SCIENCE 709
THE SUN AND OTHER STARS

CONTENTS

2017 Printing

The material in this book is the product of the Lord's blessing and many individuals working together on the teams, both at Alpha Omega Publications and Christian Light Publications.

Christian Light Publications, Inc.

Harrisonburg, Virginia 22802

Tel. 1-540-434-0768

Printed in USA

Cover photo credits:
African Elephants: John M. Coffman
Scientist: Dogwood Ridge Photography

reflector telescope (ri flek′ tur tel′ u skōp). A telescope which uses a system of mirrors.

refractor telescope (ri frak′ tur tel′ u skōp). A telescope which uses a system of lenses.

Rigel (rī′ jul). A blue supergiant star located in the constellation Orion.

solar flares (sō′ lur flārz). Bright spots surrounding the dark part of a sunspot giving off enormous amounts of charged particles and energy.

spectroscope (spek′ tru skōp). An instrument for studying the spectrum. When used to study the heavenly bodies it helps determine what elements they are made of and the speed at which they move.

sunspots (sun′ spots). Dark areas, believed to be magnetic storms, which occur on the sun.

Taurus (tôr′ us). Constellation known as the Bull.

Ursa Major (ėr′ su mā′ jur). The Great Bear constellation which contains the Big Dipper.

Ursa Minor (ėr′ su mī′ nur). The Little Bear constellation which contains the Little Dipper.

Note: All vocabulary words in this LIGHTUNIT appear in **boldface** print the first time they are used. If you are unsure of the meaning when you are reading, study the definitions given.

Pronunciation Key: h**a**t, **ā**ge, c**ā**re, f**ä**r; l**e**t, **ē**qual, t**ė**rm; **i**t, **Ī**ce; h**o**t, **ō**pen, **ô**rder; **oi**l; **ou**t; c**u**p, p**u**t, r**ü**le; **ch**ild; l**o**ng; **th**in; /*ŦH*/ for **th**en; /*zh*/ for mea**s**ure; /*u*/ represents /*a*/ in **a**bout, /*e*/ in tak**e**n, /*i*/ in penc**i**l, /*o*/ in lem**o**n, and /*u*/ in circ**u**s.

I. THE SUN

Our sun is an average star in size and brightness. The North Star, called **Polaris**, is about 2,500 times as bright as the sun. Out of all the billions and billions of stars, our sun is the only one that supplies heat and energy for the earth. It cannot be an accident that this one star is located in the proper position to provide light for the earth. Life on earth would not be possible except for the energy from this one star. If the sun were closer, it would burn the earth. If it were farther away, the earth would freeze.

The sun is the only star that we can see during the daytime; therefore, it is sometimes called our day star. The Scripture compares the day star to Jesus. **We are told in II Peter 1:19 to let this day star arise in our hearts. "We have also a more sure word of prophecy; whereunto ye do well that ye take heed, as unto a light that shineth in a dark place, until the day dawn, and the day star arise in your hearts."**

What is the source of the sun's energy? What temperatures are produced? What color is the sun? What size is the sun compared to the earth? What are two major elements found on the sun? These and other questions will be explored in this section of the **LIGHTUNIT**.

SECTION OBJECTIVES

☐ **Read these objectives.** When you have completed this section, you should be able:

1. To summarize the history of the telescope and the radio **telescope.**
2. To describe and to explain the chemical composition of the **sun.**
3. To tell the location of our solar system in the Milky **Way.**
4. To diagram the structure of the **sun.**
5. To give a possible explanation for the northern and southern **lights.**
6. To describe and to name in order the heavenly bodies found in our solar **system.**
7. To describe a nebula.

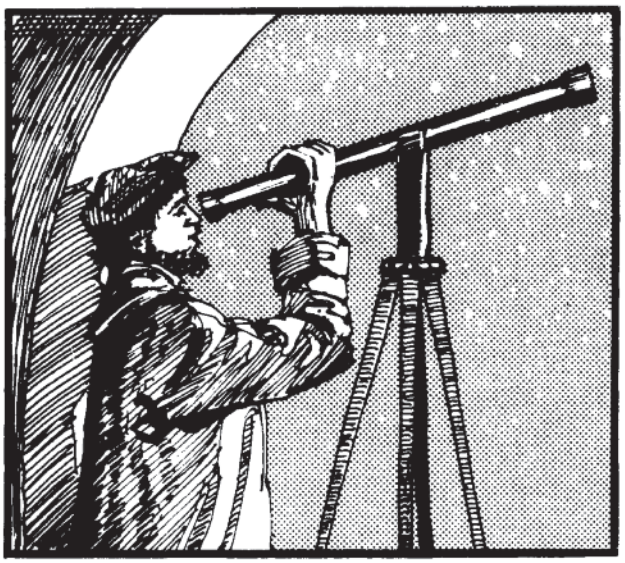
☐ **Restudy these words.**

asteroids	comets	Polaris
astronomy	corona	prominences
aurora australis	meteoroids	reflector telescope
aurora borealis	nebula	refractor telescope
core	nuclear reaction	solar flares
chromosphere	photosphere	sunspots

HISTORY

Through the ages men have observed the stars, but very little was accomplished until the development of the telescope. In 1608 Hans Lippershey, a Dutchman who made eyeglasses, invented the simple telescope. Galileo Galilei, an Italian scientist, heard about Lippershey's new telescope and built one of his own. Galileo's telescope was crudely built but it enabled him to make many discoveries. For the first time he saw mountains and craters on the moon. He also discovered that the moon shines by reflected light. He observed the rings of Saturn and discovered four of Jupiter's moons. He also observed the sun and reported **sunspots**. Galileo was the first to **note that our Milky Way is a mass of individual stars.**

Galileo was very accurate and careful about his observations. He made reports of his findings and later taught his pupils many things which he had discovered. His discoveries are mainly responsible for the growth of the science of **astronomy**. Astronomy is the scientific study of heavenly bodies.



Early Telescope

Today we have extremely powerful telescopes. In spite of these instruments, scientists still have many problems which they cannot solve. The blanket of air which surrounds the earth interferes with light reception. Even these most powerful telescopes are hindered by the air. Photographs made from satellites solve some of the problems because satellites make photographs from beyond our atmosphere.

One of the most recent methods of studying the stars is by radio telescope. Radio waves from stars were first discovered in 1932 by Karl Jansky, an American physicist. Jansky was searching for the origin of noises that were heard on radio receivers. To his surprise, the noises were coming from outer space. The noise he heard came from the nucleus of the Milky Way. Five years passed before the first radio telescope was built.

Radio telescopes collect radio waves from various stars. Stars which are not visible can be located by this method. Radio waves given off by stars are far more powerful than any radio transmitter on earth. Not all stars give off radio waves. Some are powerful sources; some are very weak. Radio telescopes are very helpful in man's effort to map the skies.

In addition to the radio telescope, two other basic types of telescopes have been developed: the **refractor telescope** and the **reflector telescope**. The refractor telescope uses a system of lenses. This telescope was the type constructed by Lippershey and Galileo. All of Galileo's observations were made with a refractor telescope. The reflector uses a system of mirrors. Modern telescopes sometimes combine both systems of lenses and mirrors into one telescope.

Match these items.

1.1 _____ discovered four of Jupiter's moons
1.2 _____ made the first telescope
1.3 _____ scientific study of heavenly bodies
1.4 _____ discovered radio waves from space
1.5 _____ noise from the nucleus of the Milky Way
1.6 _____ helpful in mapping the skies
1.7 _____ interferes with light reception when using a telescope
1.8 _____ one of the things that Galileo observed
1.9 _____ telescope which uses a system of lenses
1.10 _____ telescope which uses a system of mirrors

a. reflector
b. refractor
c. radio telescope
d. sunspots
e. radio waves
f. Jansky
g. Galileo
h. Lippershey
i. astronomy
j. blanket of air
k. Milky Way

Make a report on each of these scientists. These men are very important in the history of astronomy. Include in your discussion some mention of the item following each name. Summarize your information in one or two paragraphs for each scientist. Write your answers on a separate sheet of paper.

1.11	Nicholas **Copernicus**	the sun the center of the solar system
1.12	Sir William Herschel	the planet he discovered
1.13	Sir Isaac Newton	the prism and white light
1.14	Johannes Kepler	shape of planetary orbits

Give your paragraphs to your teacher.

DESCRIPTION

The sun, like other stars, is a luminous heavenly body made of hot, glowing gases. Glowing stars produce light. Planets do not produce light; they reflect the light of the sun.

Composition. Stars have such high temperatures that solids cannot exist in them. All elements in stars are in the form of **gases. About 99 percent of the sun is** composed of hydrogen and helium gases. **Other elements make up one percent of the** sun. Seventy of the earth's ninety-two natural elements have been identified in the sun.

Energy. The sun is like a huge atomic furnace. Scientists believe that the sun's heat is produced when four atoms of hydrogen are fused to form one atom of helium. A tremendous release of energy and heat results from such a reaction. The temperature at the surface of the sun is estimated at 10,000 degrees Fahrenheit (5,500 degrees Celsius). The internal temperature is thought to be 25 million **degrees Fahrenheit (14 million degrees** Celsius) or perhaps even more.

The radiant energy given off by the sun and other stars involves a **nuclear reaction**. A nuclear reaction takes place when one element is changed into another element. In the sun's nuclear reaction, hydrogen atoms are changed into helium atoms. This nuclear reaction is similar to the hydrogen bomb. A nuclear reaction is not like an ordinary chemical reaction. Ordinary chemical reactions involve the sharing or giving up of electrons. In the sun's core all of the electrons have been knocked off of the hydrogen and helium atoms. Only the nuclei of the hydrogen atoms fuse to make

helium in the sun's interior. Every second the sun converts $3\frac{1}{2}$ million metric tons of matter into energy by this process.

Size. The sun is approximately **864,000** miles (1,392,000 kilometers) in diameter. The volume of the sun is more than 1 million times that of the earth. In other words, if the sun were an empty ball, more than 1 million earths would fit into it. The sun is an average star in size. Stars range in size from supergiants to dwarfs. The dwarfs are about the size of the earth. Supergiant stars are more than a thousand times larger than the sun.

Structure. The sun consists of a **core**, which is the power plant. The core is the area where hydrogen is fused to helium. The next layer from the core outward is composed chiefly of hydrogen atoms. In this area the atoms bump into one another.

The next layer is the layer of glowing hot gases on the sun's surface. This layer of luminous gases is called the **photosphere**. The photosphere is the visible surface of the sun. This layer gets its name from the prefix *photo* which means *light*.

Above the photosphere is another layer of brilliant, red gases known as the **chromosphere**. The prefix *chromo* means *color*, and refers to the red color of the gases. The chromosphere is the atmosphere of the sun and other stars.

The **corona** is the outer portion of the sun located just above the surface. The crown, or halo effect, of the sun is produced by the masses of hot gases in the corona. The corona can be seen only during an eclipse of the sun. Sometimes streams of hot gases shoot out from the sun. These streams are called **prominences**. Prominences may **shoot streams of flames millions of miles** outward from the sun.

The surface of the photosphere sometimes shows dark spots. The dark spots are known as **sunspots.** After Galileo first observed sunspots, he withheld his report about them until the year 1611. His report was withheld because he did not understand his own observations. The nature of sunspots is not fully understood today. They appear to be magnetic storms. They tend to occur in pairs with one spot following another spot. They occur in eleven-year cycles with a greater cycle consisting of twenty-two years.

Bright spots may appear near the edge of the darker sunspots. These bright spots are called **solar flares**. Solar flares release an enormous amount of energy and charged particles. Showers of protons and electrons bombard the earth about twenty-six hours after the appearance of solar flares. Solar flares also give rise to X rays and cosmic rays.

When charged particles from the sun become captured by the earth's magnetic field, a brilliant glow is produced. The night sky may be streaked with green, blue, white, and red. Green is usually the major color seen. This display of lights in the Northern Hemisphere is called the northern lights or the **aurora borealis**. In the Southern Hemisphere it is called the southern lights or **aurora australis**.