

E X P L O R I N G

THE WORLD OF ASTRONOMY



FROM THE CENTER OF THE SUN TO
THE EDGE OF THE UNIVERSE

JOHN HUDSON TINER

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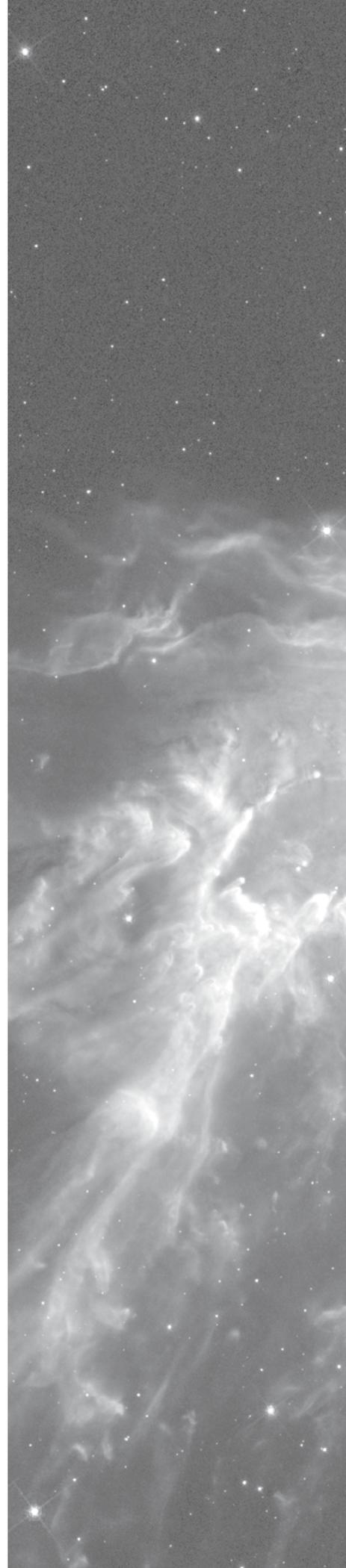
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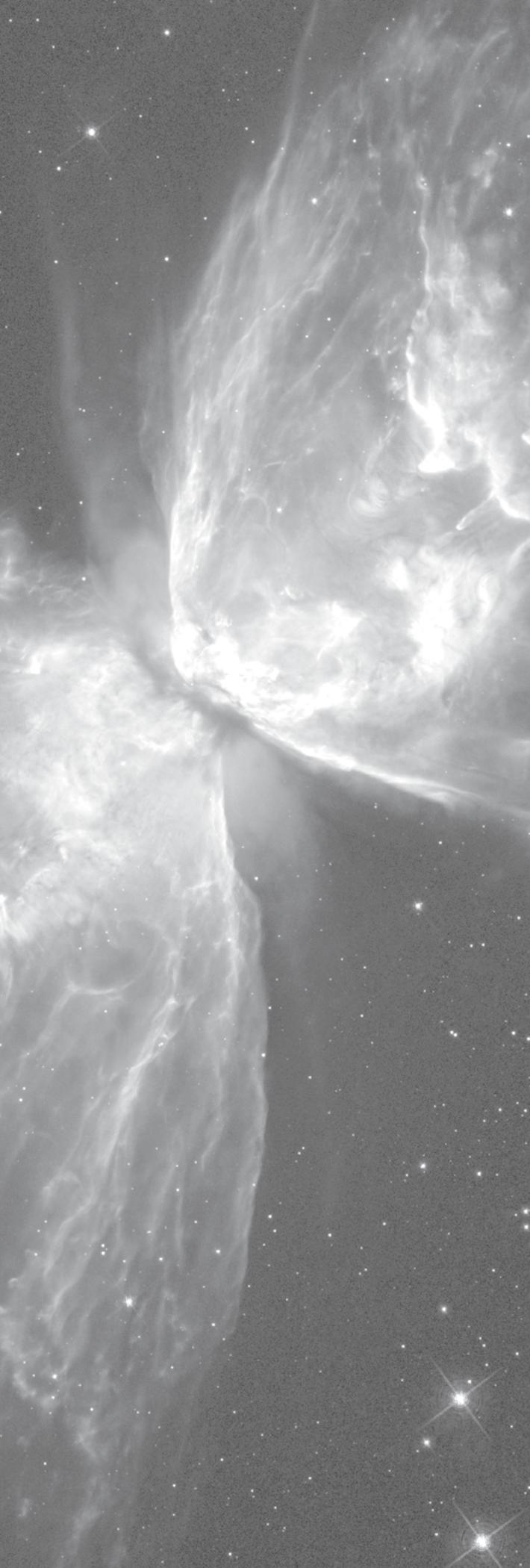


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Note to Parents and Teachers:
How to use *Exploring the World of Astronomy*

Students of several different ages and skill levels can use *Exploring the World of Astronomy*. Children in elementary grades can enjoy many of the concepts, especially if given parental help. Middle school students can read the book independently and quickly test their understanding and comprehension by the challenge of answering questions at the end of each chapter. Junior high and high school students can revisit the book as a refresher course. They will gain greater insight by using the section below the questions marked “Explore More.” The suggestions in “Explore More” offers questions, discussion ideas, and research for students to develop a greater understanding of astronomy. Additional “Explore More” opportunities start on page 162 and a whole book review can be found on page 165.

A Hubble Telescope image of the barred spiral galaxy NGC1300, located almost 69 million light years from Earth





Exploring the Moon

Astronomy is basically the study of the night sky — the moon, planets, stars, and deep space objects. Whether pursued as a profession or a hobby, astronomy is a fascinating subject filled with unexpected discoveries and delightful sights. This book will look at all aspects of observational astronomy and will offer examples of how personally to learn more about the night sky with nothing more than the unaided eyes, binoculars, and a small telescope.

As a form of recreation, astronomy can be enjoyed with simple equipment. The unaided eyes are capable of wide-angle views and of rapid movement that cannot be matched by any other optical instruments.

The eyes can follow the swift passage of shooting stars. The eyes can scan the Milky Way and search out star patterns. Only with the eyes is it possible to see constellations in their entirety — the regal head of Leo the Lion and his hunched hindquarters, the symmetry of the twins of Gemini, the quick curl

Explore

1. What is the moon's terminator?
2. What was the Great Moon Hoax?
3. What is a blue moon?



The constellations of the Scorpion, Leo, and Gemini

of the Scorpion’s stinging tail to his red heart. The Milky Way, star groupings, meteorites, comets, and other subjects can be seen and explored by merely going out on a dark night and looking to the heavens.

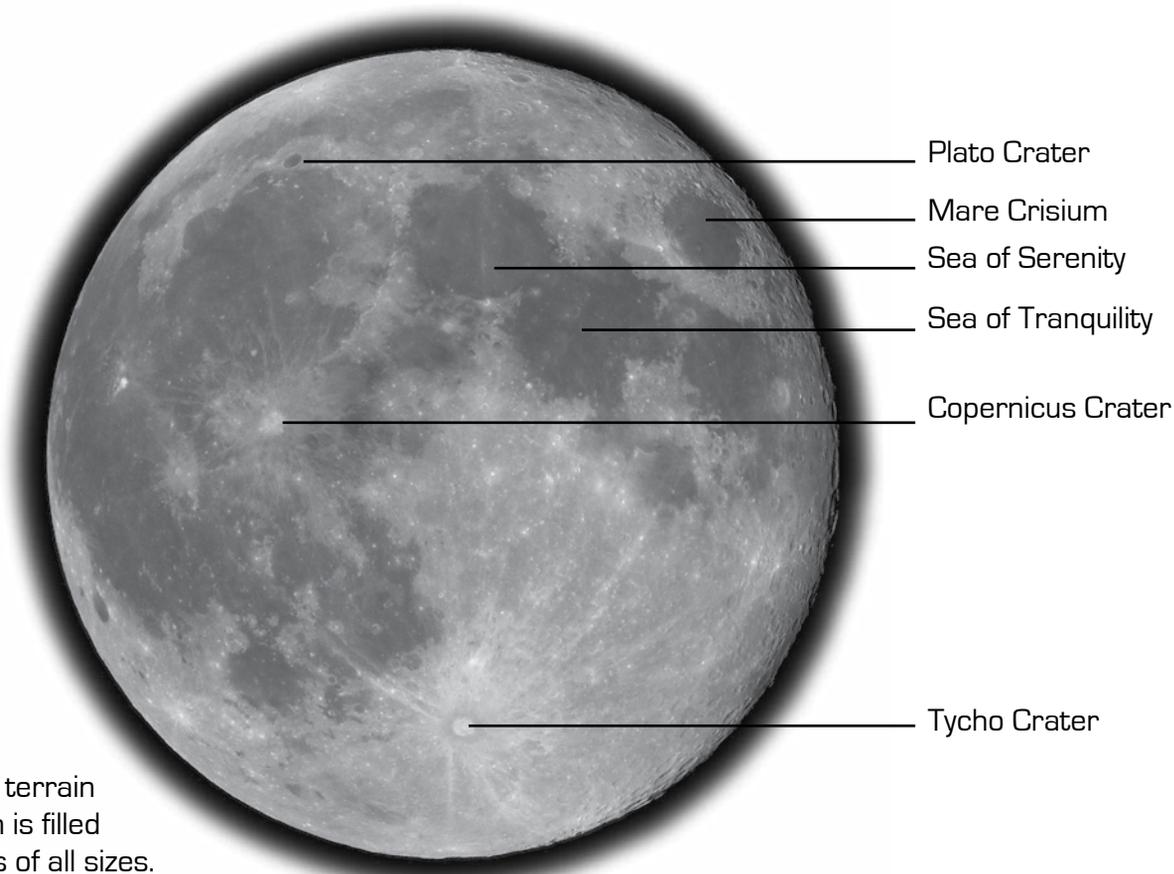
Even the moon is a satisfying subject to first explore with the eyes alone.

The moon in its cradle of stars is the favorite object of beginning astronomers. Even experienced professionals cannot resist viewing the moon time and again. Galileo said, “It is the most beautiful

and delightful sight.” The moon is a rugged and grand place. It has sharp peaks, dust-covered plains, and ring-shaped craters. Mountains reflect light like crinkled aluminum foil. Vast dark plains, called *maria* (singular *mare*), cover part of its surface.

The moon has many interesting features visible to the eyes alone. At first, the moon’s surface may seem a baffling confusion of craters, seas, and mountains. But once an outstanding feature is found, it can serve as a guide to other sights. Such a guidepost is Mare Crisium — the Sea of Crises.

Here’s the way to find Mare Crisium. Look at the moon when it rises in the east. Imagine the moon as a clock face with twelve o’clock at the top. Let your eye travel along the curve of the disk. At about two o’clock you will find a small, dark oval.



The uneven terrain of the moon is filled with craters of all sizes.

Anyone with normal eyesight can find the spot quite easily. The dark oval is Mare Crisium, one of the many seas of the moon. It is a great plain, three hundred miles in diameter, surrounded on all sides by mountains.

Mare is Latin for sea, but in the case of the moon, the maria are bleak plains of lava. The moon is a harsh body. The temperature soars to more than 250°F during the day, then plunges to a couple hundred degrees below zero at night. In addition, the moon has no atmosphere. Astronauts who walk upon its surface wear space suits both as protection from heat and cold and to also provide oxygen to breathe. The first people on the moon were Neil Armstrong and Buzz Aldrin, United States astronauts. On July 20, 1969, they landed on the Sea of Tranquility.

You can find the Sea of Tranquility very easily with the unaided eyes. Use Mare Crisium as a guide. The Sea of Tranquility is the large, dark plain located halfway along a line connecting Mare Crisium to the center of the moon. The Sea of Tranquility is larger than Mare Crisium, but irregular in shape.

Not only is the Sea of Tranquility the first place astronauts landed, but also it is the site of the first church service on the moon. Because they landed on Sunday, Astronaut Aldrin thought it appropriate to hold a worship service to God. In the one-sixth gravity he read a verse from the Bible, said a short prayer, and took communion.

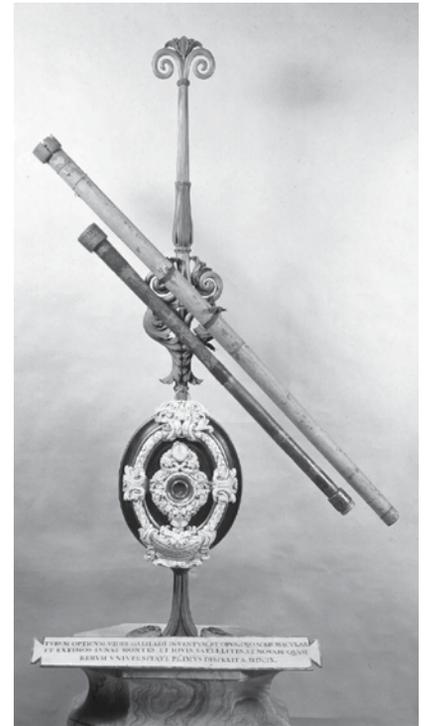
Above the Sea of Tranquility is the Sea of Serenity. It can be seen with the unaided eyes, too. When the line between light and dark cuts across

the sea of Serenity it looks like a giant crater. High mountains rim it all around. The range of mountains circling the Sea of Serenity can just be seen with the unaided eyes under the right conditions. Look when the moon is half full (first or third quarter moon). The mountains curve like a silver sword cutting into the dark side of the moon.

Shadows are as important as light to reveal small features on the moon. Shadows make details more easily seen. Watch for smaller features when they fall along the terminator — the line dividing light from dark. Near the terminator, shadows give a contrast that makes details more easily seen.

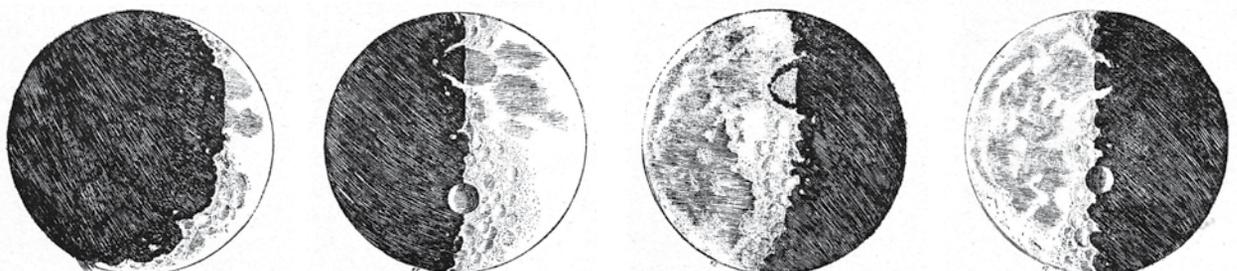
When Galileo turned his first telescope to the moon, he was astonished at the number of craters. They crowded over each other, spilled across each other, and even fell inside one another. Craters of all sizes are sprinkled everywhere across the moon, even in the maria.

Ordinary binoculars are as powerful as Galileo's first telescope. They are powerful enough to reveal craters, including three that are easy to find. Tycho



Galileo's telescopes

Galileo's drawing of the moon



Crater near the lower edge of the moon is named after a famous astronomer, Tycho Brahe. The crater has long white rays spreading out from it. The white streamers can be seen running halfway across the moon.

Astronomers believe the white rays are material thrown out as the craters formed due to an impact by a large meteor or comet. Over time, small meteors bombard the rays, and the moon's intense temperature changed their color. The rays faded away. If this idea is true, then Tycho is a relatively young crater.

Copernicus Crater, named after the Polish astronomer, is found near the center of the moon. It is a blaze of white. Compare it with the inky black of the third well-known crater, Plato, which is at the top of the moon. Plato is named after one of the great ancient Greek thinkers.

Once you find these craters with binoculars, you will be able to glimpse them with the unaided eye. They are best seen when the line dividing light

from dark passes through them. The longer shadows make the crater walls stand out better. One rim is thrust into bright sunlight, while the other rim is still inky black in darkness.

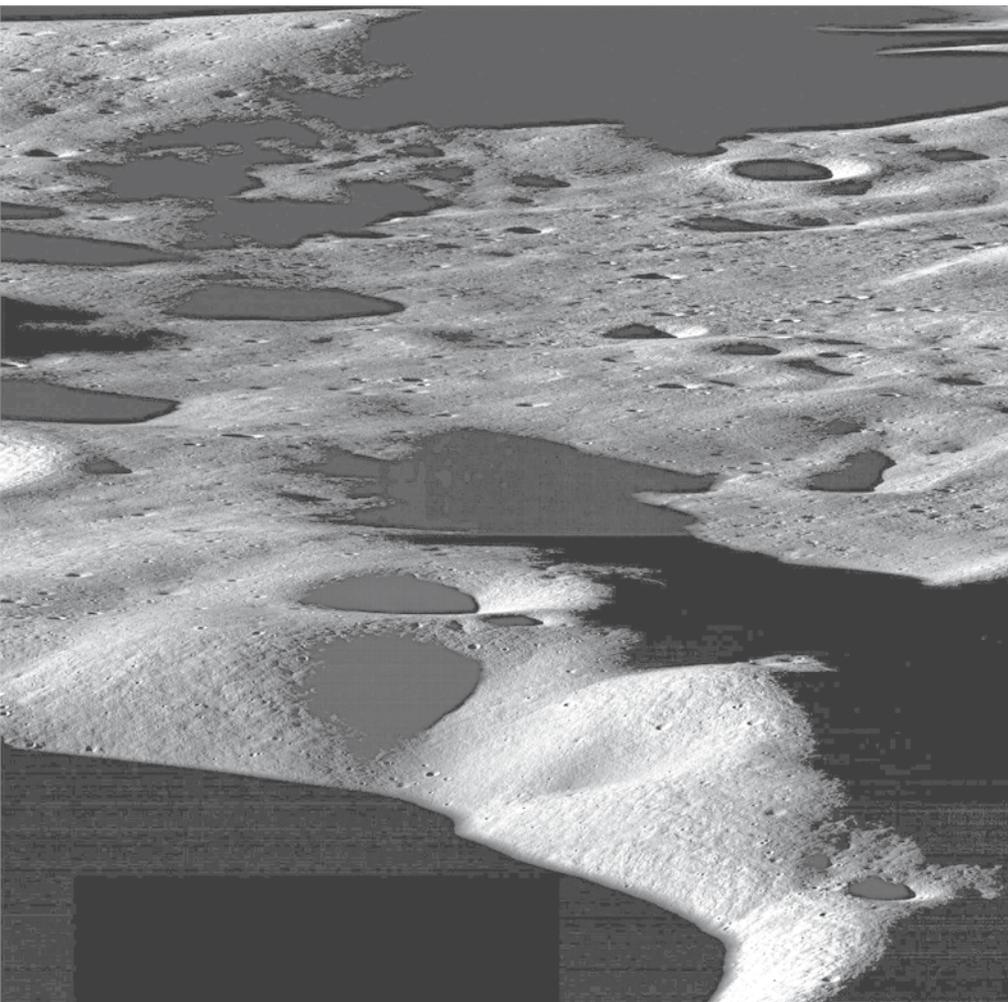
Watch from night to night as the moon changes phases and the line dividing light from dark marches across the face of the moon. The inky blackness of new moon changes to the bleached raw whites of full moon. Mountain peaks catch the light first. With binoculars, you can spot the jagged peaks of the mountains. In a telescope, the peaks seem to float like pyramids of flame because of the bright sunlight. See if you can spot the speckle of a peak poking out of darkness into light.

Despite its smaller size, the moon's mountains are as tall as those on earth. Galileo measured one of the mountains on the moon to be four miles high. When the light is right, a high mountain can have shadows one hundred miles long. It seems strange that we can look up and see the mountains of another world hanging over our heads.

In the 1960s, the United States prepared for astronauts to land on the moon. Before the moon shot, the United States sent unmanned vehicles to test the moon's surface. Cameras would transmit photos, and instruments would test the mineral content of its surface. The first unmanned probe sent to land on the moon was *Surveyor 1*.

Some scientists expressed concern that the moon's surface would not support a vehicle. Without an atmosphere, meteorites that impacted its surface

The uneven terrain of the moon is filled with craters of all sizes.



The Great Moon Hoax

One of the most outlandish and famous hoaxes of all time involved the moon. The word hoax means to trick people into believing as true something that is false. The moon has no seas of water, although early astronomers did not know this. The fact that the features were named *maria*, meaning seas, caused some people to think there might be life on the moon. In 1835, a New York newspaper took advantage of this interest in the moon to boost sales of the paper.

The *New York Sun* newspaper printed a series of reports about life on the moon. According to the *Sun*, the famous British astronomer Sir John Herschel had invented a new type of telescope. John Herschel was the son of William Herschel who discovered the planet Uranus. Like his father, he was an accomplished and well-respected astronomer. The newspaper claimed that John Herschel turned his powerful telescope to the moon. He saw beaches, trees, animals and birds. Finally, he saw bat-like moon people.

John Herschel could not be questioned. He was on an expedition to South Africa. The *Sun* newspaper claimed to base its stories upon articles that appeared in the *Edinburgh Journal of Science*, a Scottish scientific magazine.



Great Moon Hoax lithograph of “ruby amphitheater” for *New York Sun*, August 28, 1835

Other newspapers could not find the Scottish journal. Rather than questioning the astonishing story, they pretended to have access to the original articles in the journal. They simply rewrote the *Sun* articles and passed them off as their own as if they had independently verified the story.

Finally, after many months, John Herschel was reached in South Africa. He had no super telescope, nor had he written about the moon. The Scottish journal did not exist. Instead, a reporter for the *Sun* had written the stories to boost newspaper circulation. The *Sun* enjoyed the largest circulation of any newspaper in the world at that time.

would have turned bedrock into powder. The extremes of heat and cold would have done the same thing. The best, smoothest landing sites would be the ones most likely covered by powder. Some scientists feared *Surveyor 1* would land in a sea of soft powder. It would be swallowed up as if by quicksand when it touched down.

On June 2, 1966, *Surveyor 1* touched down on the moon. The landing pads sank only a

couple of inches into the loose surface, hardly more than it would have on earth. The probe’s camera sent back 11,150 photographs before it shut down for the long night on the moon.

The flat areas of the moon are covered with a layer of fine particles. It is as much as 5 to 20 feet deep in some places. However, the particles stick together. They make a firm surface.