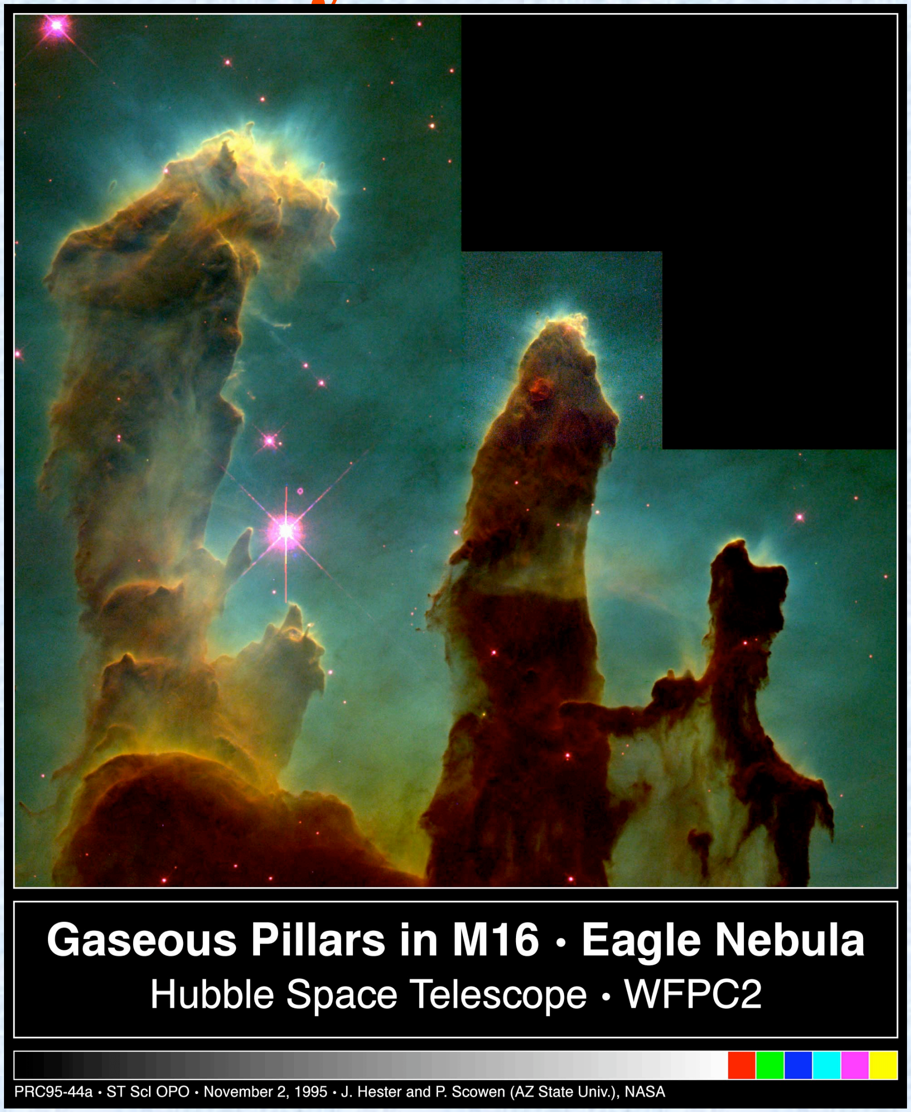
Astronomy 1 – Winter 2011



Lecture 18; February 16 2011

Previously on Astro-1

- **Beyond the giant planets**
  - **Uranus**
  - **Neptune**
  - **Pluto and the other TNOs**

Homework – Due 02/23/10

- On your own: answer all the review questions in chapter 15
- To TAs: answer questions 15.34 15.44

Friday: midterm-2

- **Open book – open notes**
- **No cell-phones internet**
- **Twenty multiple choice questions**
- **One problem like homework**
- **Bring scantron form and calculator**

Today on Astro-1

- Asteroids
- Comets
- Meteors

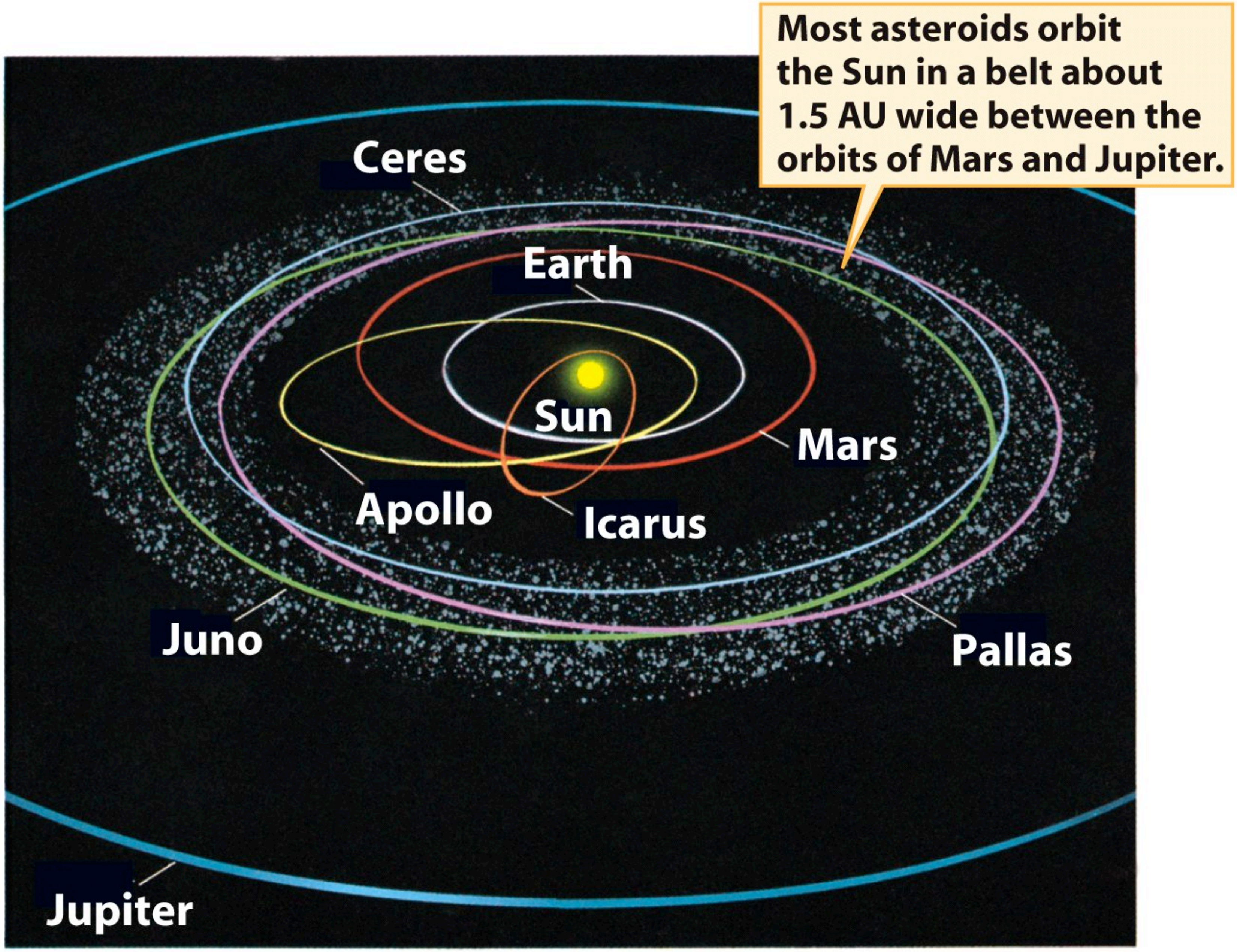


Figure 15-3
Universe, Eighth Edition

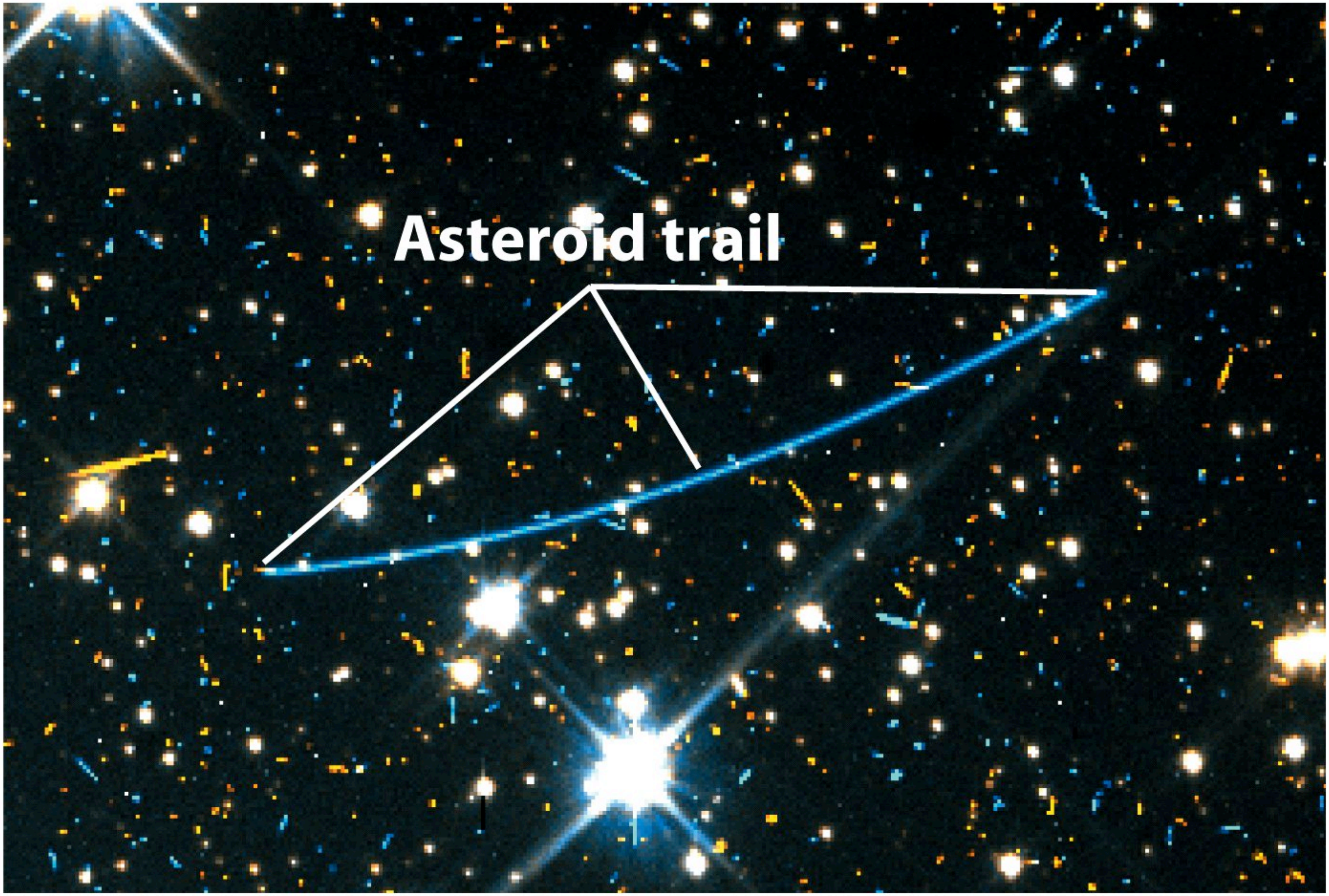


Figure 15-2
Universe, Eighth Edition

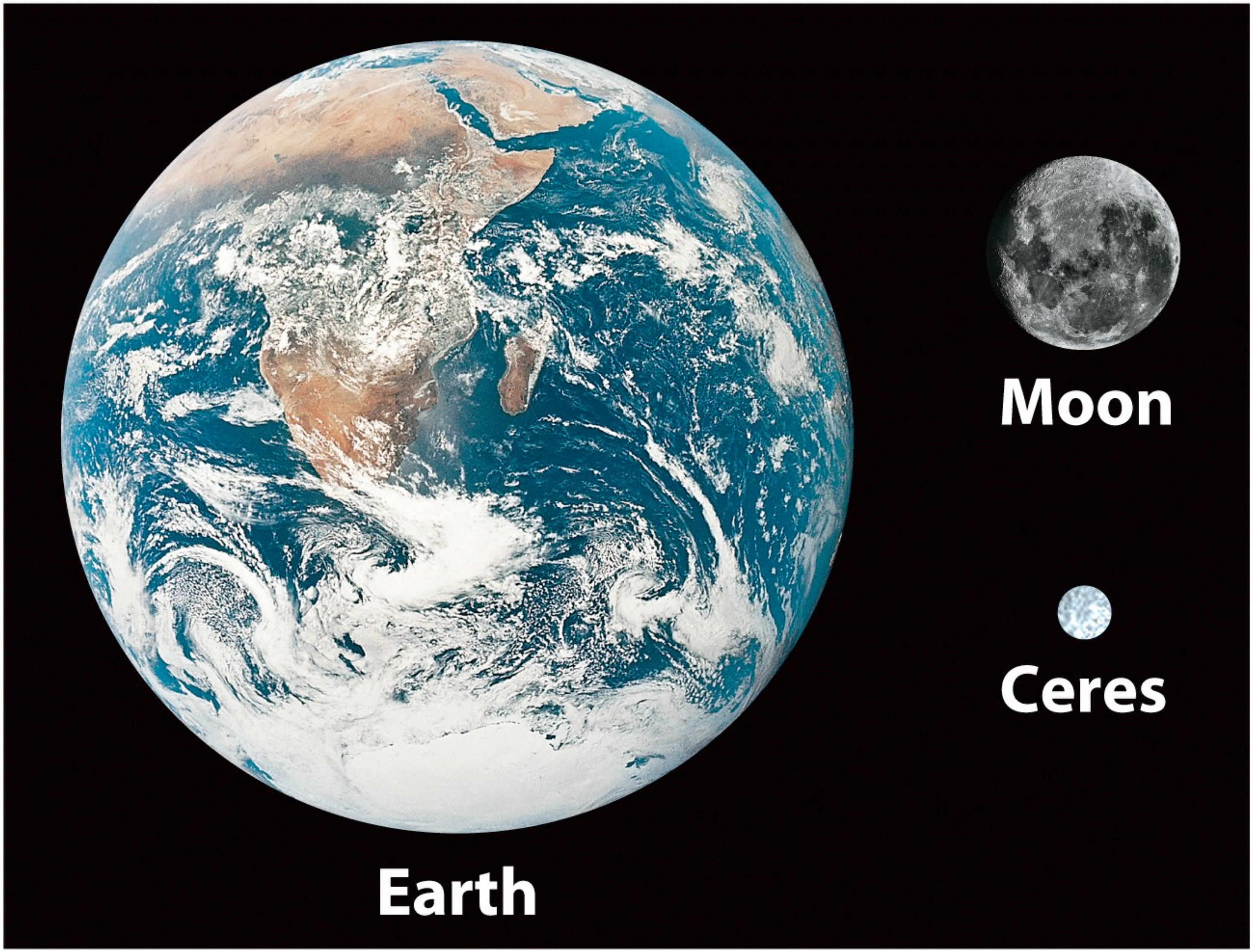


Figure 15-1
Universe, Eighth Edition

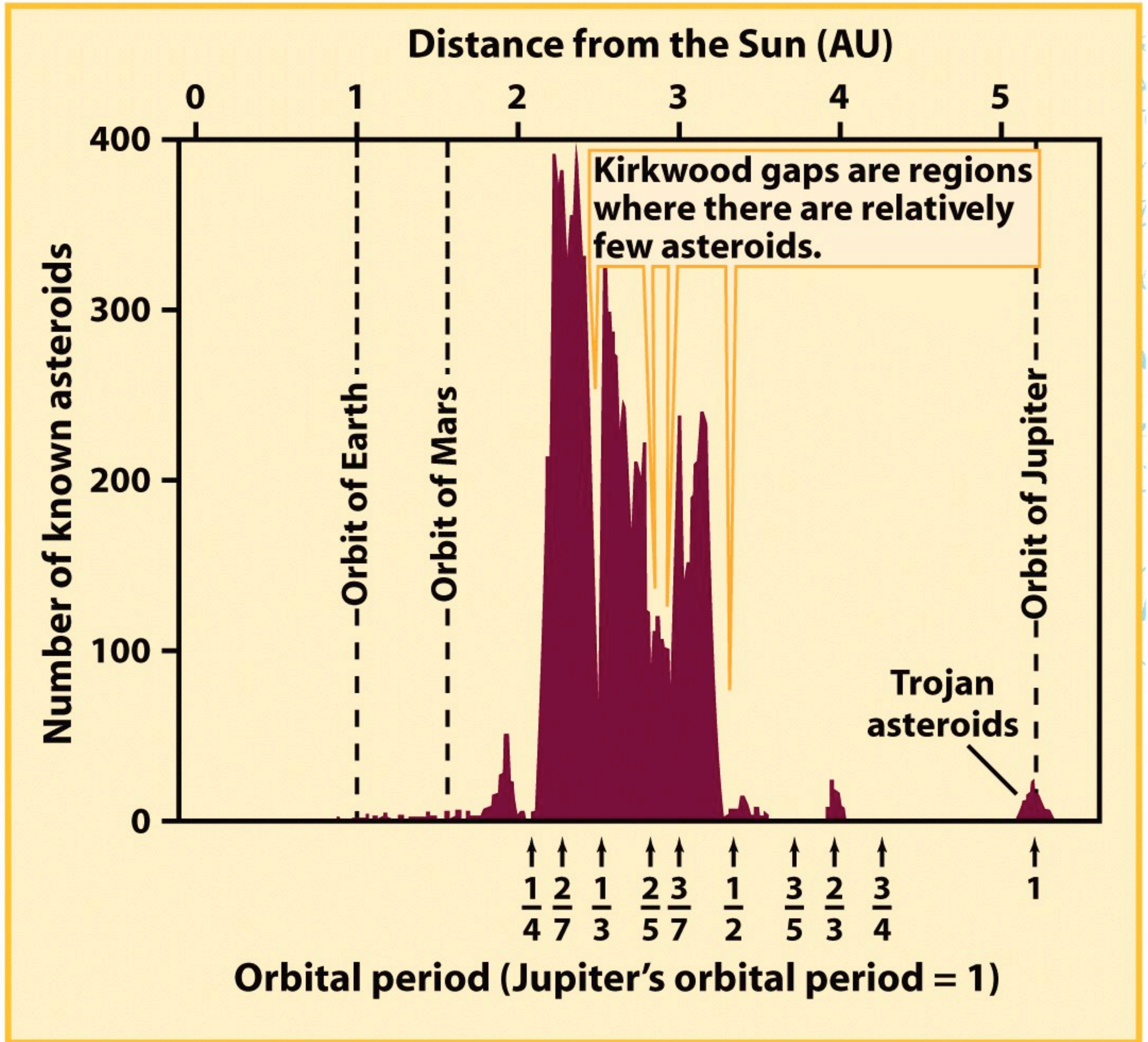


Figure 15-4
Universe, Eighth Edition

Hubble Space Telescope Image of Ceres

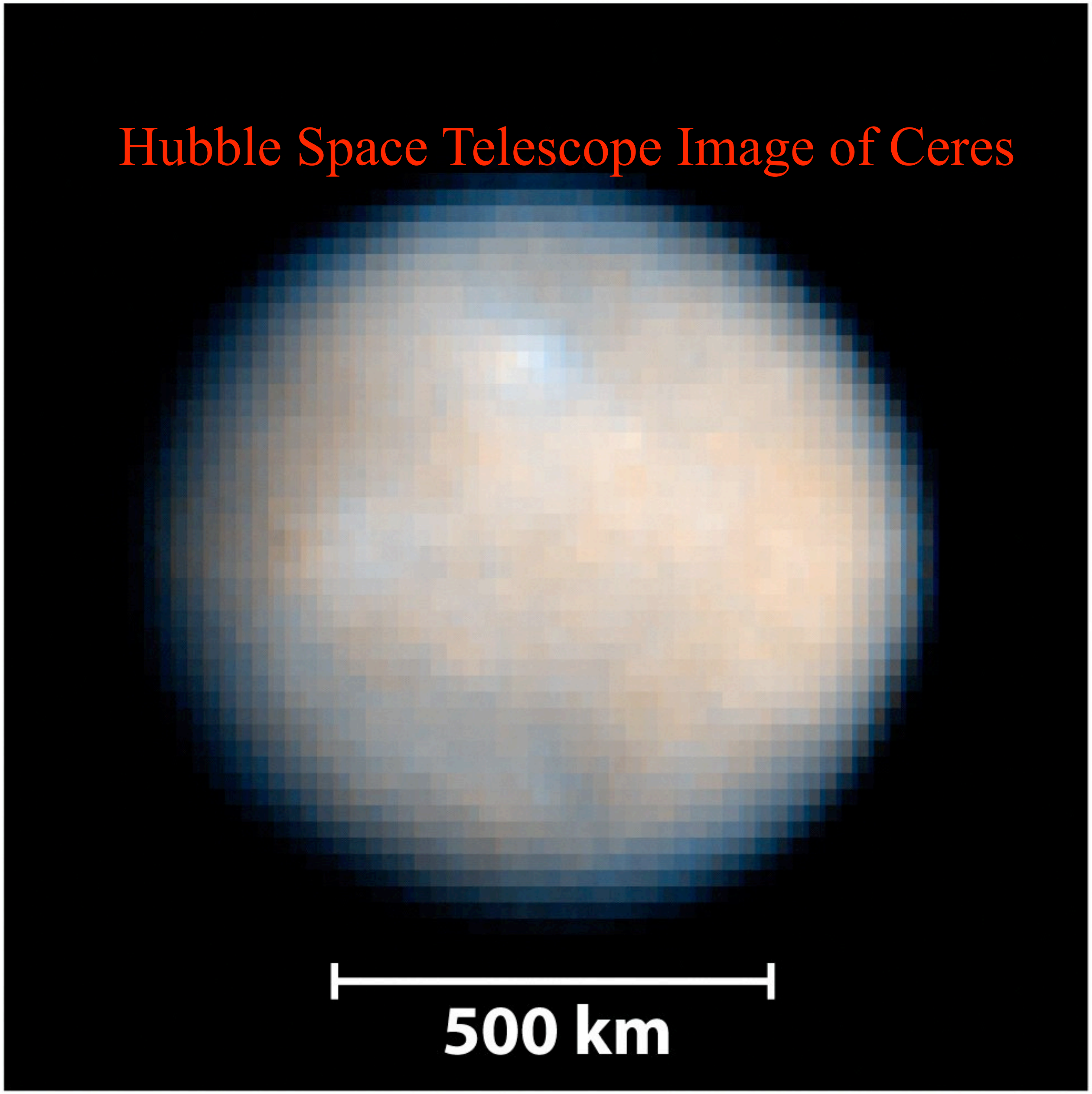


Figure 15-5
Universe, Eighth Edition

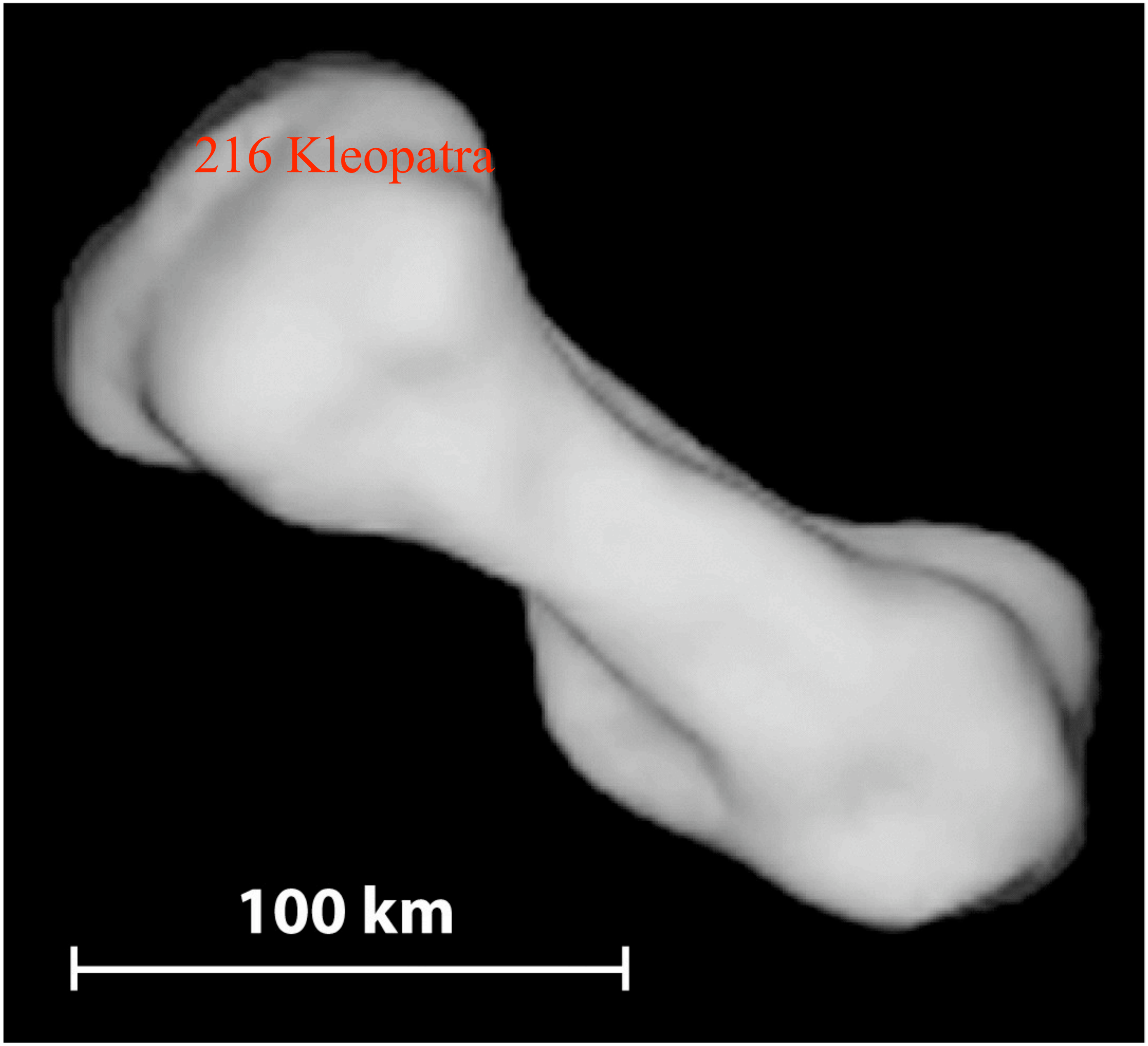


Figure 15-6
Universe, Eighth Edition

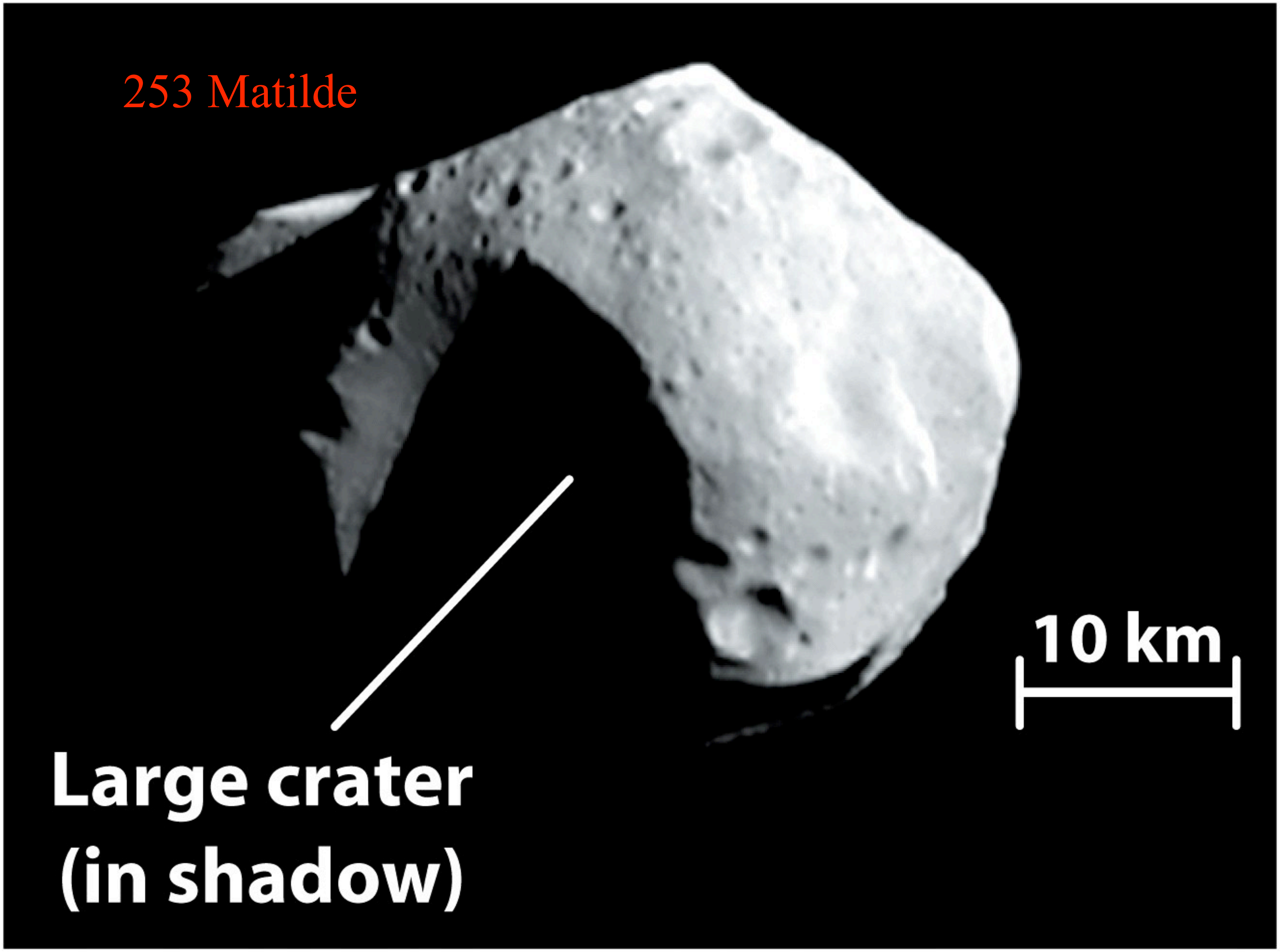


Figure 15-7
Universe, Eighth Edition

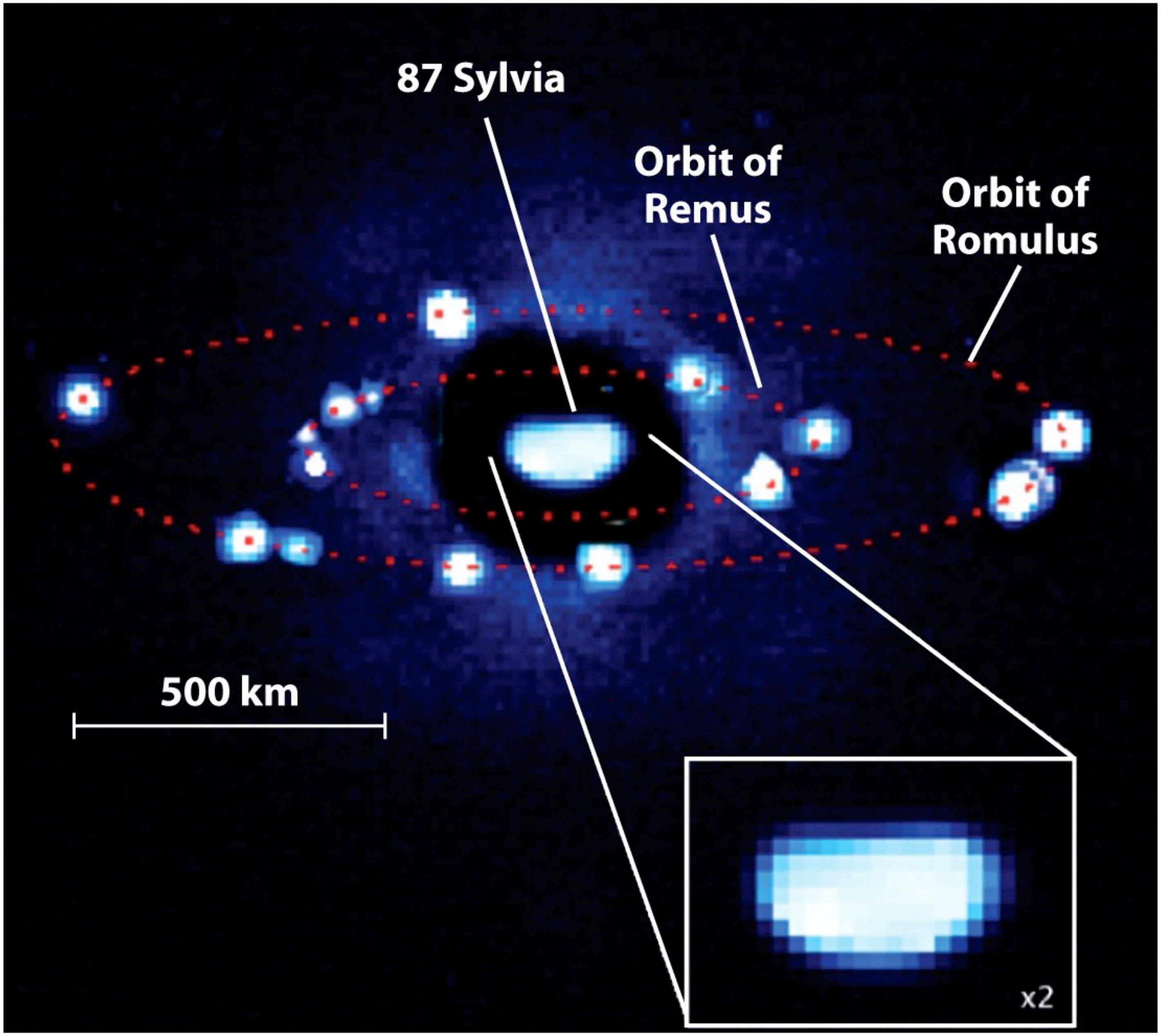


Figure 15-8
Universe, Eighth Edition

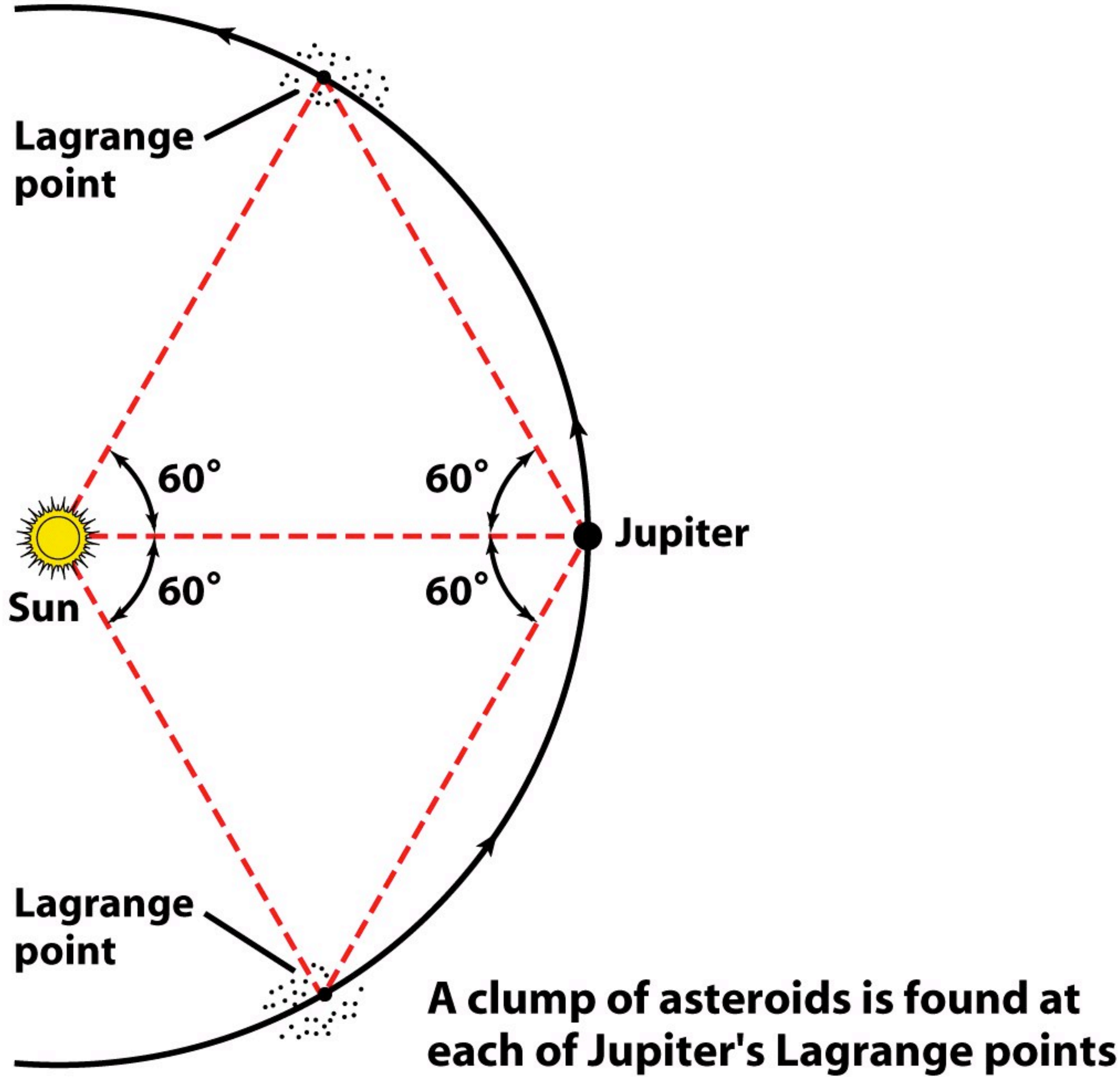
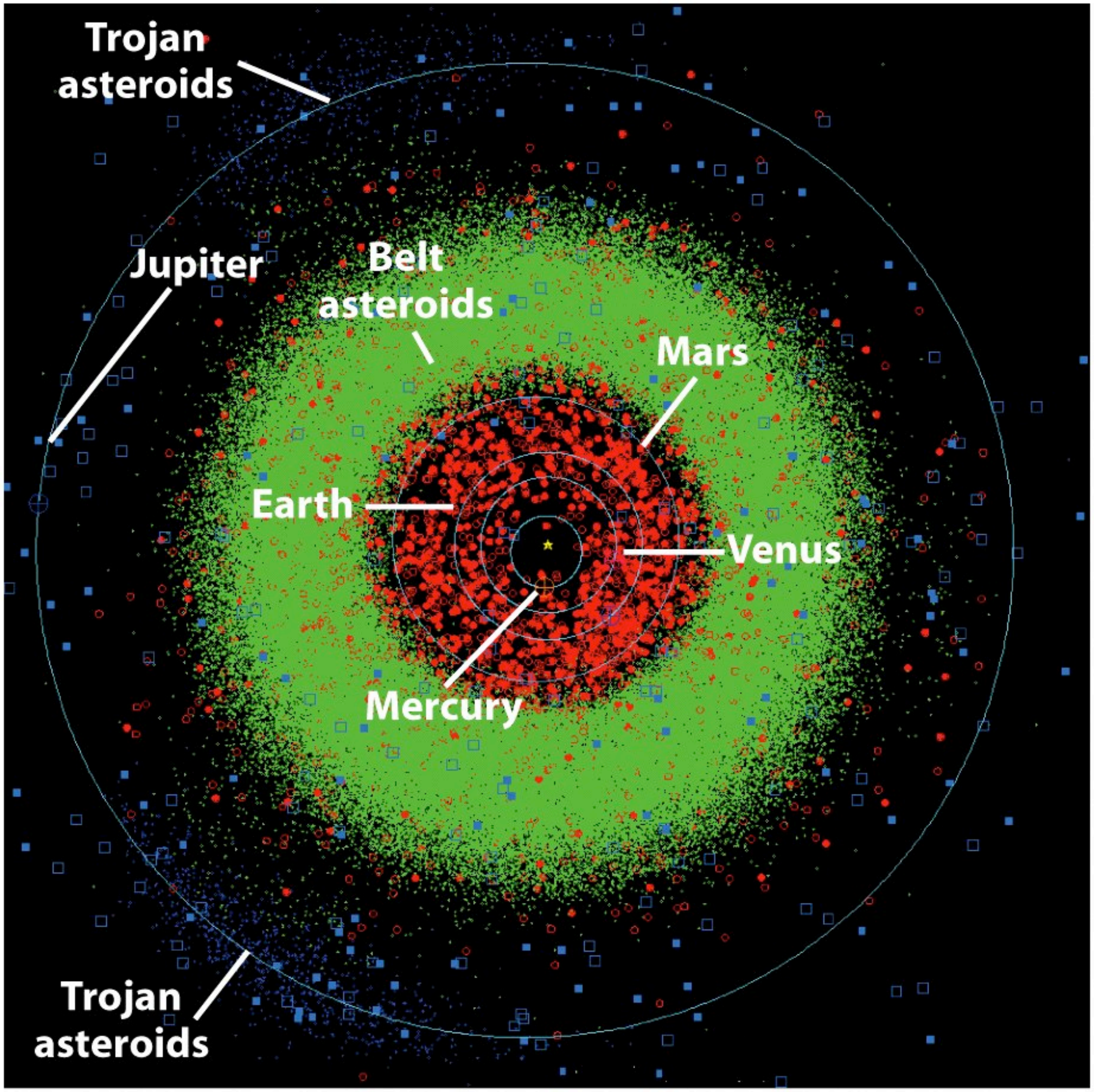


Figure 15-9a
Universe, Eighth Edition



A map of all asteroids within Jupiter's orbit

Figure 15-9b
Universe, Eighth Edition

Question 18.1 (iclickers!)

- Only the few largest asteroids are found to be spherical. Why is this?
  - A) Repeated collisions with other asteroids have worn them to spheres
  - B) Self gravity for the most massive asteroids was sufficient to pull them to this shape during their early history
  - C) Their visible outer atmospheres assume a spherical shape even though their surfaces are irregular
  - D) They solidified from spherical gas clouds in their early history and retained this shape

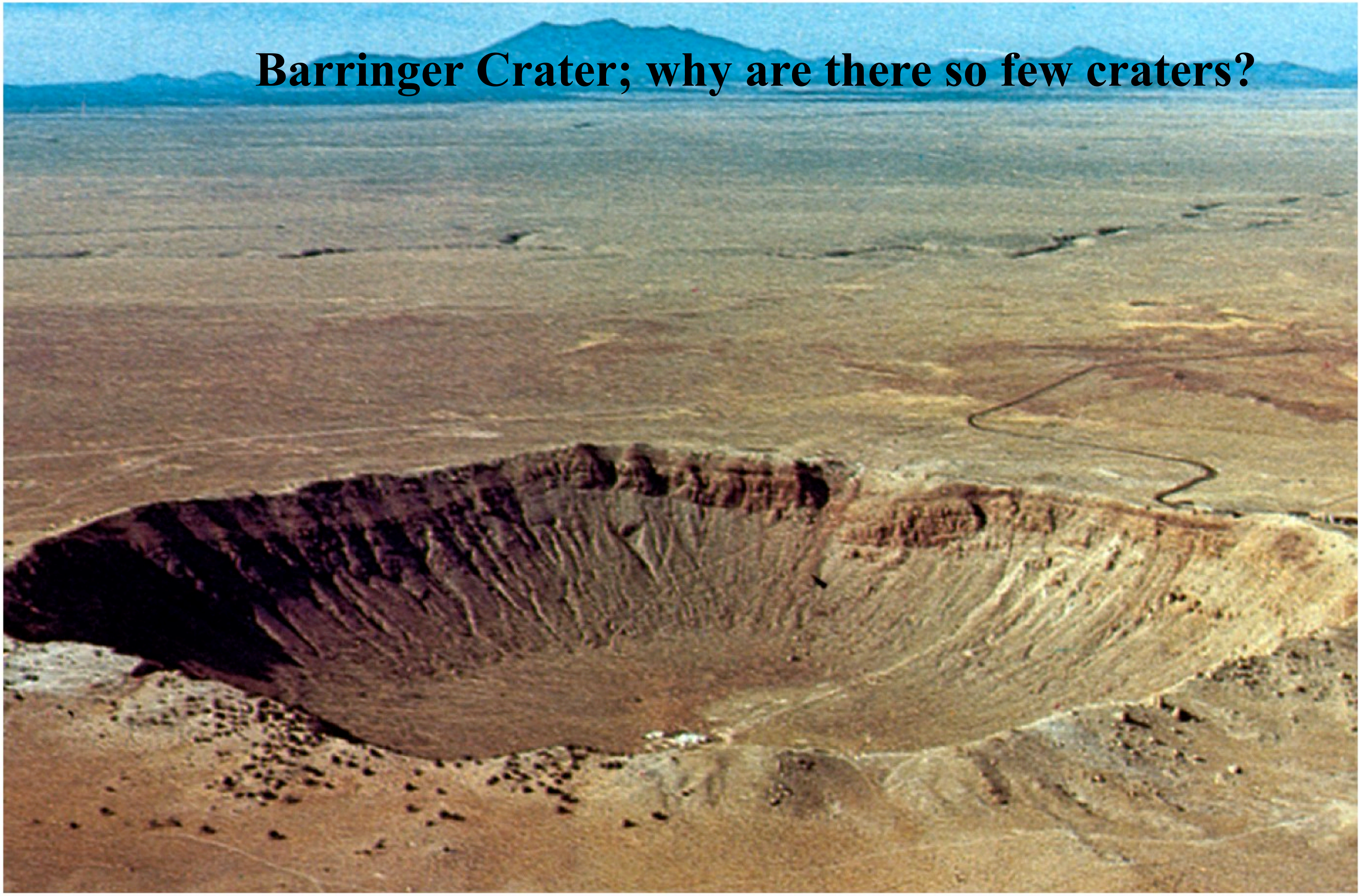


Figure 15-10
Universe, Eighth Edition

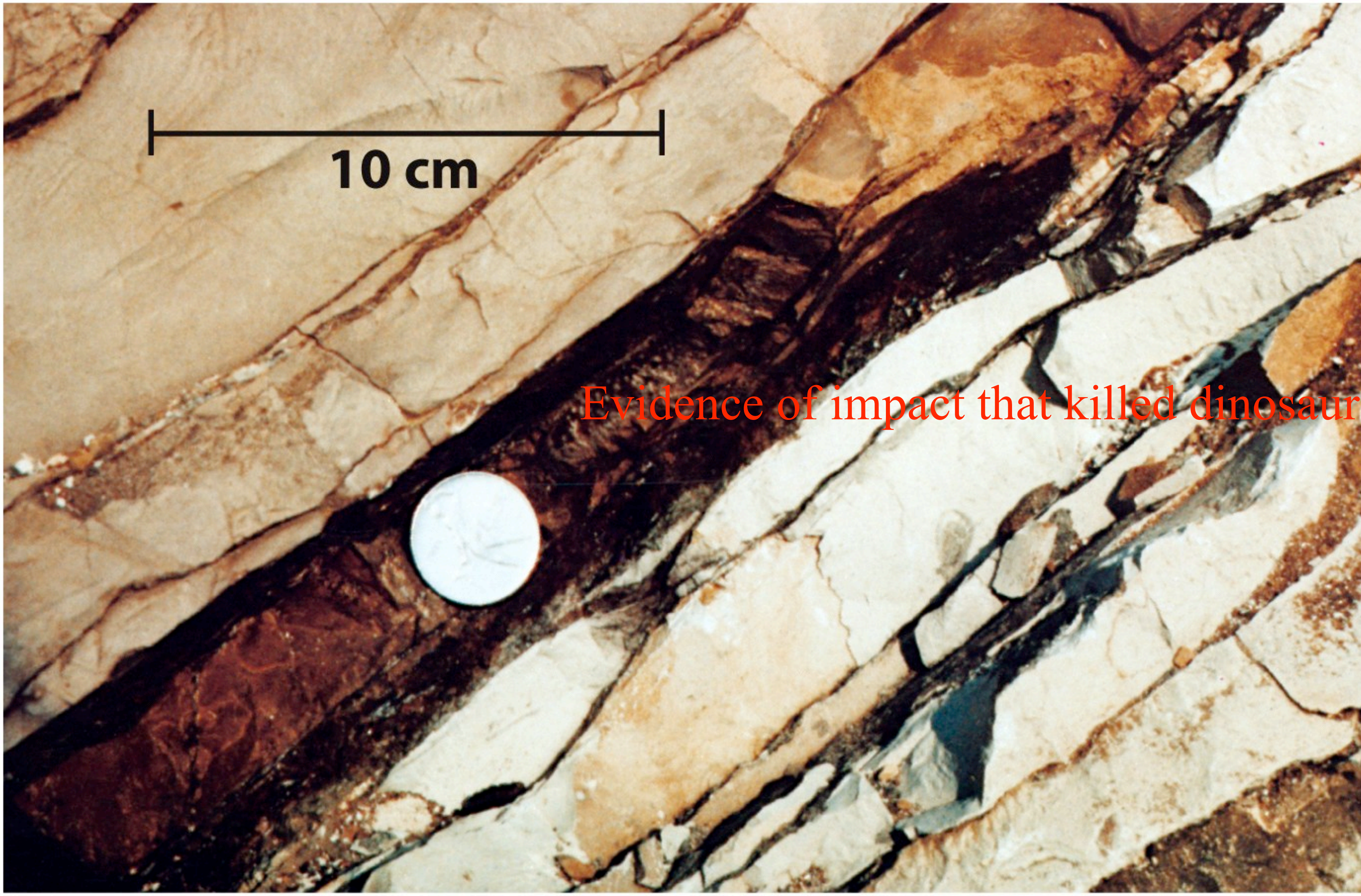
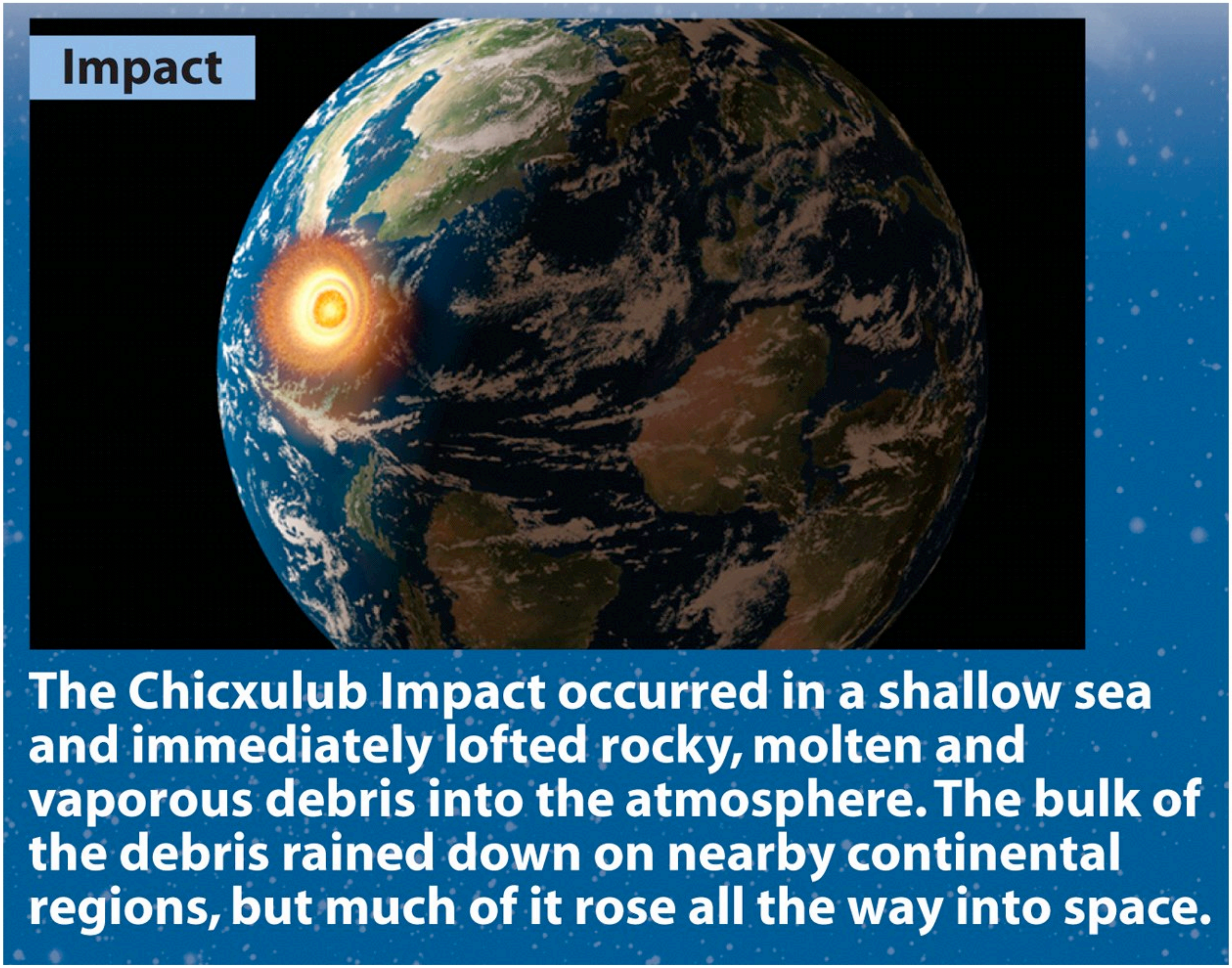


Figure 15-11
Universe, Eighth Edition

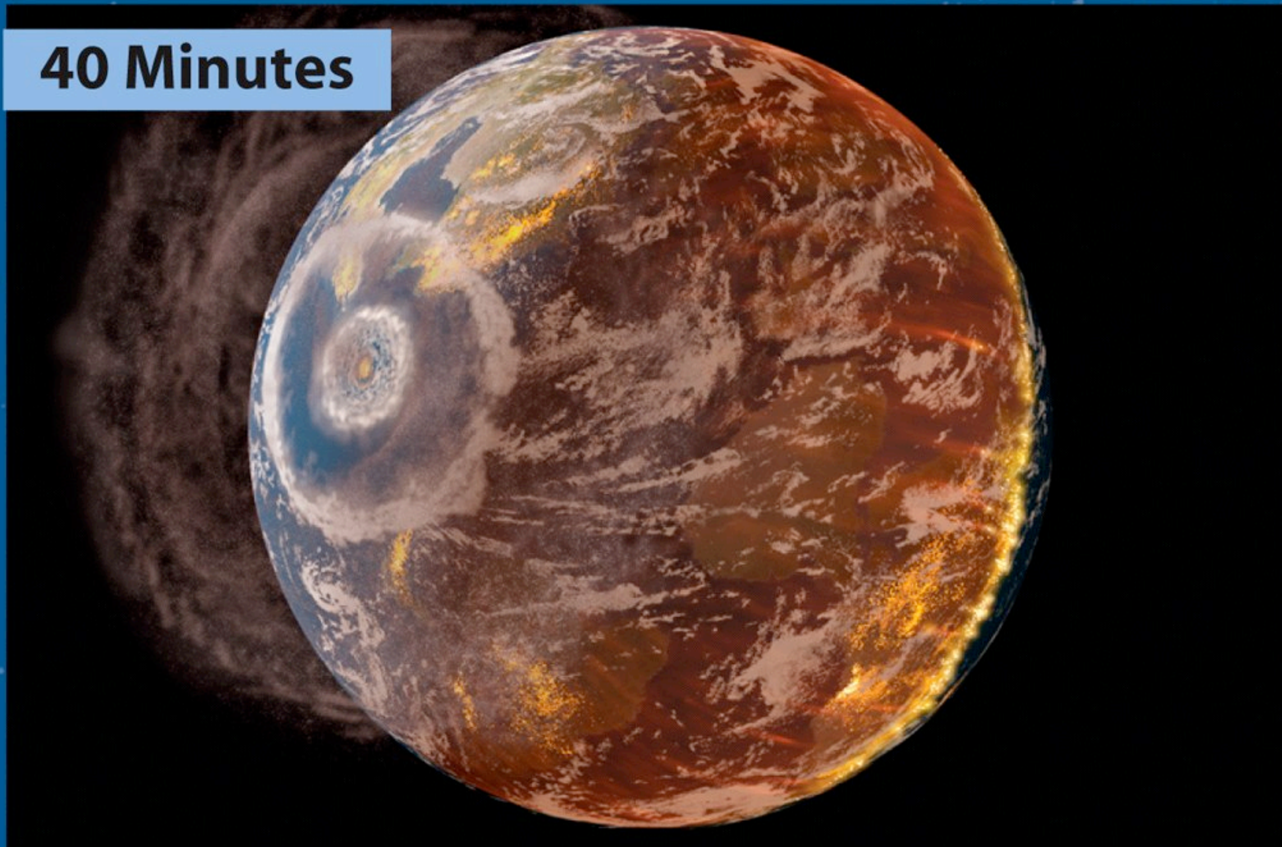
Late Cretaceous swamps and rivers in North America had a mix of coniferous, broad-leaved evergreen, and deciduous trees. They formed canopied forests and open woodlands with understories of ferns, aquatic plants and flowering shrubs.

Cosmic Connections 15 pt 1
Universe, Eighth Edition



Cosmic Connections 15 pt 2
Universe, Eighth Edition

~10 km in diameter, only!

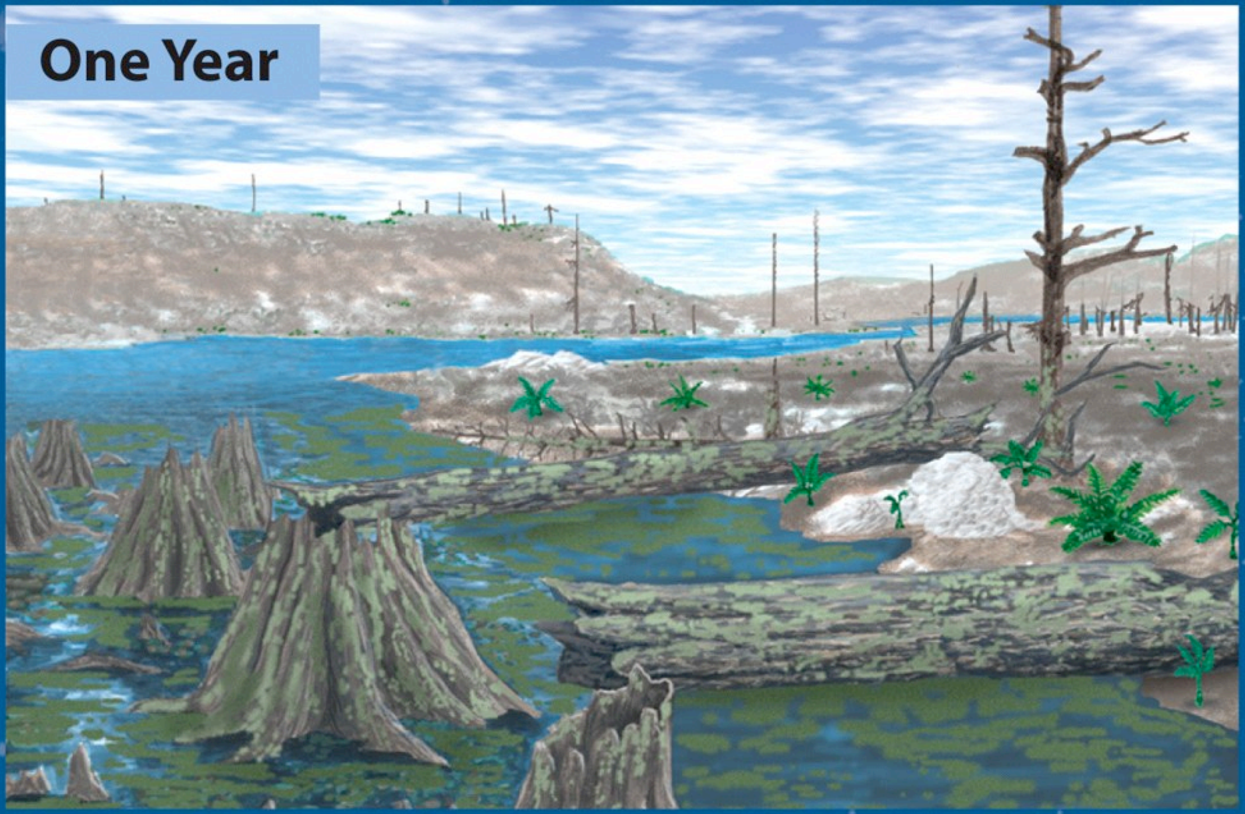


The vapor-rich plume of material expanded to envelop Earth. As material in that plume fell back to the ground, it streaked through the atmosphere like trillions of meteors, heating it in some places by hundreds of degrees.

Cosmic Connections 15 pt 3
Universe, Eighth Edition

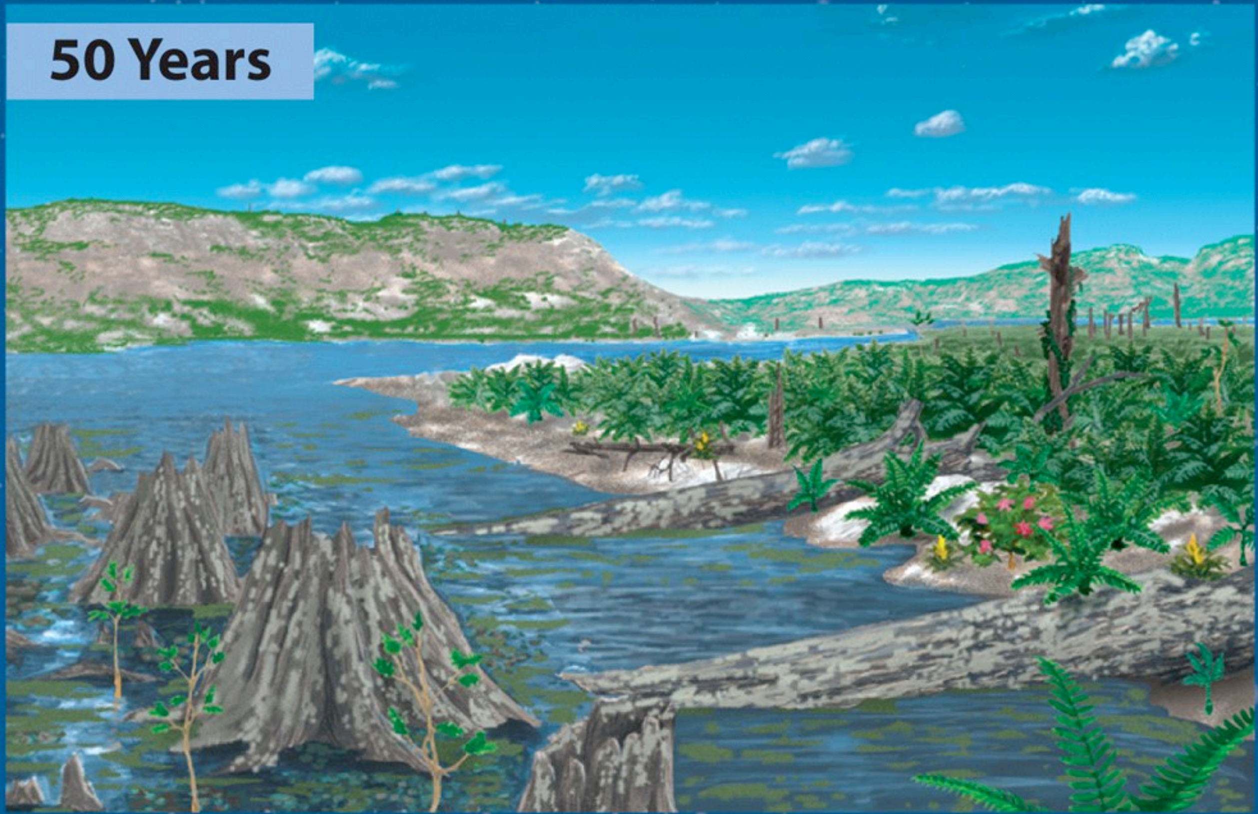
After fires had ravaged the landscape, only a few stark trunks and skeletons remained. Soot from the fires and dust from the impact slowly settled to the ground. Sunlight was dramatically, if not totally, attenuated for months.

Cosmic Connections 15 pt 4
Universe, Eighth Edition



The postimpact environment was less diverse. Ferns and algae were the first to recover. Plant species in swamps and swamp margins generally survived better than species in other types of ecosystems. Conifers fared particularly badly.

Cosmic Connections 15 pt 5
Universe, Eighth Edition



Shrubs took advantage of the vacant landscape and began to cover it. Species pollinated by the wind did better than those that relied on insects. Trees began to grow, but it took years for forest canopies to rebuild. The recovery time is uncertain.

Cosmic Connections 15 pt 6
Universe, Eighth Edition

Tunguska: 80m asteroid = 100s of kilotons of TNT

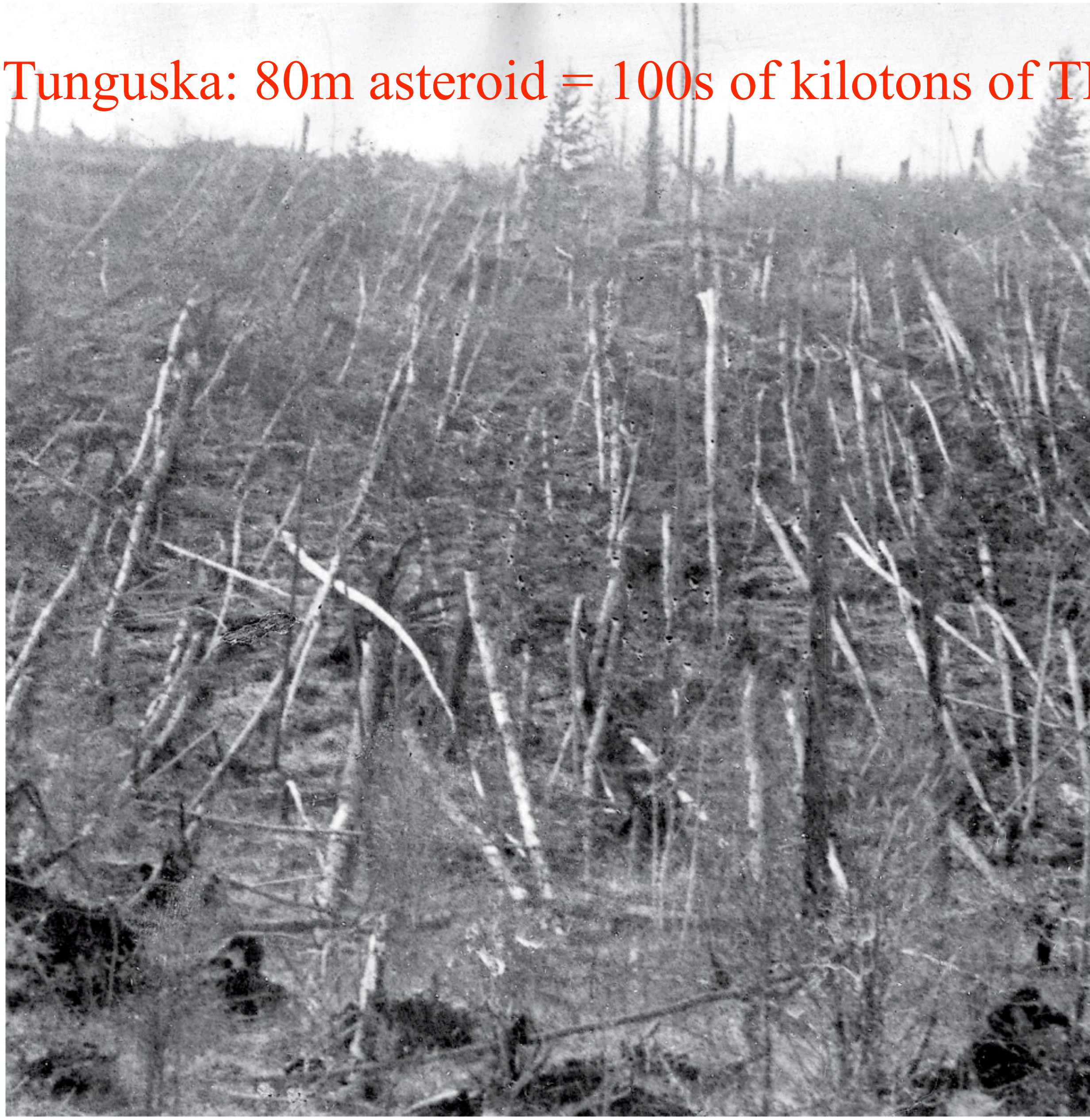
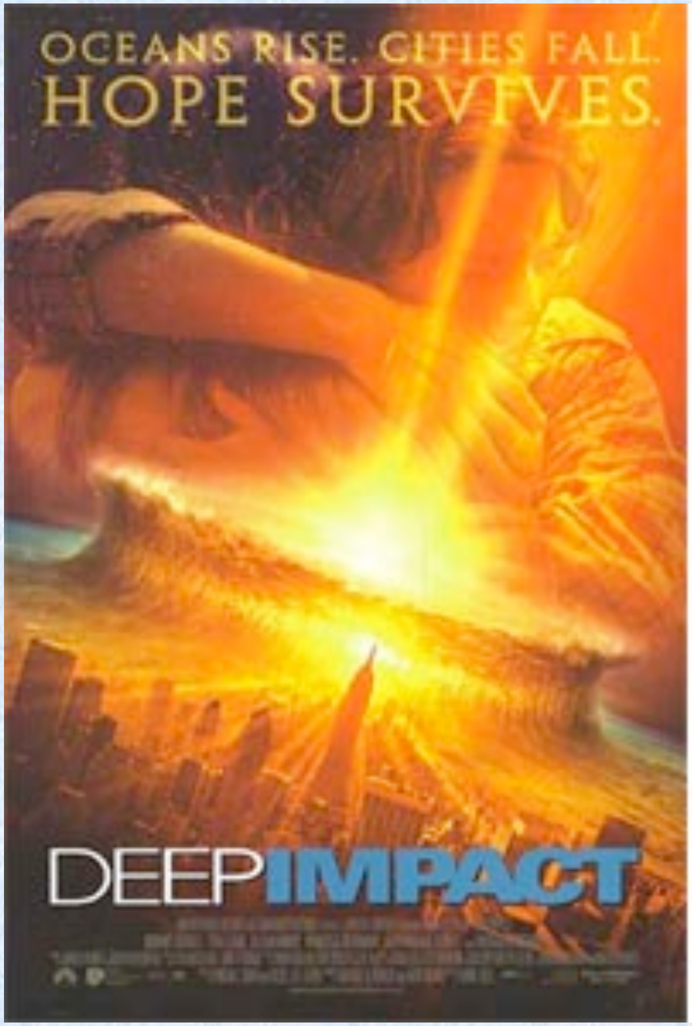
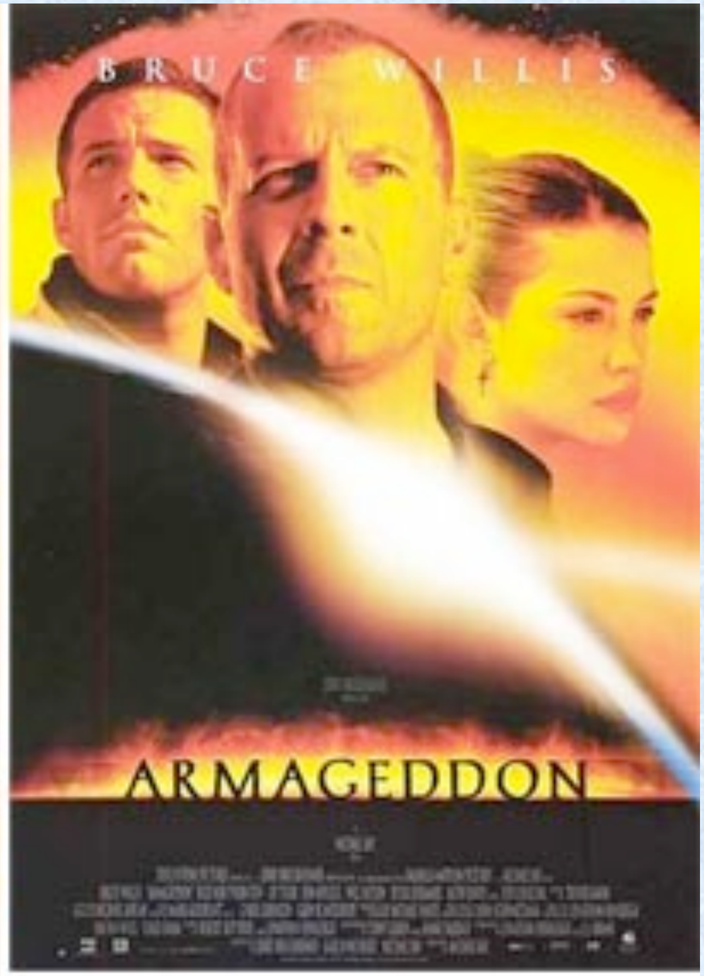


Figure 15-12
Universe, Eighth Edition

Deep impact.
What are the odds of 1 km asteroid?





1/300000 years; monitoring under way, e.g. Panstarrs

Question 18.2 (iclickers!)

- If an asteroid is found to be orbiting a circular path around the Sun at the same distance as Jupiter (5.2 AU) what will be its orbital period compared to that of Jupiter, which is 11.86 years?
    - A) The same as Jupiter
    - B) Exactly ½, because it will be in a synchronous orbit with Jupiter
    - C) About 10 times as long, because the Sun's gravitational force is much smaller on such a small object
    - D) About 1/10 of Jupiter's period, because it is a much smaller object

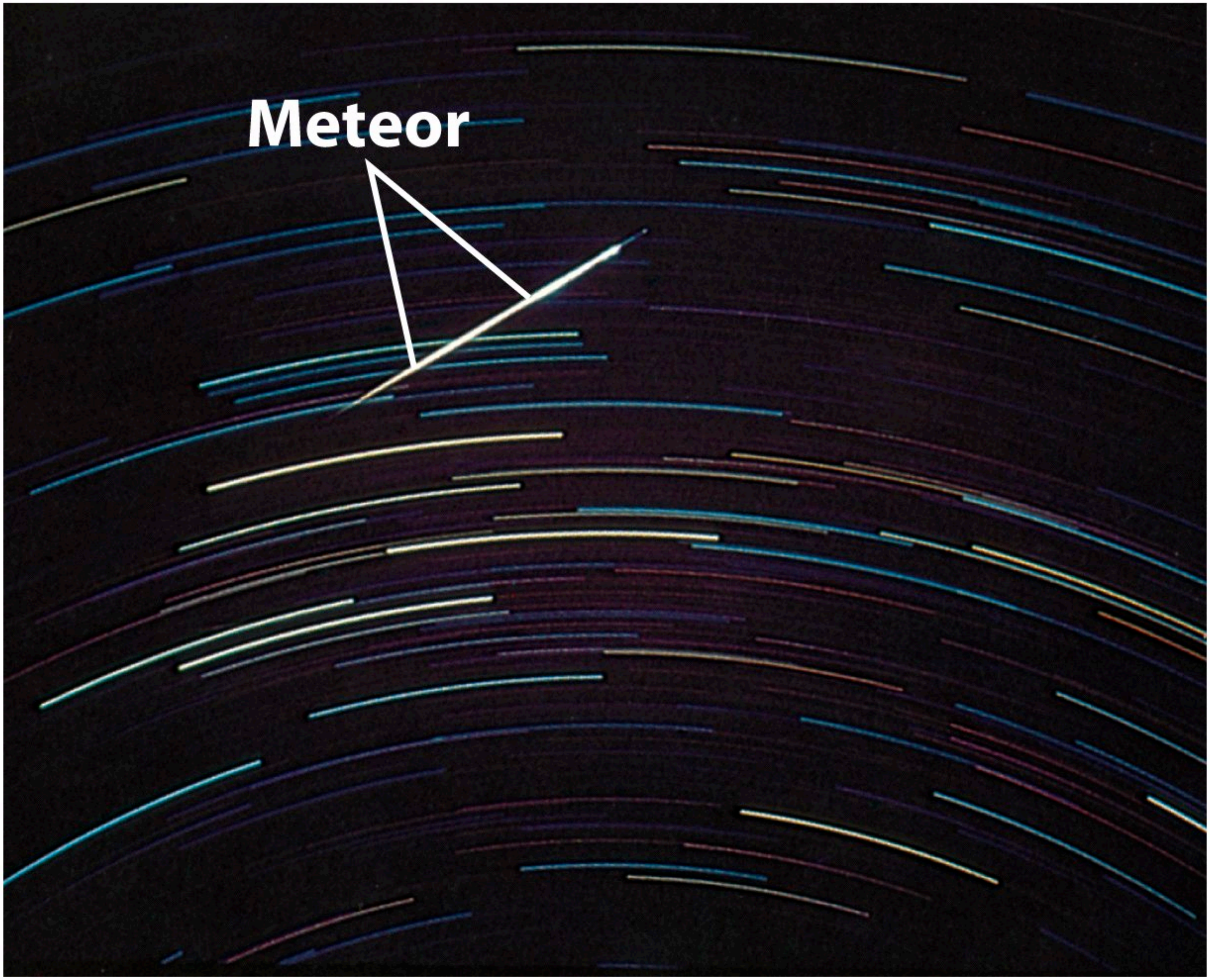


Figure 15-13
Universe, Eighth Edition

300 tons per day; not covered by car insurance…

Figure 15-14
Universe, Eighth Edition

Many stony meteorites are coated with dark fusion crusts…

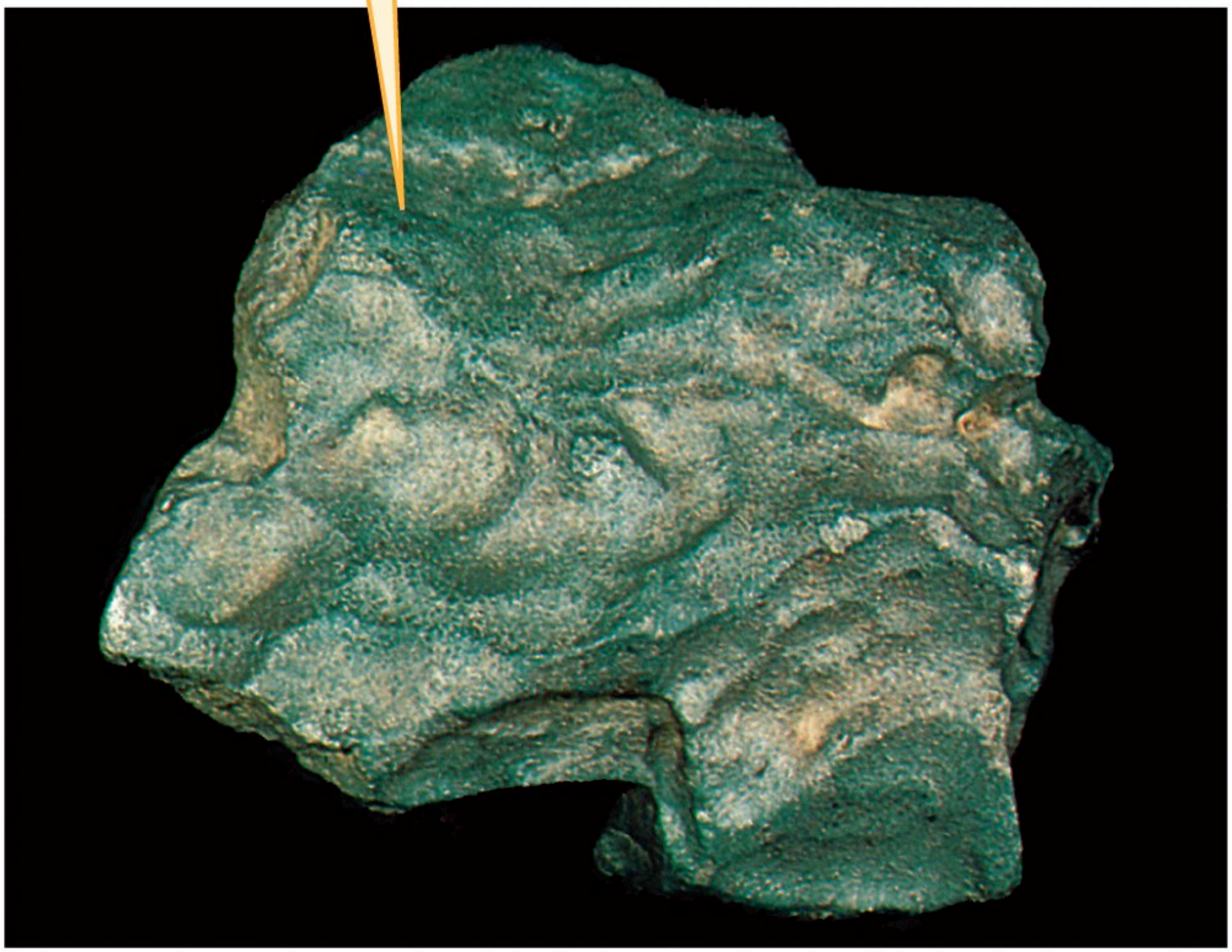


Figure 15-15a
Universe, Eighth Edition

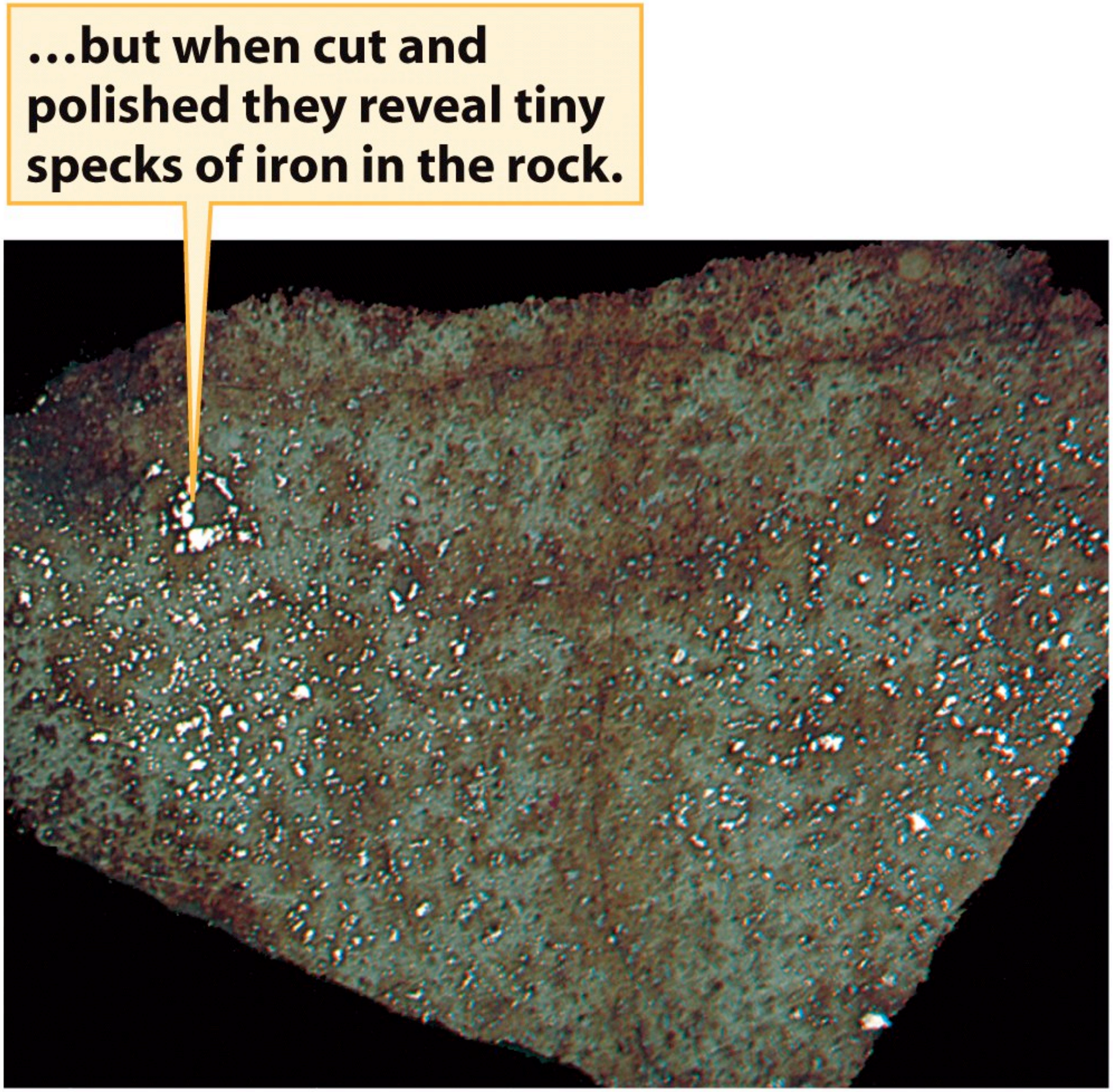


Figure 15-15b
Universe, Eighth Edition

Meteors help reveal the origin of the solar system
Did a supernova explode 4.56 billion years ago triggering
The formation of the solar system?

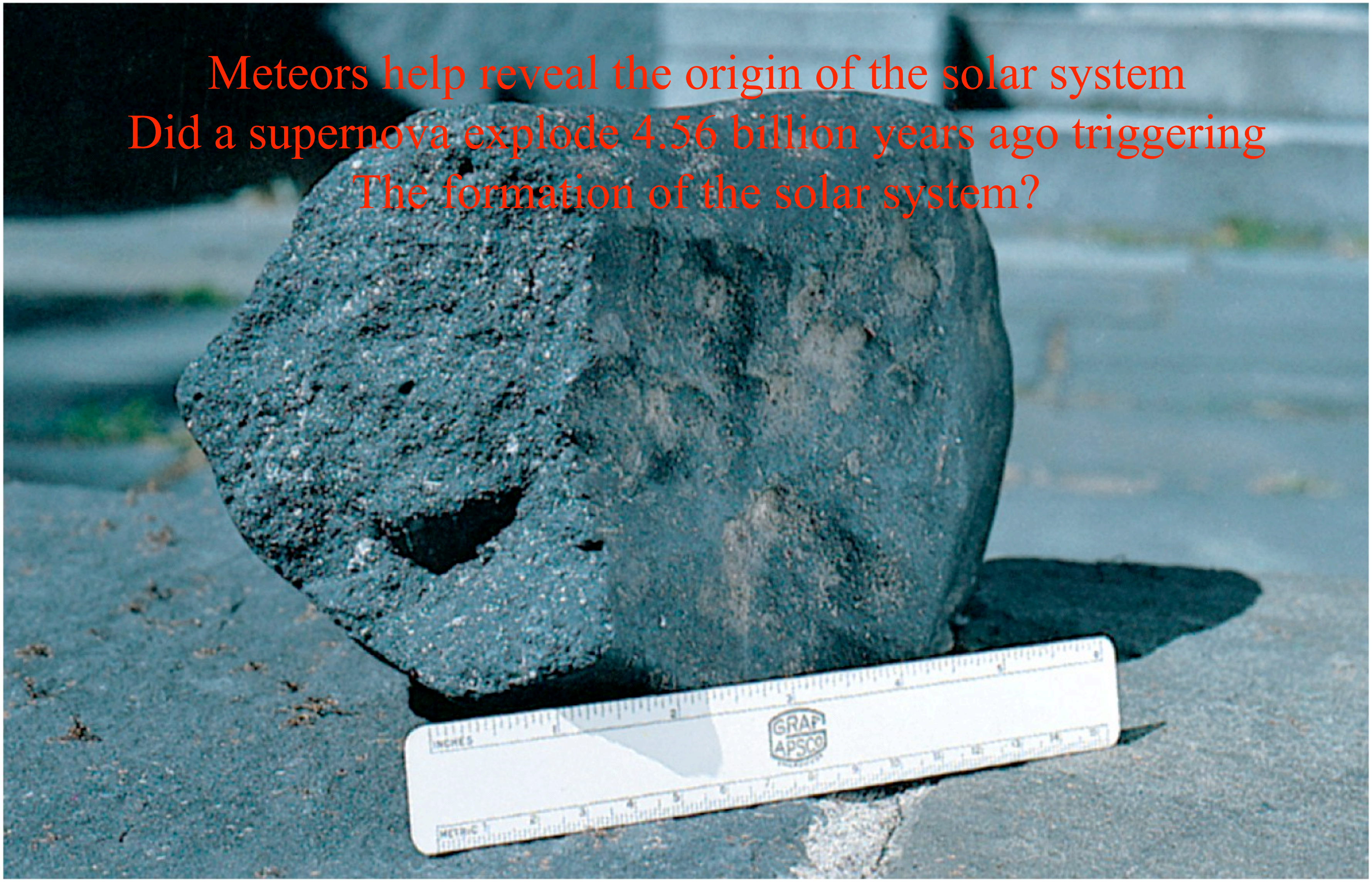


Figure 15-18
Universe, Eighth Edition

Chapter 15 Opener
Universe, Eighth Edition

Figure 15-19
Universe, Eighth Edition

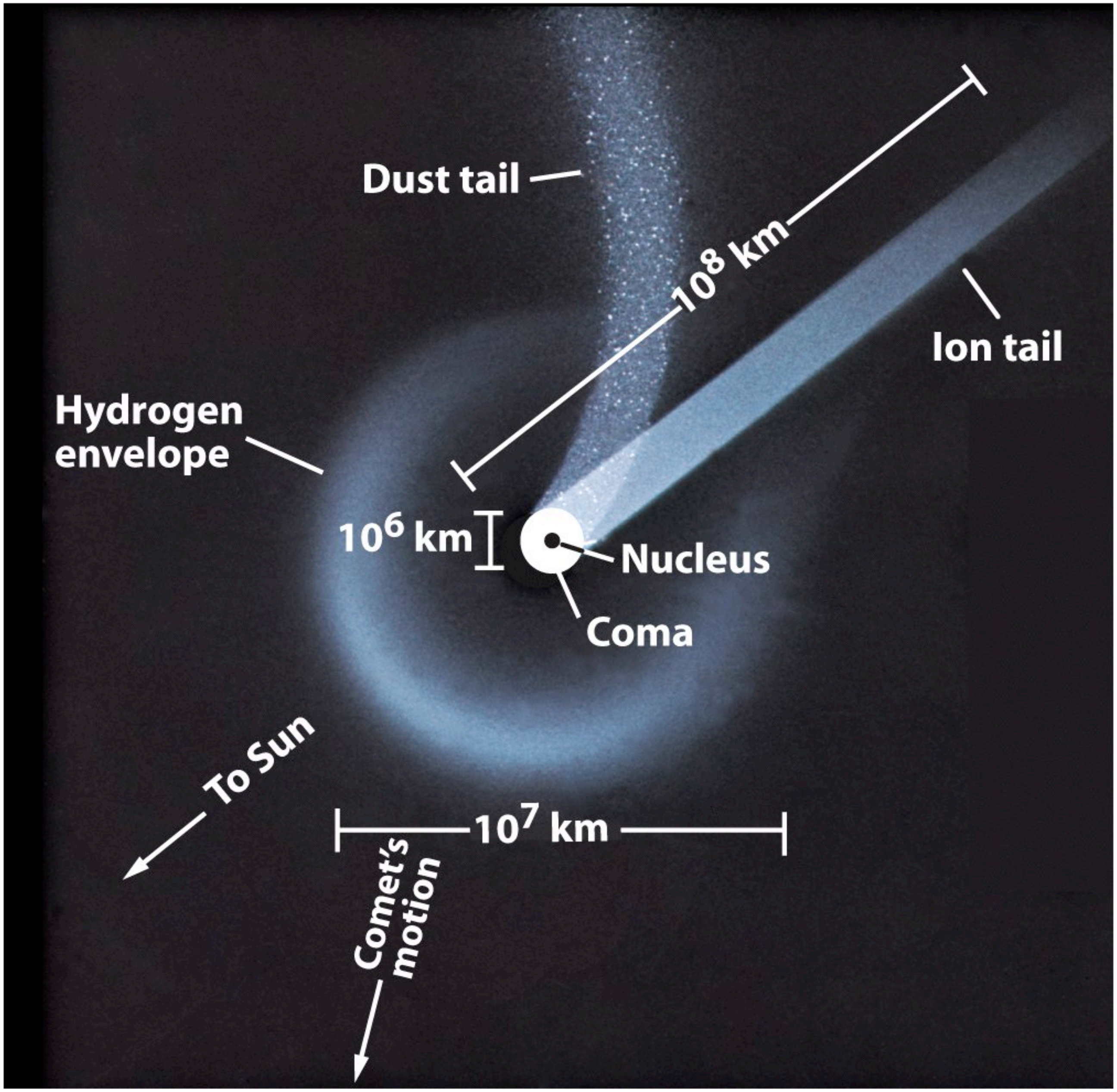
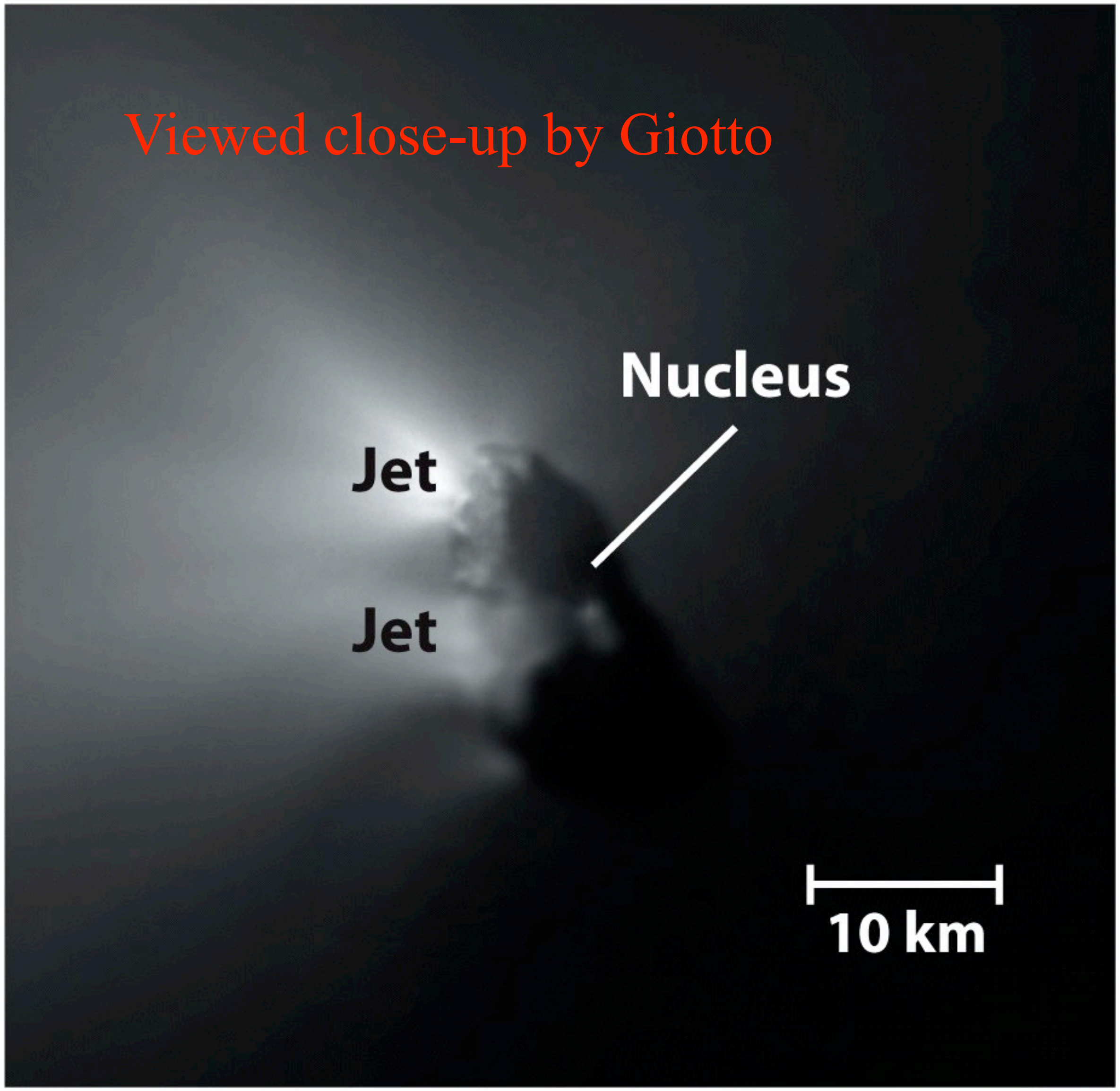
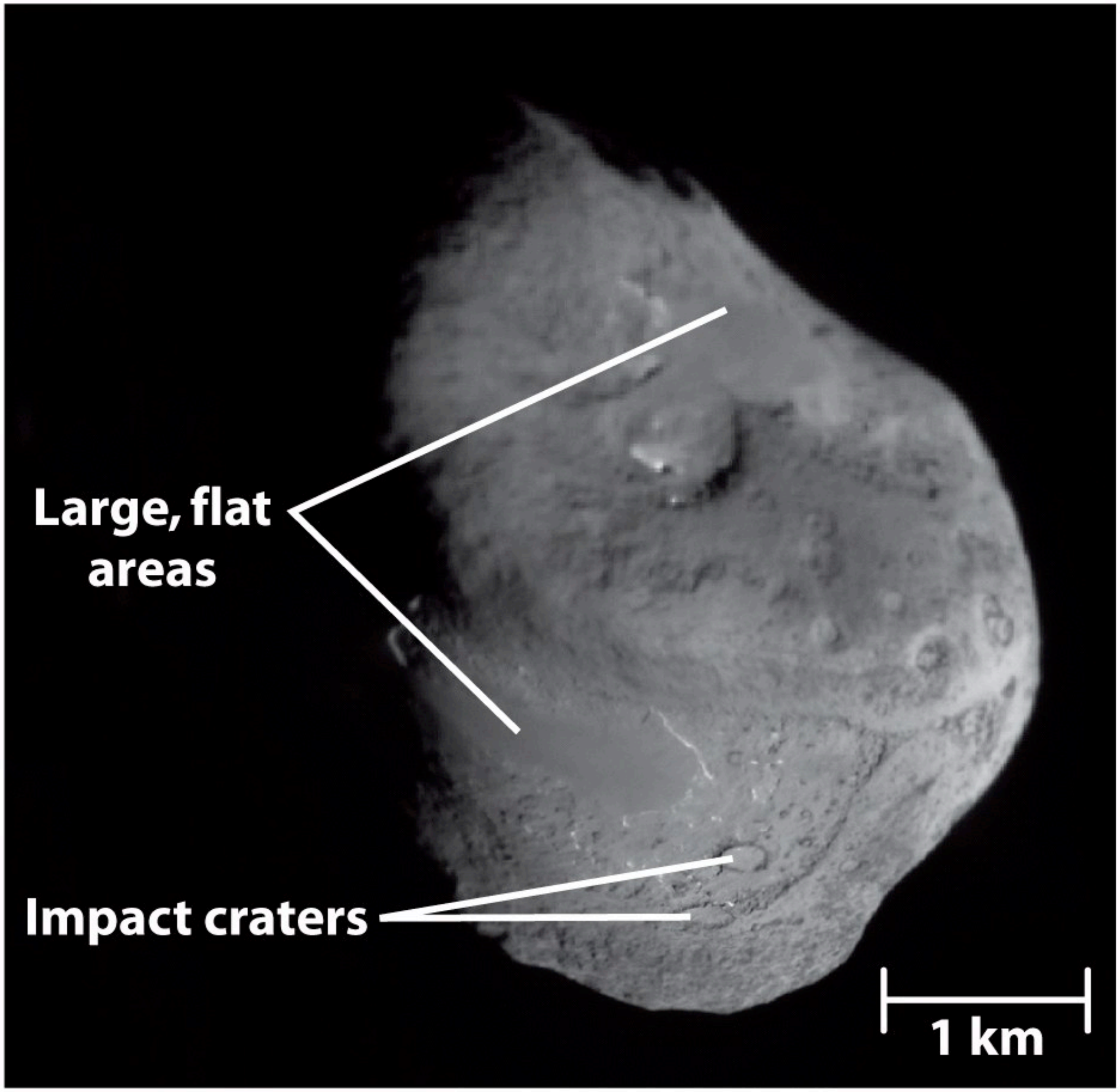


Figure 15-20
Universe, Eighth Edition



Comet Halley

Figure 15-21a
Universe, Eighth Edition



Comet Tempel 1

Figure 15-21b
Universe, Eighth Edition

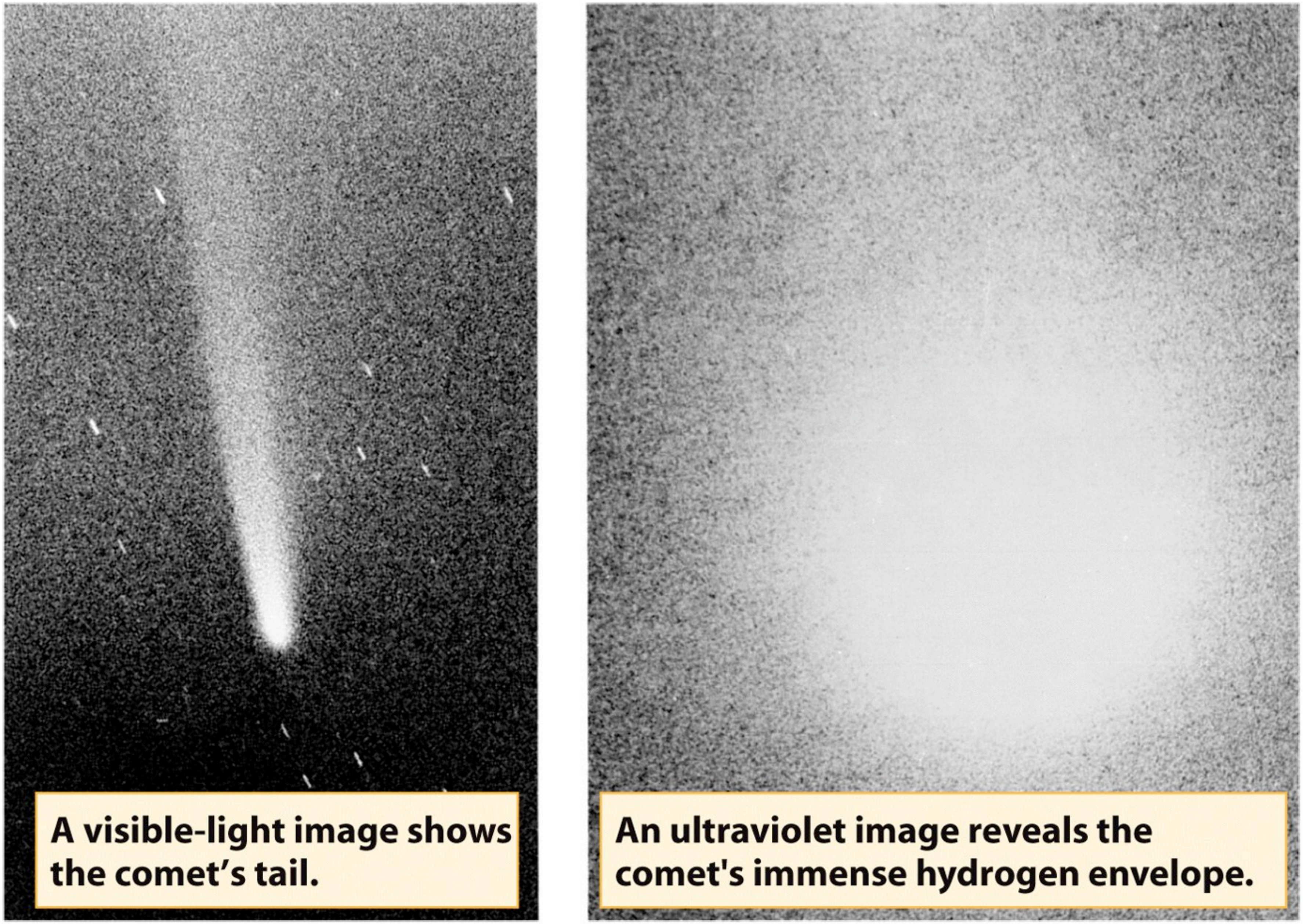


Figure 15-22
Universe, Eighth Edition

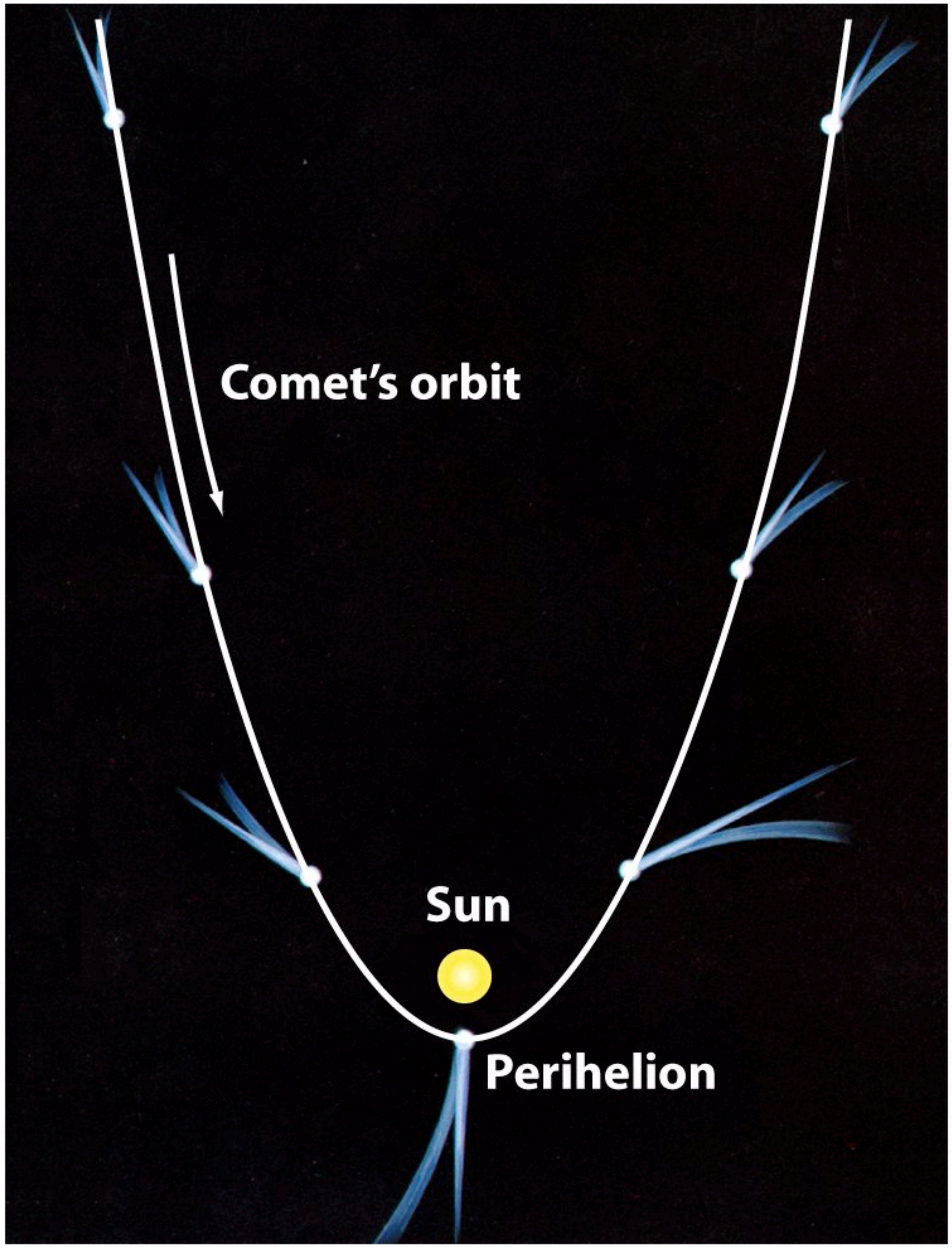


Figure 15-23
Universe, Eighth Edition

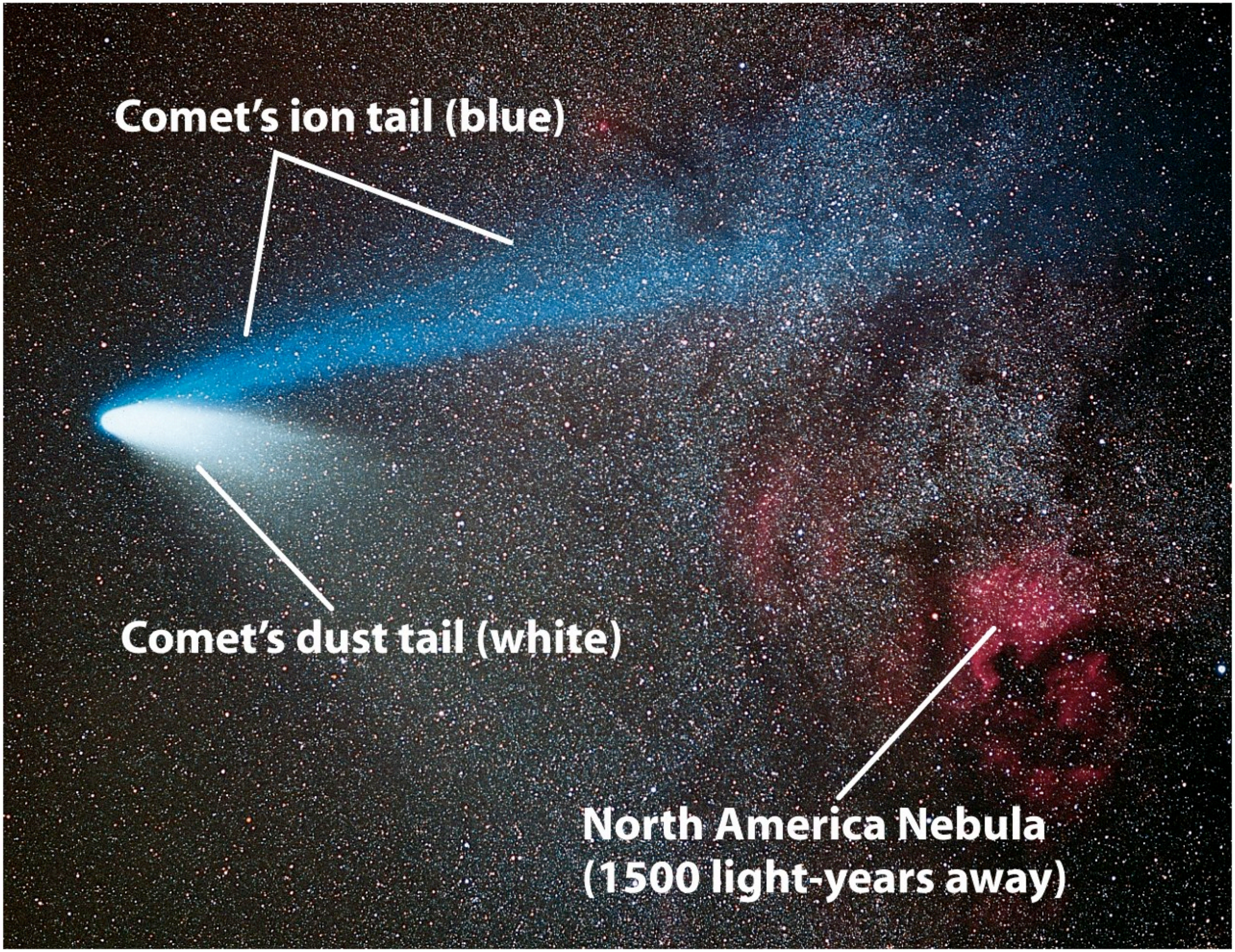


Figure 15-24
Universe, Eighth Edition

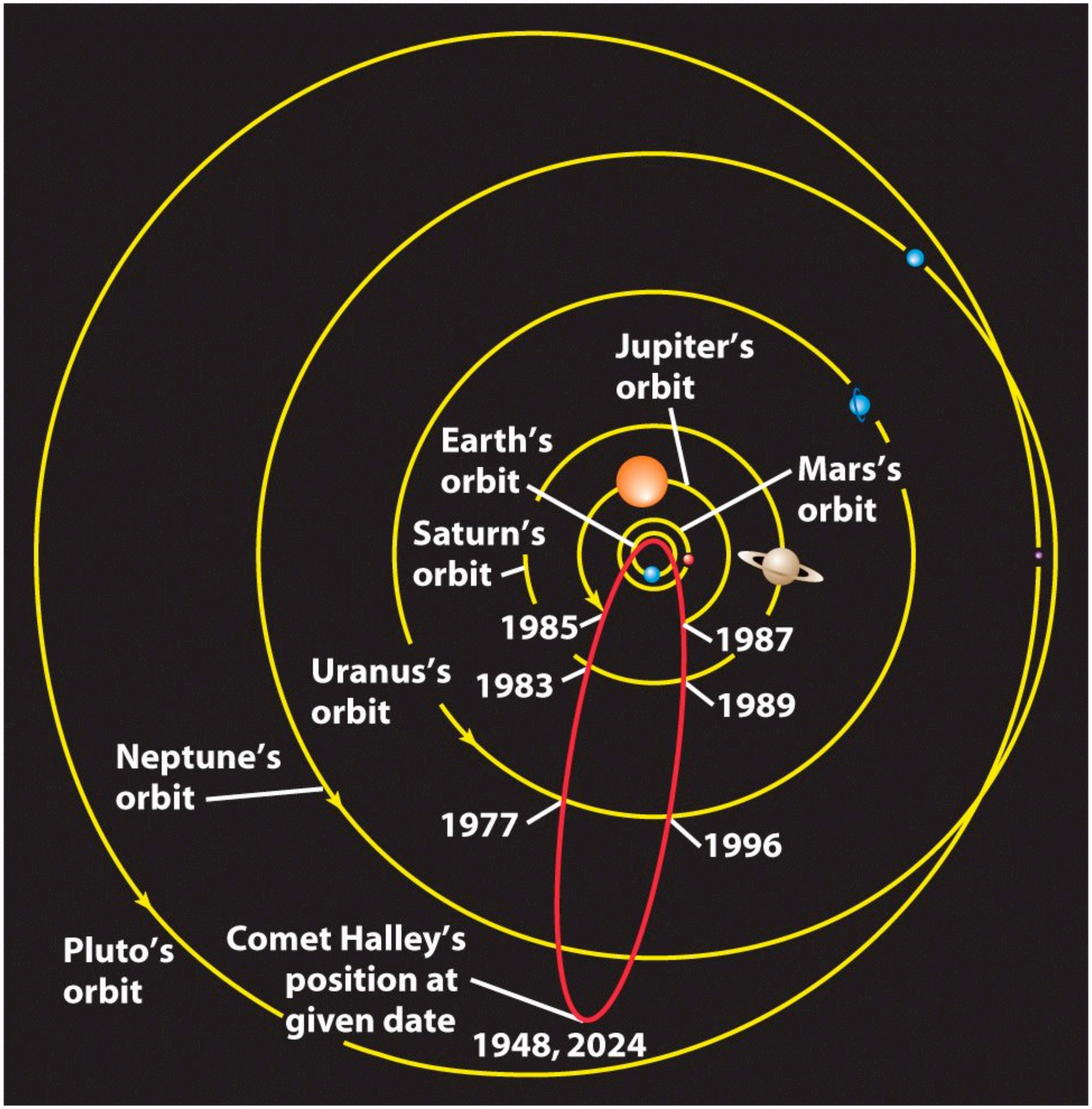
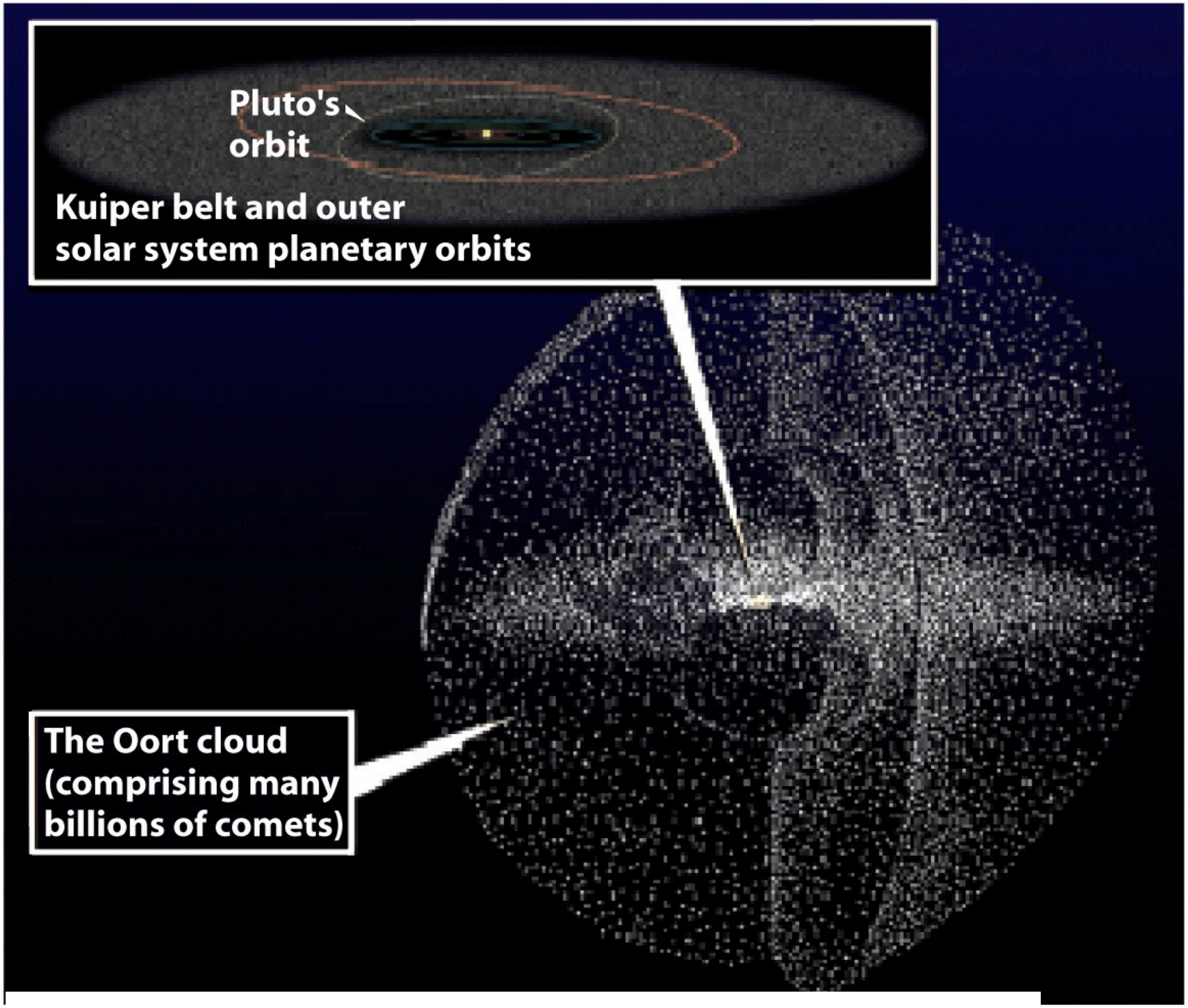


Figure 15-26
Universe, Eighth Edition



~50000 AU equivalent to 1.3 million miles
if distance to mercury is scaled to distance to SB

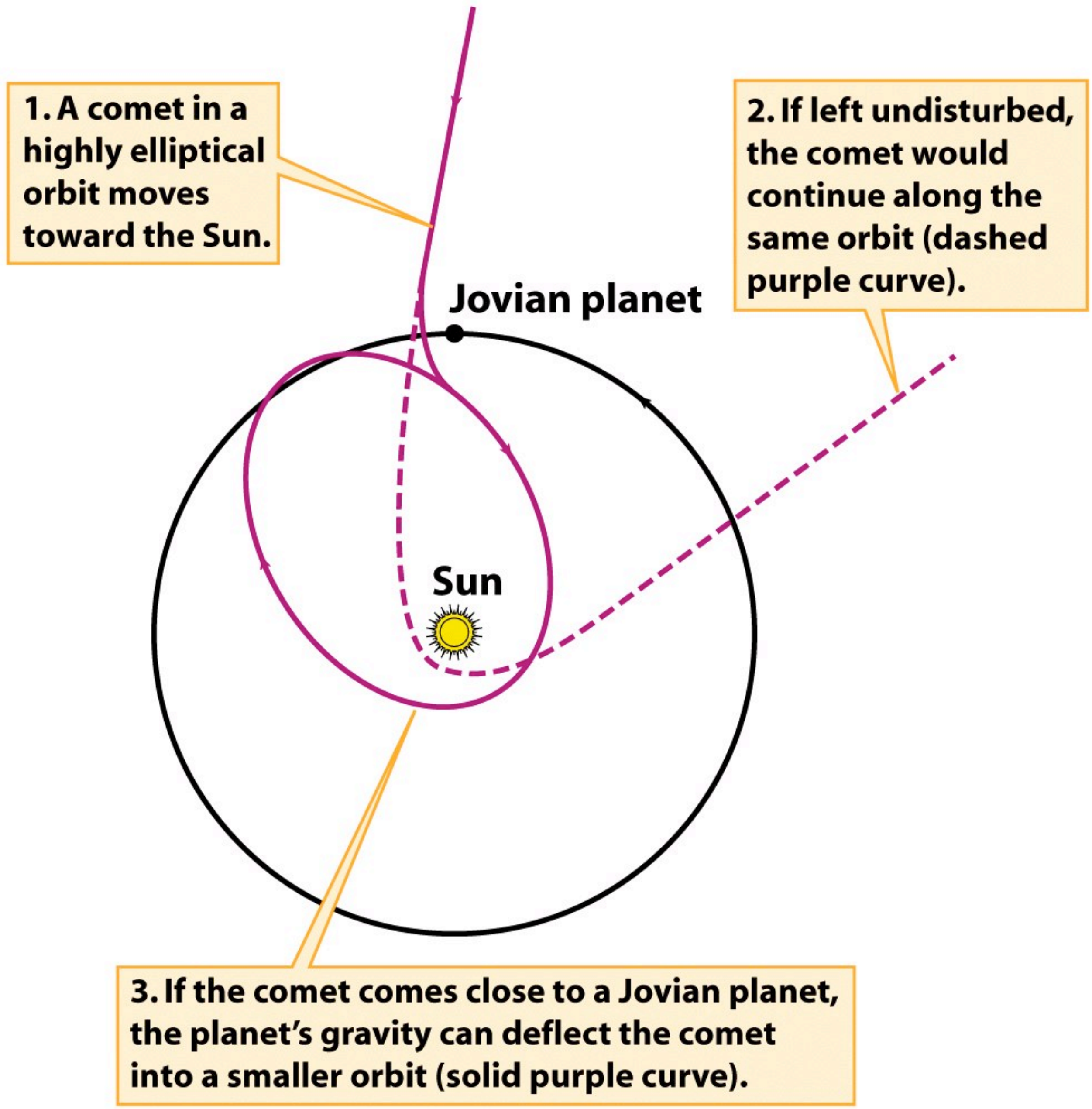


Figure 15-28
Universe, Eighth Edition

Comets break up due to tidal forces!

Figure 15-29
Universe, Eighth Edition

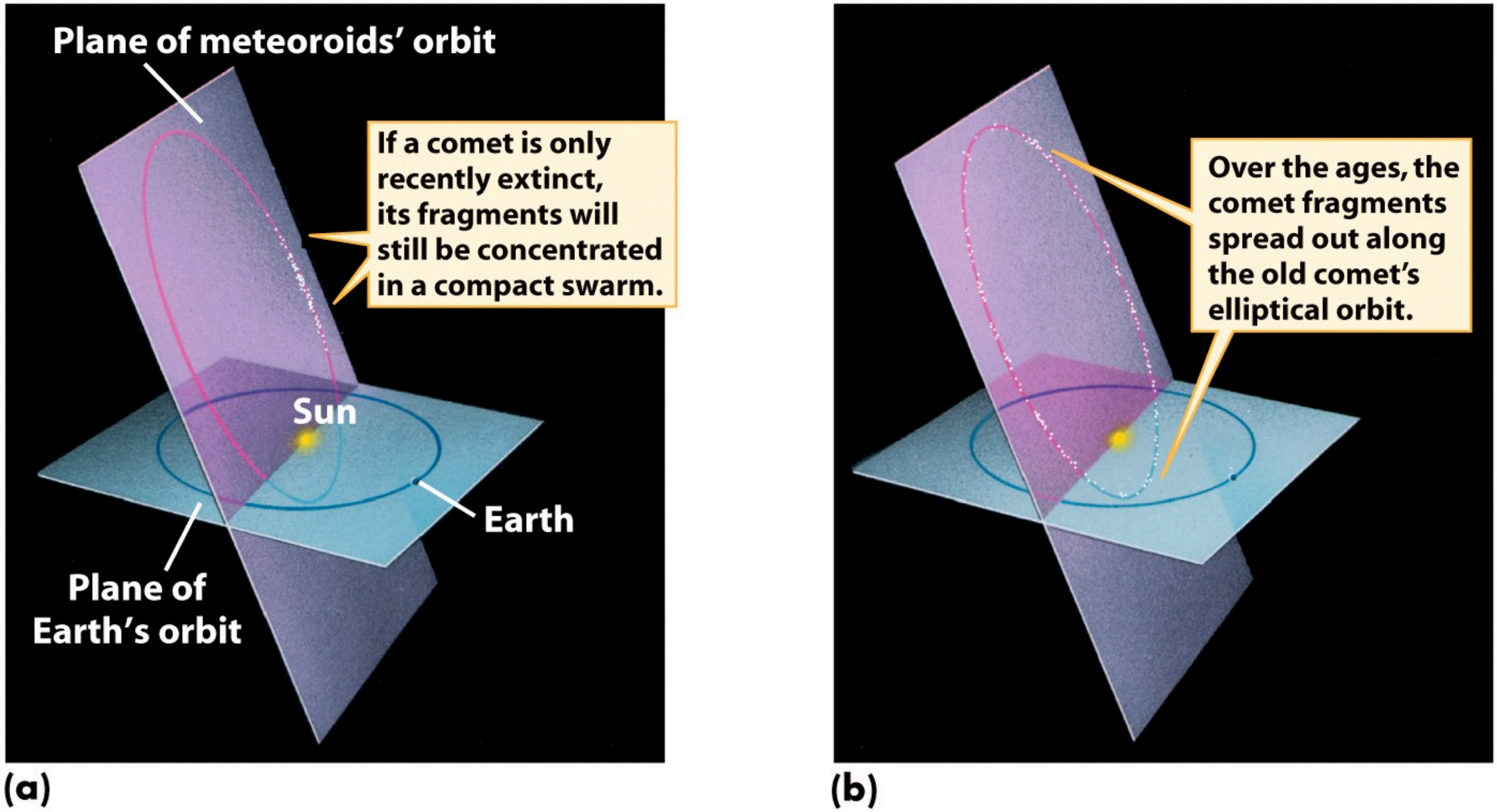


Figure 15-30
Universe, Eighth Edition

Question 18.3 (iclickers!)

- The major difference between the orbits of most asteroids and those of comets is that
  - A) Comet orbits are mostly circular and in the ecliptic plane, whereas asteroids have elliptical orbits inclined at random to the ecliptic plane
  - B) Comets never approach closer to the Sun than approximately Jupiter's orbit, whereas some asteroids approach very close to the Sun
  - C) Asteroids orbit the Sun continuously, whereas all comets approach the Sun's vicinity only once before leaving the Solar System
  - D) Come orbits are highly elliptical and at random inclinations to the ecliptic plane, whereas asteroids have circular orbits in the ecliptic plane

For the romantically inclined… shooting stars

Table 15-1 Prominent Yearly Meteor Showers

Shower name	Date of maximum intensity*	Typical hourly rate	Average speed (km/s)	Radiant constellation
Quadrantids	January 3	40	40	Boötes
Lyrids	April 22	15	50	Lyra
Eta Aquarids	May 4	20	64	Aquarius
Delta Aquarids	July 30	20	40	Aquarius
Perseids	August 12	50	60	Perseus
Orionids	October 21	20	66	Orion
Taurids	November 4	15	30	Taurus
Leonids	November 16	15	70	Leo
Geminids	December 13	50	35	Gemini
Ursids	December 22	15	35	Ursa Minor

**The date of maximum intensity is the best time to observe a particular shower, although good displays can often be seen a day or two before or after the maximum. The typical hourly rate is given for an observer under optimum viewing conditions. The average speed refers to how fast the meteoroids are moving when they strike the atmosphere.*

Table 15-1
Universe, Eighth Edition

Summary

- In between Mars and Jupiter there is an asteroid belt, possibly due to the gravitational effects of Jupiter
- The inner solar system is populated by asteroid, sometimes almost as big as the Moon (actually, the Moon could have been an asteroid at some point!)
- Some asteroids impact Earth on a regular basis (NEO)
  - Possibly responsible for extinction of dinosaurs
  - Provide information on the early-solar systems
- Comets are dirty snowballs on highly elliptical orbits
- When they travel close to the Sun, their ice is vaporized forming spectacular tails.
  - Direction of tails is due to solar wind and solar radiation pressure.
  - Originate from the Kuiper Belt

The End

See you on Friday: MIDTERM!