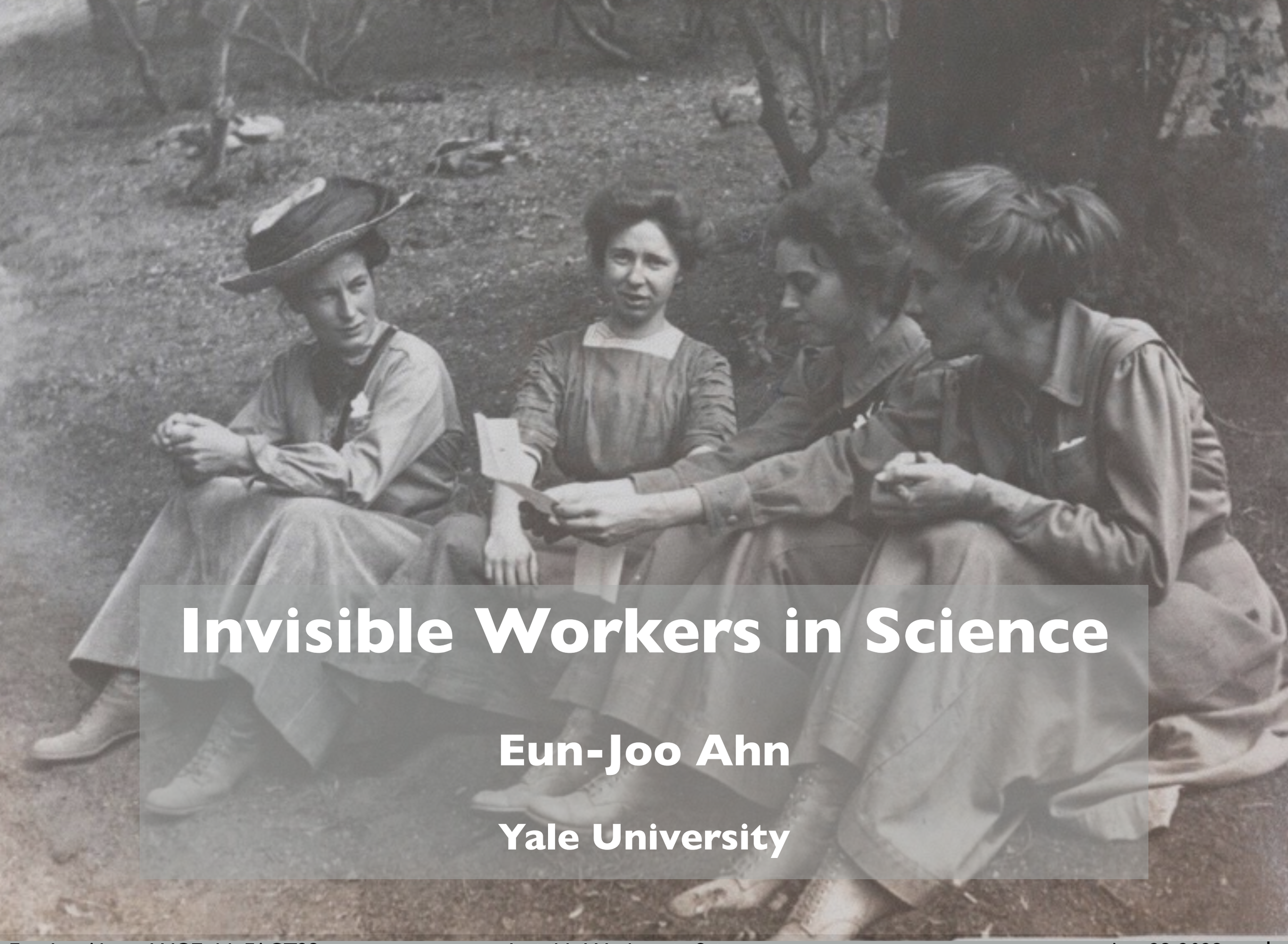
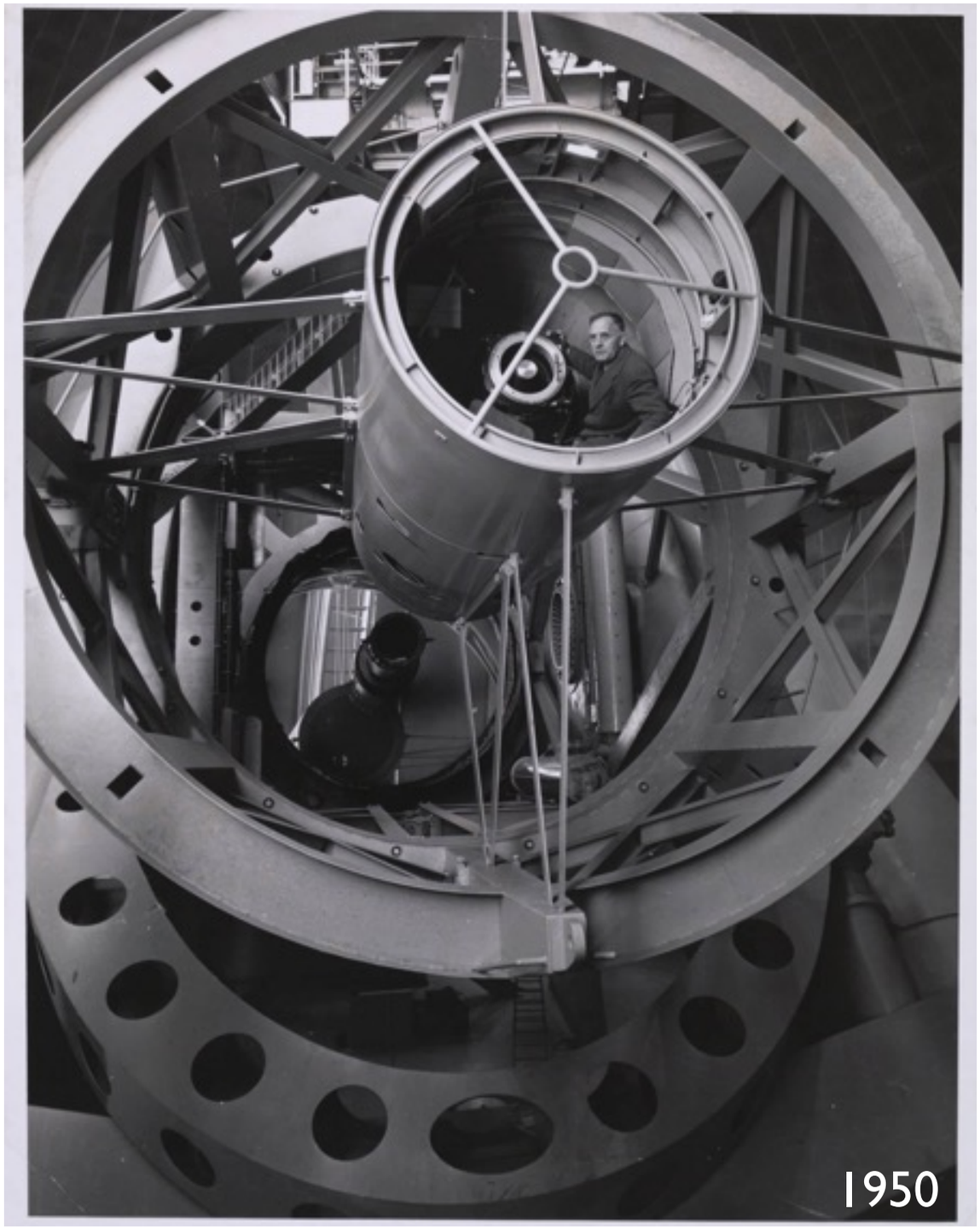


Invisible Workers in Science

Eun-Joo Ahn

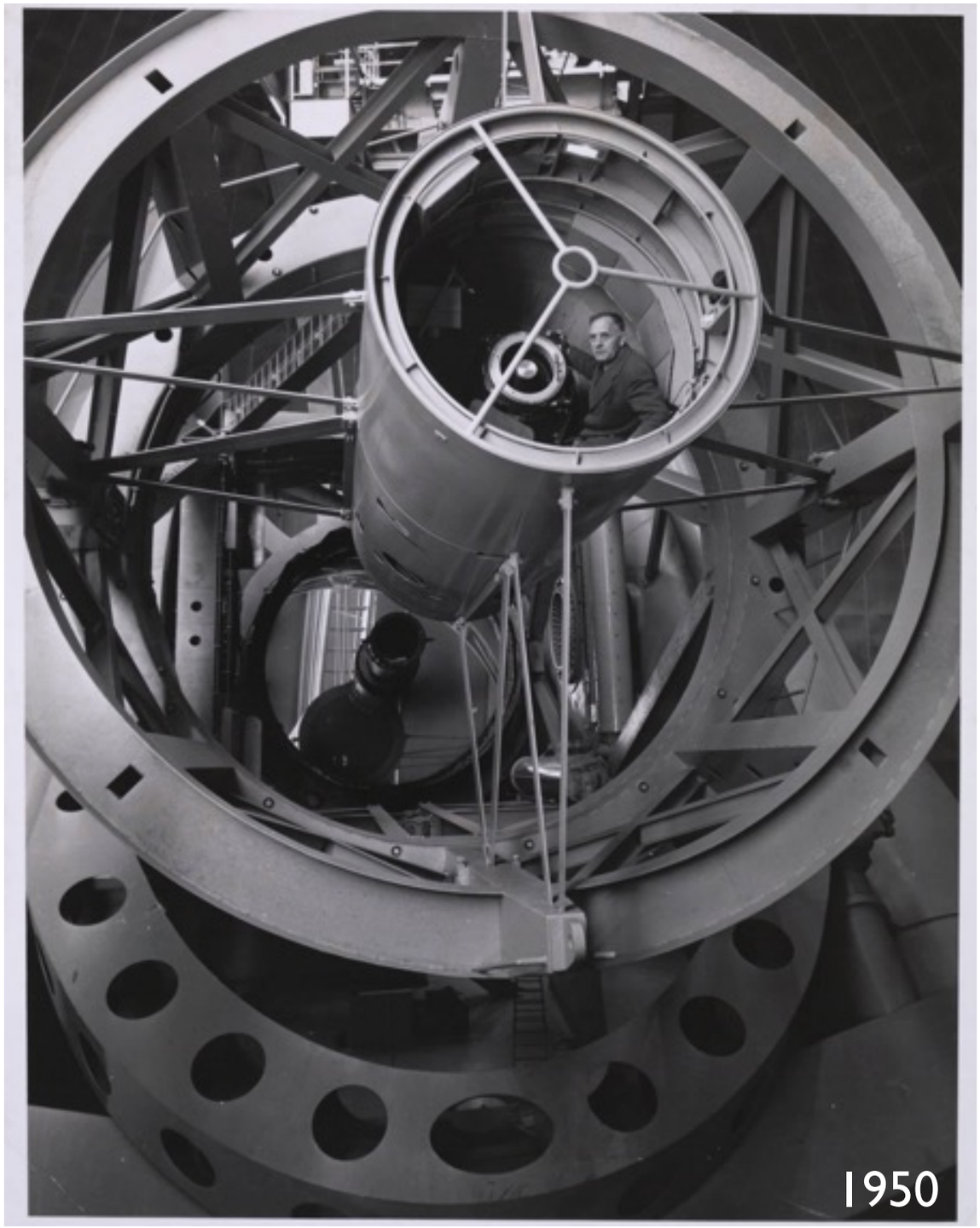
Yale University

Image of Modern Astronomy?



(Huntington Digital Library)

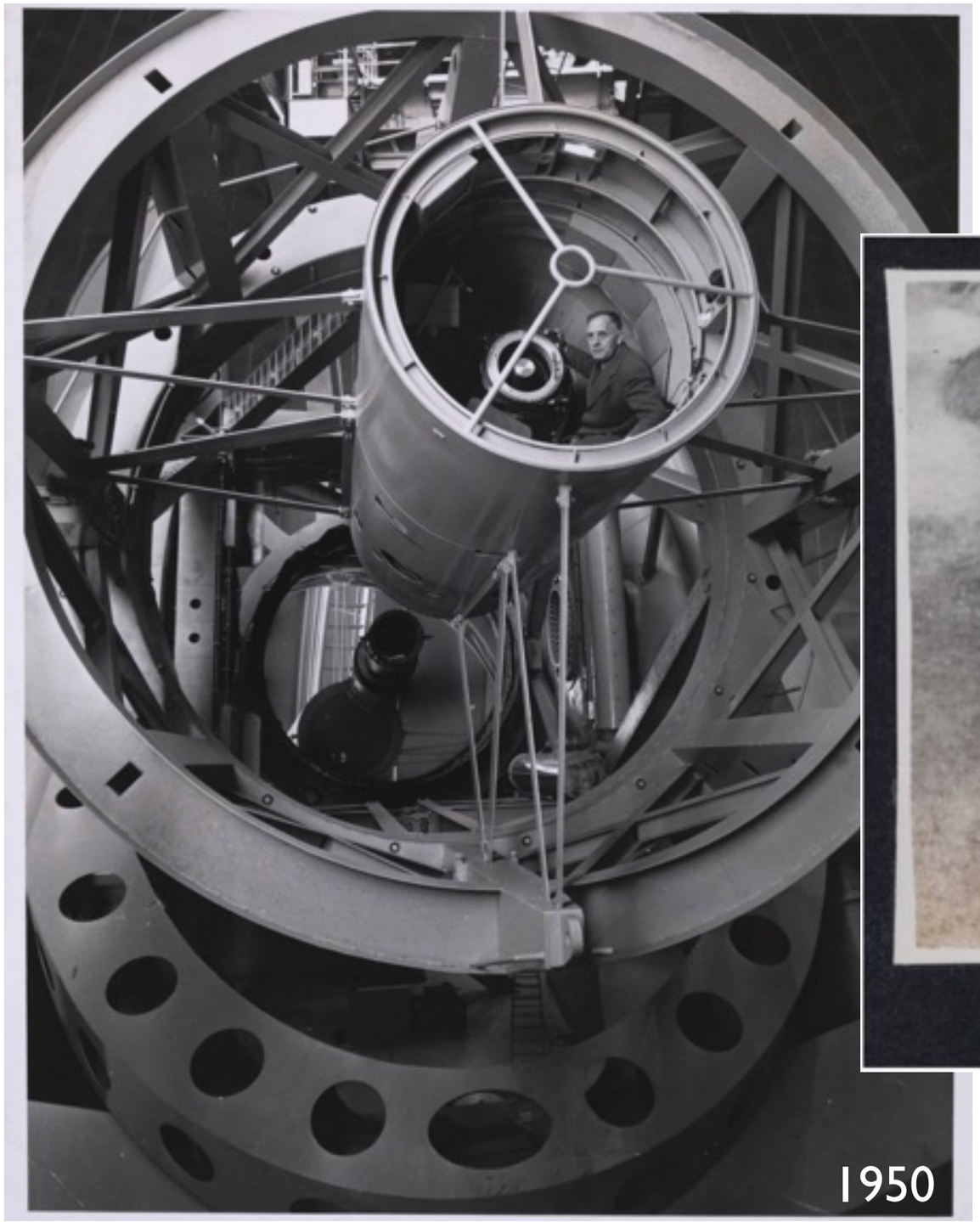
Image of Modern Astronomy?



(Huntington Digital Library)

Lone male scientist, solitude, large telescopes

Image of Modern Astronomy?



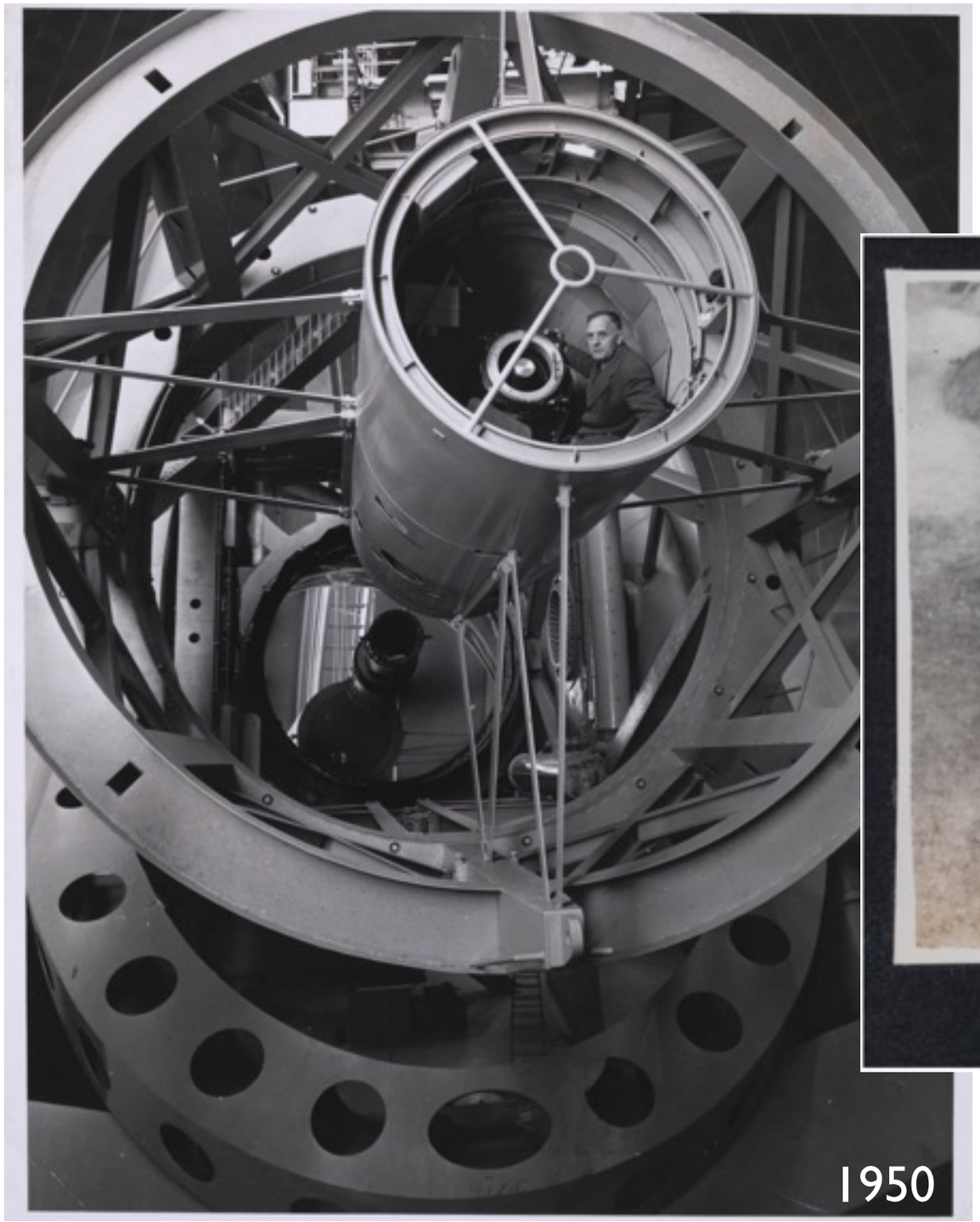
(Huntington Digital Library)

Lone male scientist, solitude, large telescopes

(Smithsonian Institution)

"The Four Friends"

Image of Modern Astronomy?



(Huntington Digital Library)

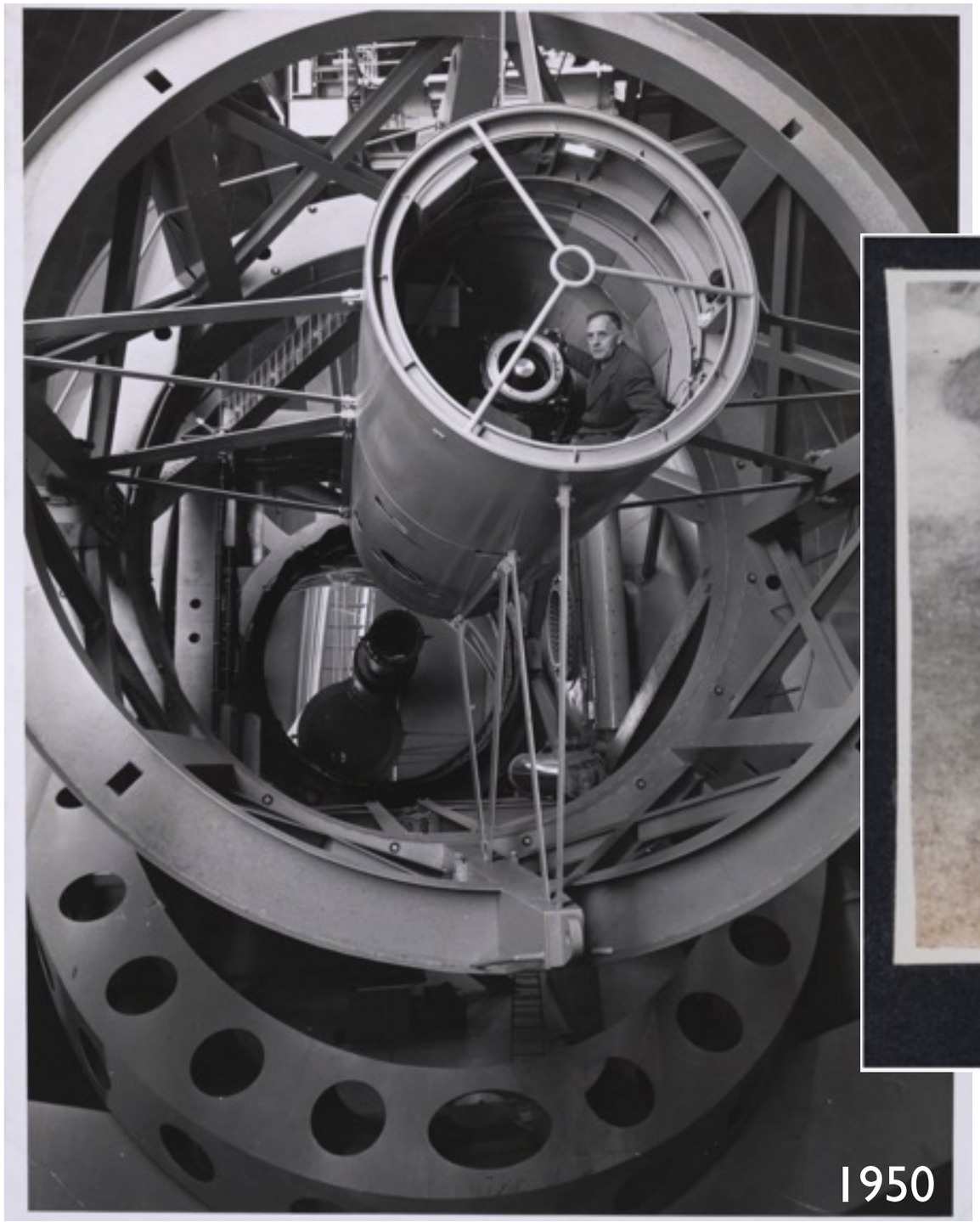
Lone male scientist, solitude, large telescopes

Colleagues, discussions, conferences

(Smithsonian Institution)

"The Four Friends"

Image of Modern Astronomy?



(Huntington Digital Library)

Lone male scientist, solitude, large telescopes

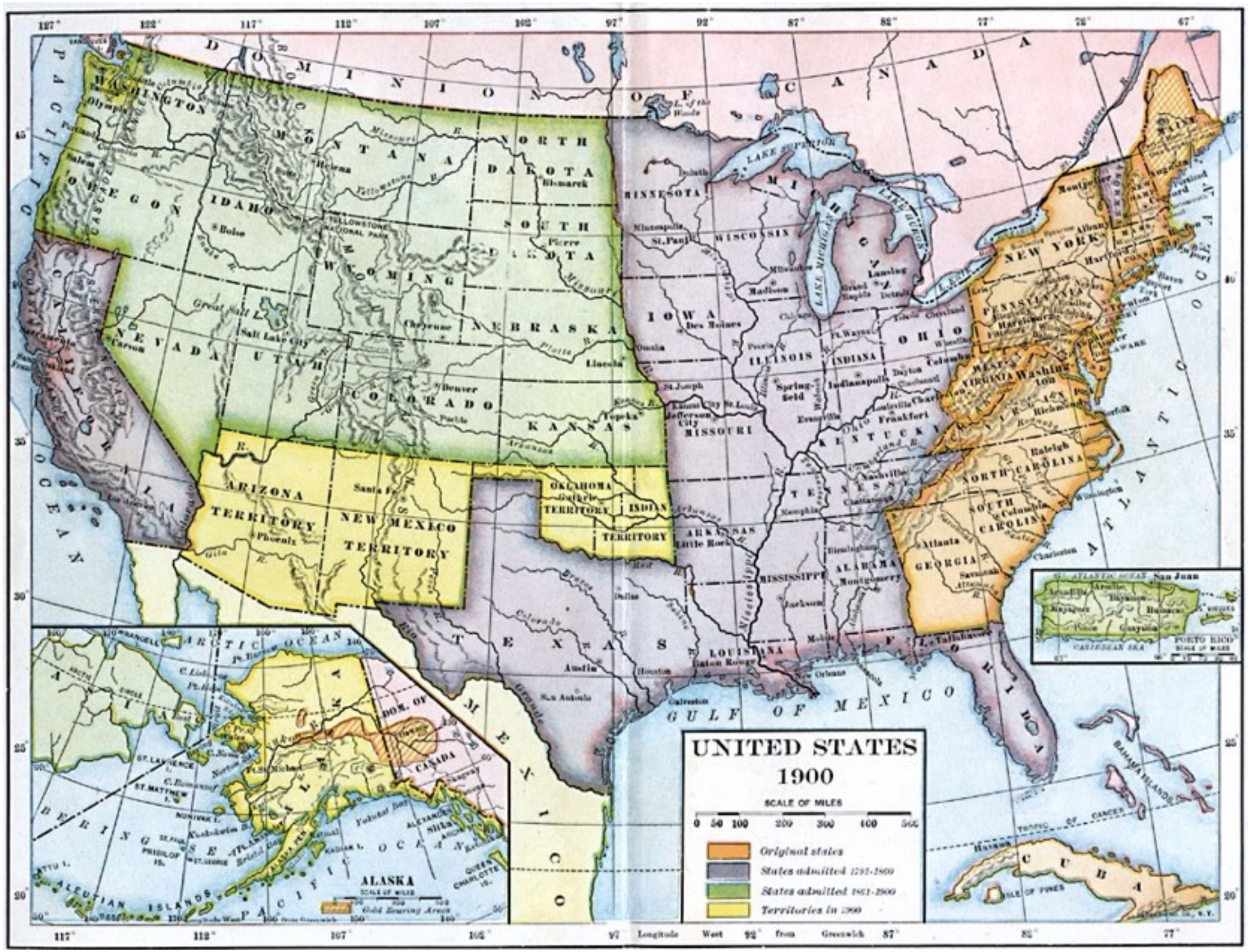
Colleagues, discussions, conferences

(Smithsonian Institution)

"The Four Friends"

Story telling matters

Telling stories of Mount Wilson Observatory (founded 1904)



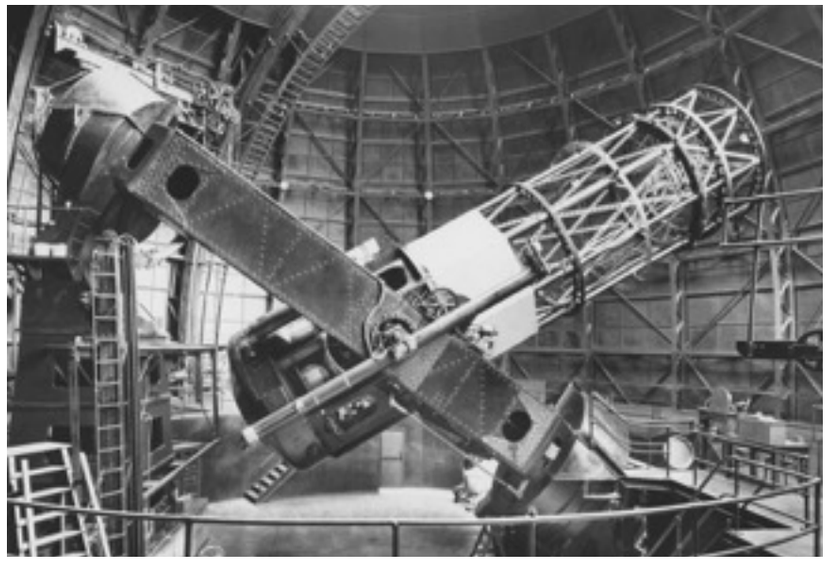
Telling stories of Mount Wilson Observatory (founded 1904)

Telling a story of Mount Wilson Observatory (founded 1904)

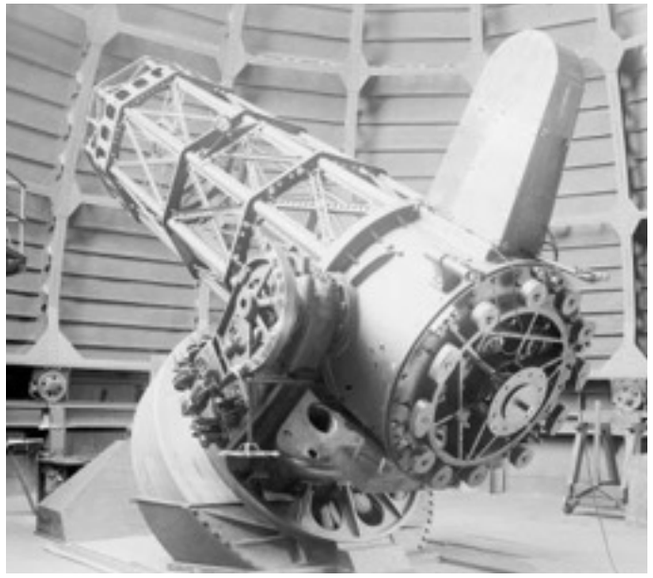
George E. Hale

(Photos from the Huntington Digital Library)

Telling a story of Mount Wilson Observatory (founded 1904)



100-inch Telescope



60-inch Telescope

George E. Hale

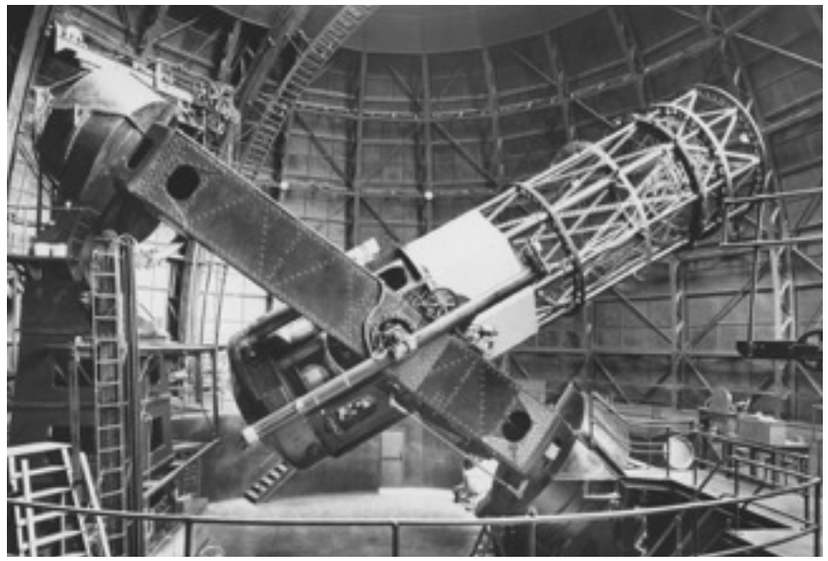
Snow Telescope (1905)

150-ft Tower
Solar Telescope

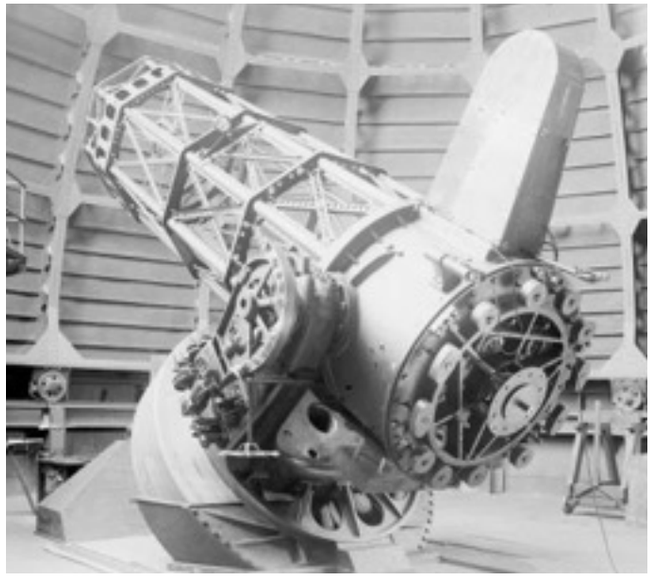
60-ft Tower
Solar Telescope

(Photos from the Huntington Digital Library)

Telling a story of Mount Wilson Observatory (founded 1904)



100-inch Telescope



60-inch Telescope

George E. Hale

Edwin P. Hubble

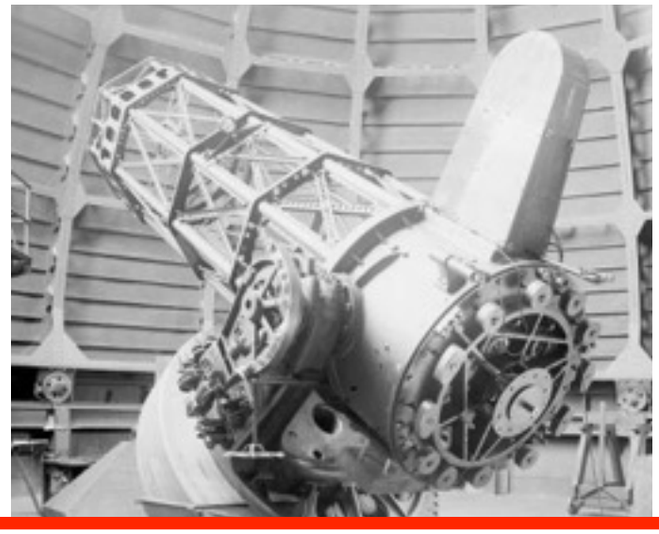
Notable Discoveries:

- **Sunspot temperature** (Hale, Adams, Gale, *ApJ* 1906)
- **Solar B field** (Hale, *ApJ* 1908)
- **Distance ladder (spectroscopic parallax)** (Adams & Kohlschütter, *ApJ* 1914)
- **Expanding Universe** (Hubble, *PNAS* 1929)
- **Supernovae** (Baade & Zwicky, *PNAS* 1934)

(Photos from the Huntington Digital Library)

Telling a story of Mount Wilson Observatory (founded 1904)

100-inch Telescope



George E. Hale

Were there other workers at the observatory?

Edwin P. Hubble

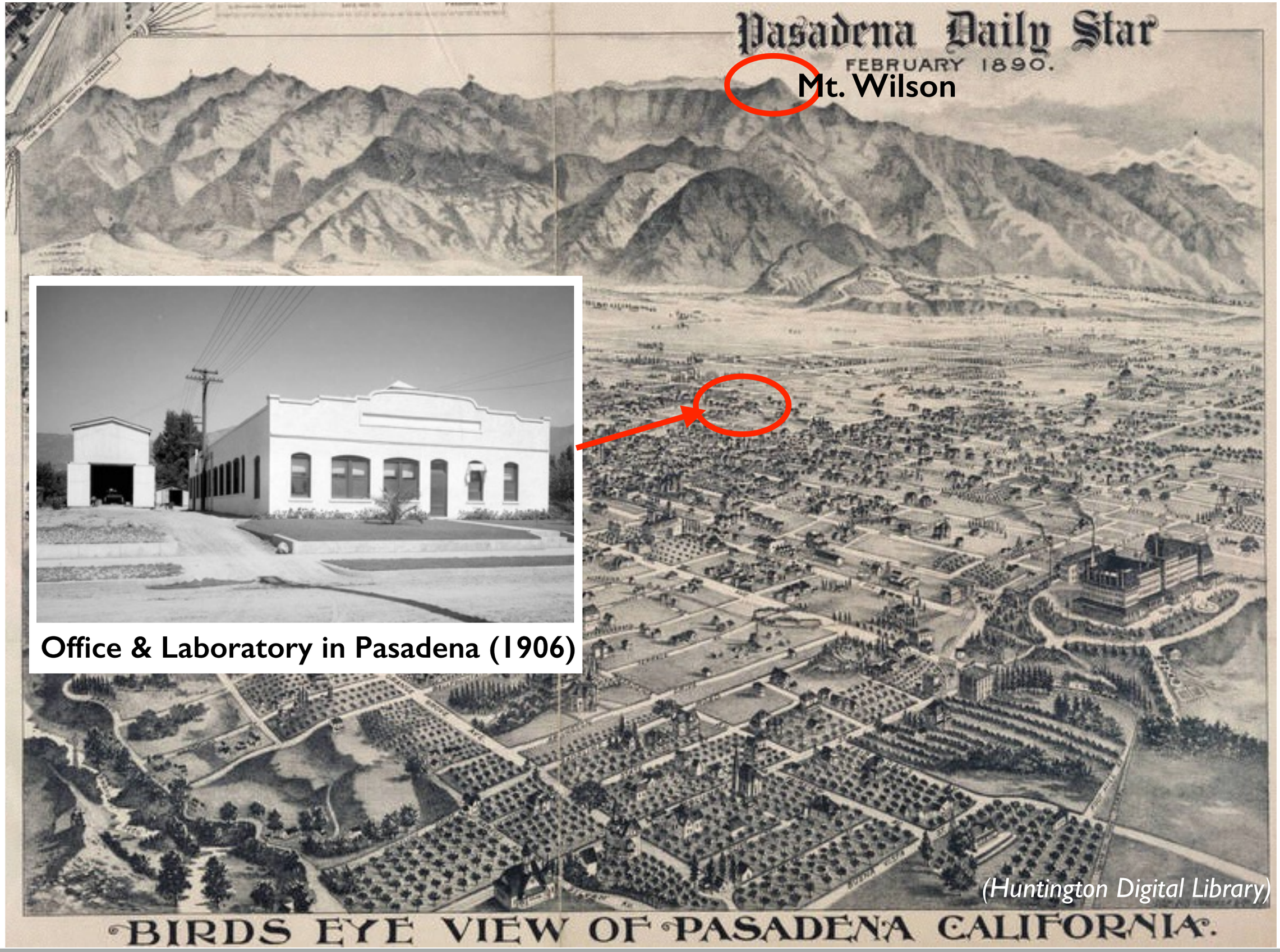
Notable Discoveries:

- **Sunspot temperature** (Hale, Adams, Gale, *ApJ* 1906)
- **Solar B field** (Hale, *ApJ* 1908)
- **Distance ladder (spectroscopic parallax)** (Adams & Kohlschütter, *ApJ* 1914)
- **Expanding Universe** (Hubble, *PNAS* 1929)
- **Supernovae** (Baade & Zwicky, *PNAS* 1934)

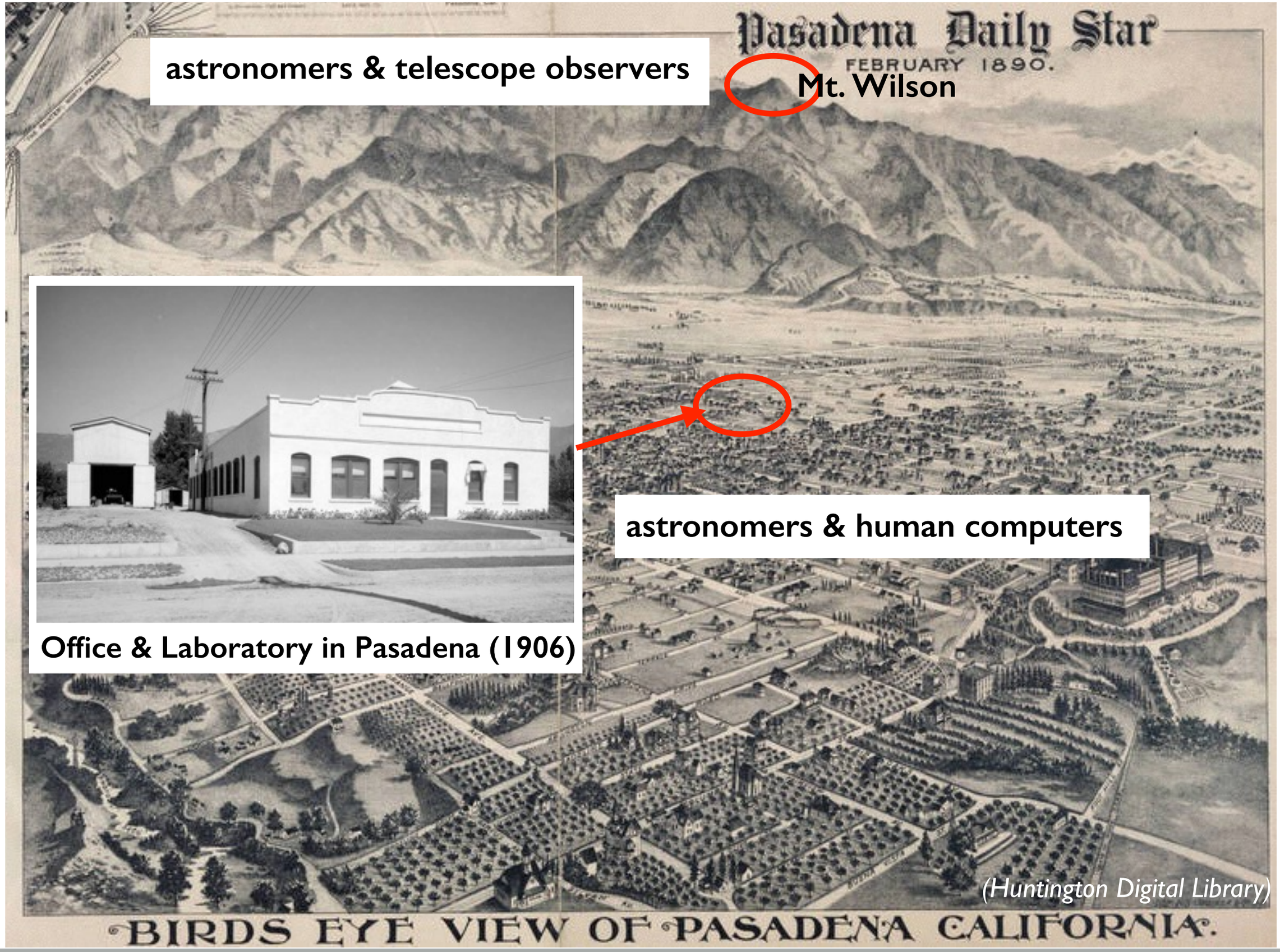
(Photos from the Huntington Digital Library)

A more inclusive narrative (Ahn, *HSNS* 2022, PhD dissertation)

A more inclusive narrative (Ahn, *HSNS* 2022, PhD dissertation)



A more inclusive narrative (Ahn, *HSNS* 2022, PhD dissertation)



A more inclusive narrative (Ahn, *HSNS* 2022, PhD dissertation)

astronomers & telescope observers

Mt. Wilson

MWO Staff photograph 1917

administrators, astronomers, carpenter, computers, draftsman, instrument maker, janitor, machinist, opticians

(missing: truck driver, night assistants, solar observers)

Human computers at MWO

- mostly highly educated women astronomers (B.S. or M.S. in astronomy)
- lower salary than night assistants
- gendered glass ceiling: research scope depended on supervisor

Human computers at MWO

- mostly highly educated women astronomers (B.S. or M.S. in astronomy)
- lower salary than night assistants
- gendered glass ceiling: research scope depended on supervisor

Human computers at MWO

- mostly highly educated women astronomers (B.S. or M.S. in astronomy)
- lower salary than night assistants
- gendered glass ceiling: research scope depended on supervisor

Cora Burwell: 32 refereed pubs.

Louise Ware: 7 refereed pubs.

Staff for 40+ years

Human computers at MWO

- mostly highly educated women astronomers (B.S. or M.S. in astronomy)
- lower salary than night assistants
- gendered glass ceiling: research scope depended on supervisor
  difficulty observing (geographical separation of observatory)

(Smithsonian Institution)

Human computers at MWO

- mostly highly educated women astronomers (B.S. or M.S. in astronomy)
- lower salary than night assistants
- gendered glass ceiling: research scope depended on supervisor
  difficulty observing (geographical separation of observatory)

Jennie Lasby: observed with 60-inch telescope

(resigned 1915)

1910

(Smithsonian Institution)

60-inch Telescope

Human computers at MWO

- mostly highly educated women astronomers (B.S. or M.S. in astronomy)
- lower salary than night assistants
- gendered glass ceiling: research scope depended on supervisor
  difficulty observing (geographical separation of observatory)
  women unable to change to other staff positions

Human computers at MWO

- mostly highly educated women astronomers (B.S. or M.S. in astronomy)
- lower salary than night assistants
- gendered glass ceiling: research scope depended on supervisor
  difficulty observing (geographical separation of observatory)
  women unable to change to other staff positions

Night Assistants → Astronomer Computer

Human computers at MWO

- mostly highly educated women astronomers (B.S. or M.S. in astronomy)
- lower salary than night assistants
- gendered glass ceiling: research scope depended on supervisor
  difficulty observing (geographical separation of observatory)
  women unable to change to other staff positions

Night Assistants → Astronomer Computer

Milton Humason

Wendell Hoge

(Huntington Digital Library)

Parallels with today's science

❖ Non-dominant groups are:

- present but less visible
- have more setbacks (institutional, sociocultural, political, economical)

Parallels with today's science

❖ Non-dominant groups are:

- present but less visible
- have more setbacks (institutional, sociocultural, political, economical)

❖ IDEEO - expand who becomes the dominant group

Parallels with today's science

❖ Non-dominant groups are:

- present but less visible
- have more setbacks (institutional, sociocultural, political, economical)

❖ IDEEO - expand who becomes the dominant group

WG7 at NuFACT2022

- Kate Shaw "Widening the talent pool for physics worldwide"
- Anders Knospe "LGBTQ+ Inclusivity in Physics and Beyond"
- Simona Kriva "Mentoring program initiative by Women in Technology at CERN (WIT)"
- Xinhua Bai "Stimulate IDEEO in Neutrino Education through the IceCube Masterclass"
- Tino Nyawelo "Investigating the Development of STEM-Positive Identities of Refugee Teens in a Physics Out-of-School Time Experience (INSPIRE)"
- Simone Donati et al. "INVOLVING THE NEW GENERATIONS IN FERMILAB ENDEAVOURS"
- Gilles Ferrand "3D visualization of astronomy data using virtual reality"

7 talks, 1 facilitated discussion, 1 career workshop

WG7 at NuFACT2023

- Hyein Im "KPS Women's committee activities"
- Shota Takahashi "Public Communications"
- Eun-Joo Ahn "Invisible Workers in Science"
- Mia West "Diversity and outreach in research"

- Margherita Boselli "Beamline for Schools"

Parallels with today's science

❖ Non-dominant groups are:

- present but less visible
- have more setbacks (institutional, sociocultural, political, economical)

❖ IDEEO - expand who becomes the dominant group

WG7 at NuFACT2022

- Kate Shaw "Widening the talent pool for physics worldwide"
- Anders Knospe "LGBTQ+ Inclusivity in Physics and Beyond"
- Simona Kriva "Mentoring program initiative by Women in Technology at CERN (WIT)"
- Xinhua Bai "Stimulate IDEEO in Neutrino Education through the IceCube Masterclass"
- Tino Nyawelo "Investigating the Development of STEM-Positive Identities of Refugee Teens in a Physics Out-of-School Time Experience (INSPIRE)"
- Simone Donati et al. "INVOLVING THE NEW GENERATIONS IN FERMILAB ENDEAVOURS"
- Gilles Ferrand "3D visualization of astronomy data using virtual reality"

7 talks, 1 facilitated discussion, 1 career workshop

WG7 at NuFACT2023

- Hyein Im "KPS Women's committee activities"
- Shota Takahashi "Public Communications"
- Eun-Joo Ahn "Invisible Workers in Science"
- Mia West "Diversity and outreach in research"

- Margherita Boselli "Beamline for Schools"

Inclusive narrative of science can help us understand the ways non-dominant groups face difficulties