

The Astronomy Book

First Printing: 1999
Sixth Printing: September 2008

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Printed in China

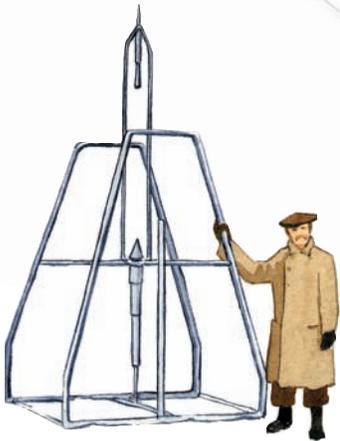
Cover Design by Janell Robertson
Interior Design by Brent Spurlock and Janell Robertson

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ISBN-13: 978-0-89051-250-0
ISBN-10: 0-89051-250-7

Library of Congress: 99-070077



Dedication

To Sharon,
and Faith, David, Daniel, and Charity



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Chapter 1

WHAT IS ASTRONOMY?

Astronomy is the branch of science dealing with the sun, the moon, the planets, and the stars. The word “astronomy” comes from two Greek words meaning “knowledge of the stars.” An astronomer is a person who has scientific knowledge about the stars and other heavenly bodies.

Astronomy should not be confused with astrology. Astrology is a false science which comes from ancient paganism. It is the belief that the stars can predict our future and set the course for our lives. The Bible teaches that only God can guide our lives, a truth repeated again and again in verses like Psalm 143:8 and James 4:13–15.



A view of the earth and moon as seen from outer space.

What Do Astronomers Study?

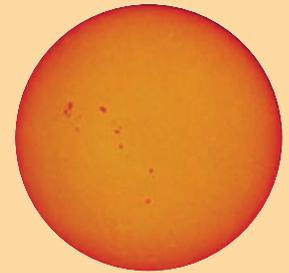
Astronomers study the sun, the moon, and the planets and their moons, all of which are considered to make up the solar system. What is the difference between moons and planets? We picture planets orbiting the Sun, and moons orbiting planets.

Astronomers also study stars outside the solar system. Stars produce their own light, but planets shine by reflected light. All the objects in the heavens are called “celestial bodies.”

The only star in the solar system is the sun. The sun’s gravitation holds nine known planets. There may possibly be undiscovered planets beyond the ones we know. Most of the planets have one or more moons which orbit them. The earth has one moon, and at the other extreme some planets have many known moons. Mercury and Venus have no moon.

Aside from the sun, all other stars are far outside the solar system. They are in groups called galaxies, and the galaxies themselves are in larger groups called “galaxy clusters.”

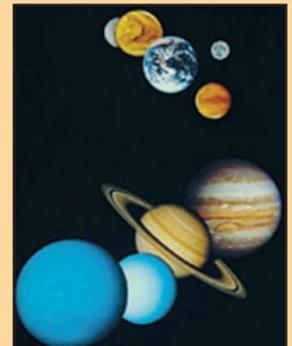
Astronomers estimate that the portion of the universe we can see has about 100 billion galaxies, each with an average of about 100 billion stars. The solar system itself is located in the Milky Way Galaxy which has somewhere between 200 and 300 billion stars.



The sun



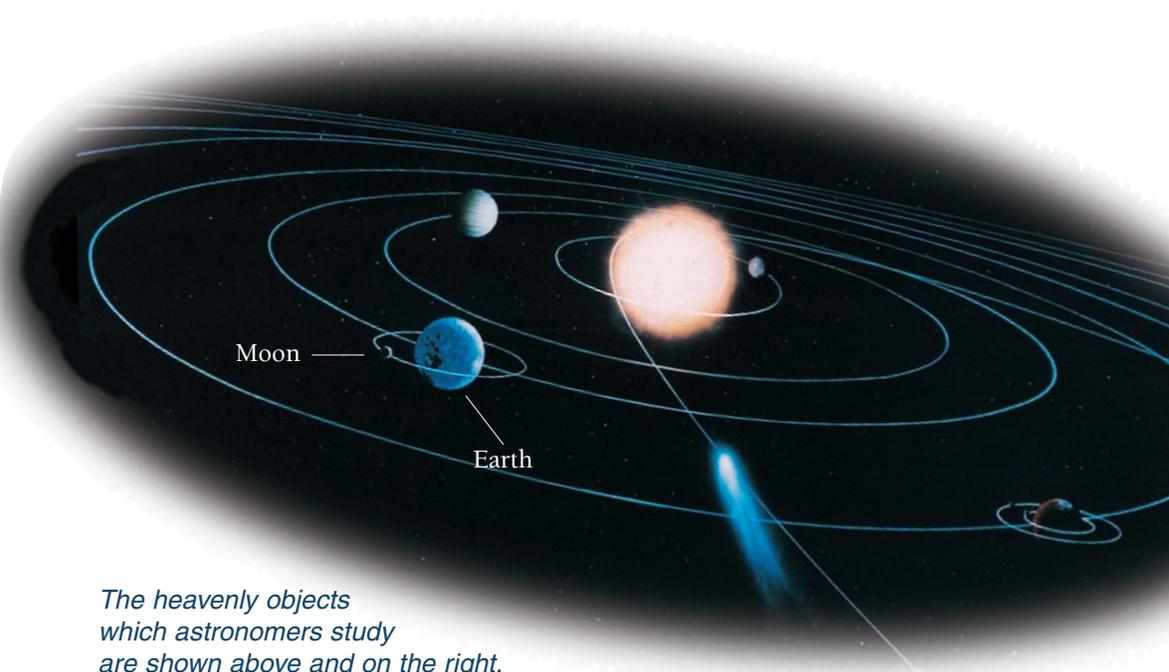
The moon



The nine planets



Stars and galaxies of the universe.



The heavenly objects which astronomers study are shown above and on the right.



Chapter 2

HOW BIG IS THE UNIVERSE?

The size of the universe has never been measured. The solar system itself is so large that it staggers the imagination. The moon, the closest celestial body to us, is nearly 250,000 miles away. To travel this far, you would have to circle the earth ten times.

The nearest planet is Venus. The distance of Venus varies but sometimes is as close as 24 million miles. The sun is nearly 93 million miles away. This is so far that a beam of light traveling 186,000 miles per second needs eight minutes for the trip.



Some Cosmic Distances

Closest Celestial Object to Earth:

the moon, 239,000 miles

Closest Planet to Earth:

Venus, 24 million miles at closest approach

Closest Star Outside the Solar System:

Proxima Centauri, 4 ½ light-years

Closest Independent Galaxy Outside the Milky Way:

Andromeda, about 2 million light-years

This illustration of the solar system shows all nine planets, the asteroid belt, and the sun. The planets, beginning at the sun, are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, and Pluto.

Outside the solar system, the closest star is Proxima Centauri, very near Alpha Centauri. It is about 25 trillion miles away. This is so far that a beam of light traveling 186,000 miles per second requires $4\frac{1}{2}$ years to make the trip. In other words, light from Alpha Centauri takes $4\frac{1}{2}$ years to get to us.

Such distances are so huge that astronomers have made a special way to talk about them. Light travels 186,000 miles per second, which is 6 trillion miles per year. The distance light travels in one year is called a "light-year," and is 6 trillion miles. We can say that Alpha Centauri is 25 trillion miles away, or $4\frac{1}{2}$ light-years away. Remember, the light-year measures distance, not time.

The spiral galaxy nearest the Milky Way is the Andromeda Galaxy. It is about 2 million light-years away. At this distance, light traveling at 186,000 miles per second would take 2 million years to reach us.



**Light travels at
186,000 MILES PER SECOND!**

- It takes 8 minutes for light to travel from the sun to the earth.
- It takes $4\frac{1}{2}$ YEARS for light to travel from the sun to the closest star, Proxima Centauri.

Will Astronomers Ever See the Edge of the Universe?

Astronomers believe that certain objects called quasars are the farthest they have seen. Most astronomers think that quasars are about 14 billion light-years away. However, the universe extends farther than any astronomer can see, even with the most powerful telescopes.

Never has any telescope seen the “edge” of the universe. More powerful telescopes simply reveal more galaxies which astronomers have never seen before.



Radio telescopes listen to signals traveling from deep in space to “see” objects such as quasars. As astronomers build larger telescopes to see further into space, they only reveal more wonders of God’s creation.

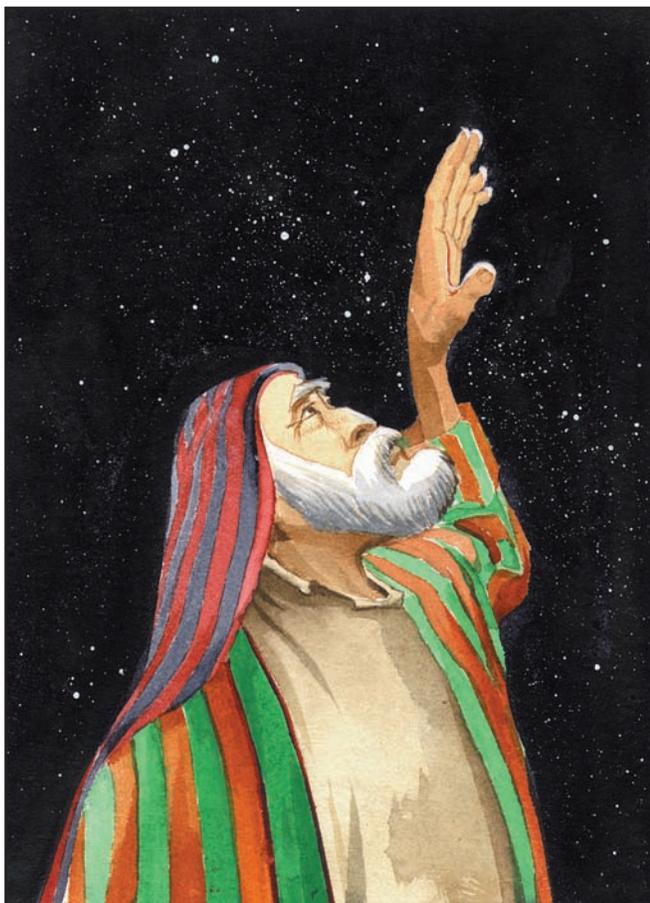
Are There Other Universes?

Scientists have observed no other universes. By definition, the universe includes the entire physical creation. If we could observe another universe, it would actually be a part of this one.

The Old Testament prophet Jeremiah, mindful of the infinite reach of God’s power, realized that man would never probe the heavens completely. Jeremiah 31:37 states that if man could completely probe the heavens, God would cast Israel off.

Since God will never abandon Israel, astronomers will never see the “edge” of the stars. Astronomers will never completely probe even this one universe.

Jeremiah, the Old Testament prophet, prophesied that man would never completely explore all of the universe.



How Do Astronomers Know How Far Away the Stars Are?

When you are traveling down a country road, the trees and buildings next to the roadside seem to move past you much faster than the trees and mountains in the distance. The speed at which objects

nearby stars have high parallax, and the distant stars have low parallax.

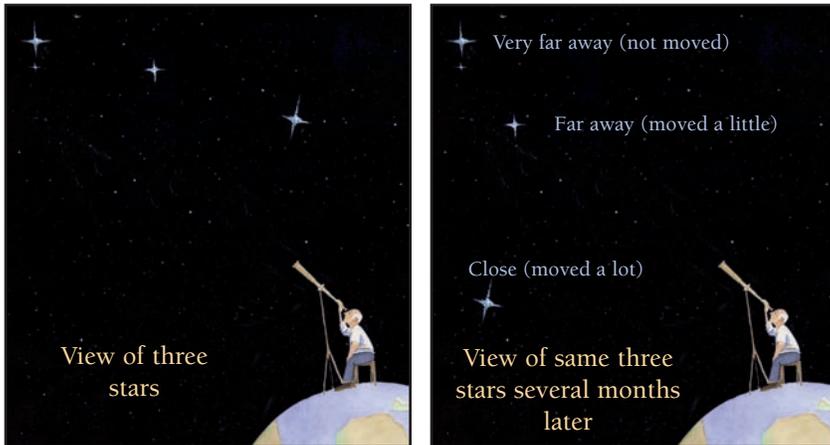
Even the closest stars are so far away that the parallax for them is very small.

Astronomers cannot observe the parallax of even the closest stars without powerful telescopes. Even so, astronomers have been able to measure the parallax for many stars. Once the parallax for a star is known, there is a certain mathematical equation which allows for calculation of the distance to the star.

If a star is too far away, even the most powerful telescopes cannot detect any parallax. The maximum distance for detecting parallax is about 2000 light-years from the earth.

How do astronomers estimate distances for stars farther than 600 light-years? The methods are indirect and are quite uncertain. For instance, most astronomers estimate that the most distant objects, the quasars, are 14 billion light-years away, but some astronomers think this distance is too small. Other astronomers think this distance may be as much as 100 times too large. If this were true, the quasars could be as close as 140 million light-years.

Regardless of uncertainties in cosmic distances, however, the universe is extremely vast and is a powerful testimony to the all-powerful might of the Creator.



appear to move past you depends on how close or far they are. Very distant objects do not seem to move at all.

Astronomers have a name for this situation. It is called "parallax." A nearby object has high parallax, and a faraway object has low parallax.

Imagine the earth orbiting the sun. Since the earth is nearly 100 million miles from the sun, the orbit would be almost 200 million miles across. Astronomers on the earth can see nearby stars, such as Alpha Centauri, moving against a background of distant stars that do not seem to move at all. The

If you are looking out the window in a moving car, the objects close to you (trees and houses) are moving fast while the mountains in the distance don't seem to move at all.

Astronomers use this same idea (parallax) to measure the distance to the stars by observing how fast the stars are moving compared to each other (above).



Solar System and Universe Facts



Jupiter's moon, Io (left), has the MOST VIOLENT

volcanic eruptions known anywhere in the solar system.

Universe Facts

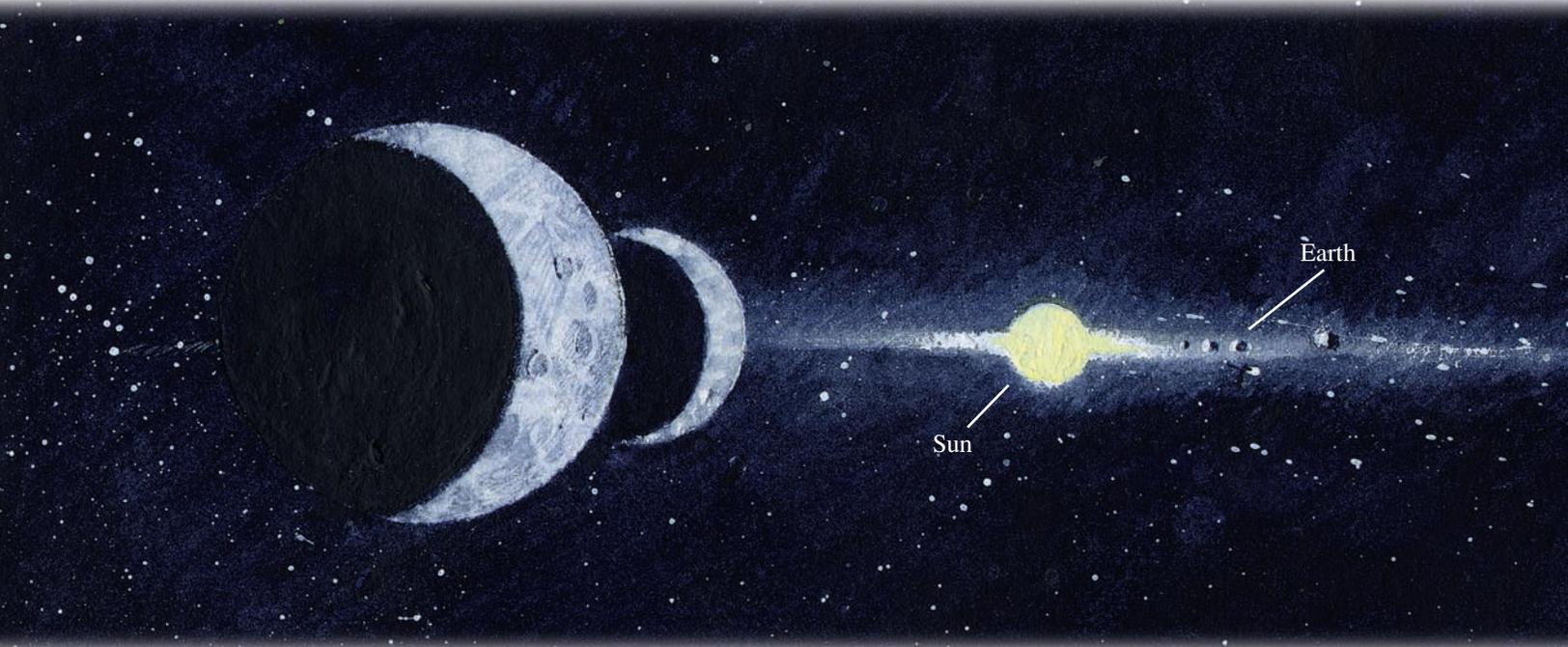
Number of Galaxies: estimated at 100 billion in the observable universe

Average Number of Stars Per Galaxy: estimated at 100 billion

Farthest Objects Seen to Date: galaxies (as much as 20 billion light-years away)

Size of the Observable Universe: very uncertain; 20 billion light-years maximum; may be as low as 7 billion light-years

Total Size of the Entire Universe: unknown



This illustration shows what the solar system might look like if you were on Pluto. In a real photo, the Sun and planets would be so small as to be nearly invisible.

Milky Way Facts

Number of stars: estimated at 200 billion to 300 billion

Size: estimated to be 70,000 to 100,000 light-years across

Type: spiral galaxy

Planet Facts

Closest to the sun: Mercury

Farthest from the sun: Neptune

Hottest surface: Venus (900°F, 500°C)

Coldest surface: Uranus (-370°F, -224°C)

Biggest planet: Jupiter (1,000 times larger than earth*)

Smallest planet: Mercury (18 times smaller than earth*)

Longest day: Venus (rotates once every 243 earth days)

Shortest day: Jupiter (rotates once every 10 hours)

Longest year: Neptune (165 earth years)

Shortest year: Mercury (88 earth days)

* Comparison by volume

Order of the Planets (going out from the sun)

Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune