The invention of practical photography by Louis Daguerre was announced in Paris in 1839. News of the daguerreotype process spread quickly around the world, and shortly the first photographs of the Moon and the Sun were produced by attaching a camera to the eyepiece-end of a telescope. Photographs of fainter celestial objects—planets, stars, nebulae, comets—proved more challenging. To capture their feeble light on a photographic plate required long time-exposures. This, in turn, demanded both speedier photographic processes and, to prevent night-sky targets from drifting out of view, telescope tracking-mechanisms more accurate than what was commonly available in the mid-1800s.

Much of the groundwork for the photographic revolution in astronomy was laid by amateur astronomers. While their professional counterparts focused on the classical astronomy of stellar positions and motions, a succession of dedicated amateurs developed the means to apply both photography and spectroscopy to a host of astrophysical problems: What are stars made of? What are the faint, cloudlike nebulae? What are the conditions on the Sun’s surface? Still, few professional astronomers admitted the potential of the new technologies. The turning point came in the 1890s when celestial photographers began to discover objects in space that were too faint to be seen though a telescope by eye alone.

To appreciate how photography helped remake astronomy into a modern science, you are going to give your impressions of a series of astronomical images from various eras. Some are drawings of celestial objects as they appeared by eye through a telescope; others are photographs recorded by attaching a camera to a telescope. But first, here’s some practice in the art of observation.

**Faraday’s Face**

**Figure 15-1** includes several images of the famous 19th-century physicist Michael Faraday, who invented the electric motor and electric generator.

1. Study the pictures carefully and decide which one best represents Faraday’s true appearance. Explain why you trust this image the most.

2. Describe some of the similarities and differences between your “most trusted” image and the others.

3. Why do you think there is such a wide variation in Faraday’s appearance among the various images?
Figure 15-1 Images of Michael Faraday.
4. Extend your reasoning to predict the relative trustworthiness (accuracy) of drawings of astronomical objects, as they appear to the eye through a telescope, versus photographs of the same objects taken through a telescope.

■ The Moon’s Face

Figure 15-2 shows several images of the moon. Figure 15-2A is a drawing of the Moon by Galileo from 1610; Figure 15-2B is a drawing by astronomical artist Etienne Trouvelot from 1875. (Trouvelot is reviled by some for his disastrous introduction of the gypsy moth to the United States.) Figure 15-2C is a vintage lunar photograph taken in 1865 by astronomer Lewis Morris Rutherfurd from his backyard observatory in New York City, and Figure 15-2D is a photograph taken in 1971 by astronaut David Scott on the U.S. Apollo 15 mission to the Moon.

5. Compare the drawings with each other and with the photographs. Describe similarities and differences among them. Assess the relative trustworthiness of the drawings versus the photographs.

■ Jupiter’s Face

Figure 15-3 shows Etienne Trouvelot’s drawing of Jupiter from the 1870s and a Voyager 1 spacecraft photograph taken about a century later.

6. Compare the drawing and the photograph. Cite similarities and differences of specific features on Jupiter.

■ Diffuse Nebulae: Clouds of Gas in Space

The Orion nebula is a distant interstellar gas cloud that can be seen with the unaided eye as a fuzzy patch below the “belt” of the constellation Orion the hunter. Figure 15-4 comprises several different images of the nebula. Figure 15-4A is William Lassell’s drawing of the nebula from 1852. Figure 15-4B, at a somewhat different scale, is the first-ever photograph of that object, taken through a telescope by New York amateur astronomer Henry Draper in 1880.

7. Compare these two images of the Orion nebula. Describe similarities and differences.

8. Which do you think better reflects the true appearance of the Orion nebula, Lassell’s drawing or Draper’s photograph? Explain.

9. Given that Draper was a skilled astronomer, why do you think his photo is so poor? Consider that in the 40 years since the advent of photography, no one before Draper had succeeded in taking a picture of any nebula through a telescope.

Figure 15-4C shows a much-improved photograph of the Orion nebula taken by English amateur astronomer A.A. Common in 1883, just 3 years after Henry Draper’s pioneering attempt. Figure 15-4D is a photograph of the same object taken by the Hubble Space Telescope in 2006.
**Figure 15-2A** Moon image.

*Images courtesy History of Science Collections, University of Oklahoma Libraries; copyright the Board of Regents of the University of Oklahoma.*

**Figure 15-2B** Moon image.

Figure 15-2C  Moon image.

© CCI Archives/Science Photo Library

Figure 15-2D  Moon image.

Courtesy of NASA
Figure 15-3A  Jupiter image.

Figure 15-3B  Jupiter image.
Courtesy of Voyager 1/NASA
10. Compare these images to Lassell’s drawing and to each other. Describe similarities and differences.

11. For his 1883 Orion nebula picture, Common used a telescope with a light-collecting mirror that was more than twice as wide as Draper’s. He also adopted a new photographic process that was much more sensitive to light than the one Draper used. Explain how these two factors might have made Common’s photograph a better rendering of the Orion nebula than Draper’s.

12. The Hubble Space Telescope has a light-collecting mirror much larger than either Draper’s or Common’s telescope, is equipped with a high-sensitivity digital camera, and is situated in orbit around Earth. Explain how these factors might have made the Hubble picture a better rendering of the Orion nebula than the earlier photographs.

A Galaxy Revealed

Among the great astronomical mysteries of the 1800s were the spiral nebulae, which appeared in telescopes as swirling cloudlike forms, but whose nature was unknown. Four different renderings of one such spiral nebula, designated M51, are shown in Figure 15-5. Figure 15-5A is a drawing from 1845 by William Parsons, the Earl of Rosse, who viewed M51 through what was then the world’s largest telescope and sketched what he saw. Figure 15-5B is a picture from 1889 by English amateur astronomer Isaac Roberts, and is perhaps the first-ever photograph of M51. Figure 15-5C is a 1950 photograph that was taken through the largest-in-the-world telescope of that era, the 200-inch Hale reflector on Mt. Palomar in California. Figure 15-5D was obtained with the Hubble Space Telescope in 2005. Today we know that spiral nebulae like M51 are actually spiral galaxies, vast star systems like our own Milky Way galaxy.

13. Compare the four pictures of M51. Describe similarities and differences.

14. What factors might have led to the noticeable improvements in these images over time?
Figure 15-4A  Orion Nebula.
© Royal Astronomical Society/Photo Researchers, Inc.

Figure 15-4B  Orion Nebula.
© Harvard College Observatory
Figure 15-4C  Orion Nebula.

Figure 15-4D  Orion Nebula.
Courtesy of NASA/ESA, M. Robberto (STScI/ESA) and the Hubble Space Telescope Orion Treasury Project Team.
Figure 15-5A  M51—Whirlpool galaxy.
© Science Photo Library

Figure 15-5B  M51—Whirlpool galaxy.
© Science Museum/Science & Society Picture Library
Figure 15-5C  M51—Whirlpool galaxy.
Courtesy of the Palomar Observatory and Caltech

Figure 15-5D  M51—Whirlpool galaxy.
Courtesy of DSS/NASA/JPL-Caltech
Picturing the Universe—How Photography Revolutionized Astronomy

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