers some women away from science? How does she think this can be changed?**

- She thinks people become cultured very early on to think men are doctors and women are nurses, for example.
- From her own experience, there are teachers who will tell women they can't do science.
- Rubin says that children should be raised with the confidence that they can be anything, so that they won't get discouraged by a lack of role models.



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#### Jocelyn Bell-Burnell

**1. How did Burnell's family life encourage or discourage her from pursuing a career in science?**

- Her family encouraged her to pursue any education she could, but people who worked for her family focused their encouragement on her brother.
- Her family would buy her any book she wanted. Her father encouraged her interests by taking her to a planetarium as she was growing up.

**2. What role(s) did Burnell's teachers play in the development of her interests in astronomy?**

- Her school initially put her in a class learning cooking and needlework rather than science.
- She almost gave up her dream of being an astronomer after she was told she would need to be awake all night.
- She was harassed over being the only women in her physics classes, and the teachers did nothing to stop it.

**3. What do you think were the most important experiences of her youth that led her to this career path?**

- When she was young, she would visit an observatory her father had helped design and learn from the astronomers there.
- She read her father's astronomy books and decided she wanted to be an astronomer, but didn't want to stay up all night, so she became interested in radio astronomy which can be done during the day.

**4. What kind of discrimination did Burnell face in college? In graduate school?**

- She was the only women in an honors physics class of 50.
- Her college had a "tradition" of foot stamping and catcalling as female students entered a lecture hall and made their way to their seats.
- She was harassed if she ever had the highest score in a class.
- After she married, people assumed she would leave astronomy completely and stopped wanting to spend much time with her.

**5. Describe Burnell's relationship with thesis advisor Tony Hewish.**

- Hewish would have meetings about her topic where Bell wasn't invited.
- He tried to take the path of least resistance to getting Jocelyn's degree, including refusing to change her thesis to pulsars.

**6. Why did Burnell's peers and supervisors treat her differently after the discovery of pulsars?**

- She found it easier or possible to get jobs that would have not normally been open to a women working part time.
- She was recognized for her accomplishment, but still expected to give up astronomy to be a housewife.

**7. Did Burnell's marriage enhance or detract from her scientific career?**

- Her husband didn't want her to take prestigious positions that would overshadow him.
- She moved around for her husband's job and didn't stay in a stable position.
- Other astronomers (including her advisor) didn't think she would continue in astronomy because she was married.

**8. What work occupied Burnell in the later stages of her career?**

- She was the editor of the Royal Observatory Journal.