Sky Facts

Issue No. 15 TORONTO 1960-61

AN INTRODUCTION to the wonders of astronomy, published by the

ROYAL ASTRONOMICAL SOCIETY OF CANADA (TORONTO CENTRE)

and distributed free to visitors at the Society's open-air meetings and Exhibition display; also at the Saturday public evenings at the David Dunlap Observatory.

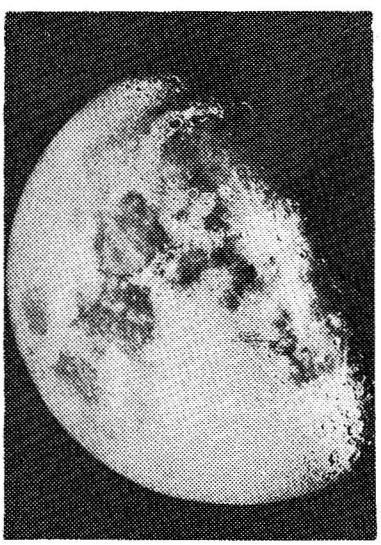
What Is Astronomy?

Astronomy is the science which treats with the celestial bodies, their positions, distances, motions, physical condition and constitutions. It deals with stars (including the Sun), planets (the Earth), satellites (the Moon), comets and meteors, and the vast conglomerations of stellar matter known as galaxies and nebulae.

While "professional" astronomy is an exact science requiring use of a comprehensive knowledge of mathematics and physics, there is much of interest to the "amateur" astronomer, who needs no knowledge of higher mathematics to enjoy this study of the heavens as a most intriguing hobby.

The Moon

Nearest of all the heavenly bodies to Earth is our satellite, the Moon — only 239,000 miles away. Earth has only one moon, Mars has two, while giant Jupiter has 12 and ringed Saturn nine. Our Moon appears to be a dead world, without trace of air or water. It is seen by us only when sunlight, falling on its rocky surface, is reflected toward our eyes. Thus its phases change as it shifts position relative to Earth and Sun while it revolves around Earth once in about four weeks (a month or "moonth"). Because it rotates on its axis in the same period, it presents the same "face" to Earth at all times. With a diameter of 2,160 miles, or about one-quarter that of Earth, it weighs only about 1/80th as much as our world. The gravitational force on the Moon is one-sixth that on Earth.



Our Nearest Neighbour

Seen in a telescope, the Moon's surface is revealed as extremely rugged, with towering mountain ranges and thousands of roughly circular craters of various sizes, some more than 100 miles across. Then, too, there are vast dark plains which have the appearance of old sea basins. Some areas are densely pock-marked with craters, many with small craterlets and sharp-pointed cones within their walls. Seen with the naked eye, these varied lunar features combine to create what is really an optical illusion, the so-called "Man in the Moon." Only the telescope can reveal the true grandeur of the lunar landscape, the massive ramparts of peaks which compare with Earth's loftiest mountains, despite the Moon's much smaller size. Perhaps the absence of air and water has allowed them to remain through the ages while similar features which may have existed on Earth in distant ages have long since been eroded away by the action of wind, rain and ice.

On the Moon, where day and month are equal in length, there are 14 earthly days of

The Society will set up telescopes for **FREE PUBLIC OBSERVATION** of the Moon, the planets and other celestial objects. as follows:

TORONTO STAR SKY-GAZING PARTIES with telescopes (weather permitting) and astronomical films, from dusk to about 10:45 p.m. on following nights:

Wednesday, JUNE 1—High Park, near Bloor St. entrance

Monday, JUNE 6—Eglinton Park (Eglinton W. at Oriole Pkwy.)

Friday, JULY 1 (Dominion Day)**—High Park,** near Bloor St.

Monday, JULY 4—Greenwood Park (Greenwood Ave. south of Gerrard E.)

Friday, JULY 29—University of Toronto Campus, near Convocation Hall.

Monday, AUG. 1 (Civic Holiday)**—Eglinton Park.**

CANADIAN NATIONAL EXHIBITION: On the terrace south of the Province of Ontario Building every clear evening during the Exhibition, Aug. 24 to Sept. 10.

For further information about the Society and its activities, see Page 3.

daylight, when the temperature goes as high as 275 degrees F., far above the boiling point of water, and then another 14 days of night, when it drops to 243 degrees below zero.

The Sun Is a Star!

Because it emits its own light and heat, the Sun is classed as a star, one of fairly average size and temperature. Only because it is so close—a mere 93 million miles—does it occupy such an important place in our lives, the source of Earth's life and energy. The Sun's light, travelling 186,000 miles a second (or six million million miles a year), takes eight minutes to reach Earth. The light of the next nearest star requires more than four years for the trip. Most stars seen with the unaided eye are upwards of 100 "light-years" distant, and the telescope reveals objects so far off that the light which left them millions of years ago is only now reaching our eyes.

The Sun is one of an estimated 200 billion stars in our galaxy (the Milky Way) and our own galaxy is just one of 150 millions of these great star-systems known to exist in the universe. Analysis of starlight by the spectroscope indicates all the bodies in the universe are made of the same chemical elements known on Earth.

The Sun, with a diameter of 860,000 miles (compared to Earth's 7,900 miles), has a volume 1,300,000 times that of our tiny world. But because the solar matter is mostly in a gaseous state, the Sun's mass or weight is only 330,000 times that of our planet. Surface gravity on the massive Sun is so great, however, that a person weighing 150 pounds on Earth would weigh more than two tons if he could stand the 11,000-degree temperature and land on the solar surface.

The Sun's Family

The Earth is one of nine planets, dark solid bodies which revolve in elliptical (roughly circular) orbits around the Sun. Even in ancient times five of these planets or "wanderers" among the stars were recognized because of their changing positions among the "fixed" stars which form the constellations. Planets shine only by reflected sunlight.

Mercury and Venus are closest to the Sun. Earth is third. Beyond Earth, in order, come Mars, Jupiter and Saturn (all sometimes visible as bright "stars") and Uranus, Neptune and Pluto (see only in telescopes). Between Mars and Jupiter lie the orbits of hundreds of minor planets or asteroids, possibly the remnants of a 10th large planet which in the distant past became disintegrated.

Mercury, innermost and smallest of the planets, is usually too close to the Sun to be seen but occasionally, as it swings around the solar orb in its year of 88 days, it is visible for a few days just after sunset or just before sunrise. During the latter part of 1960 and the first half of 1961 it may be seen as an "evening star" for a few days before and after greatest elongations east of the Sun on June 19, October 15, February 6 and May 31; and as a "morning star" at western elongations on August 5, November 24 and March 20. Best evening view is obtained at the spring elongations.

THE DAVID DUNLAP OBSERVATORY
of the University of Toronto

at Stop 23A Yonge St., south of Richmond Hill, is open to visitors without charge Saturday evenings from April to October. If weather permits, the 74-inch telescope is used to observe the heavens. Telephone Richmond Hill TUrner 4-2112 for schedule of open hours and reservations.

Earth Has a Twin

Second planet from the Sun, Venus is in size and weight almost a twin to Earth. About 67 million miles from the Sun, it has a year of 225 days. With the exception of the Sun and Moon, Venus is the brightest object in the sky when suitably placed for observation. The brilliance is due largely to its dense atmosphere and cloud blanket, which, while it reflects sunlight well, prevents astronomers on Earth from ever seeing the Venusian surface itself. Because of its nearness to the Sun, Venus receives about twice as much light and heat as we do. A "morning star" early in 1960, Venus passes the Sun on June 22 and will become visible low in the southwest, after sunset, in late summer and early autumn. Its position improves toward the year-end when it will set about three hours after the Sun. It remains in the evening sky early in 1961 but closes in toward the Sun, passing it April 10 and reappearing a little later in the pre-dawn sky. (On November 18, 1960, Venus will be close to Jupiter, and on November 27 close to Saturn.)

Next beyond Earth is Mars. With an average distance of 140 million miles from the Sun, it sometimes approaches within 35 million miles of Earth, while at it farthest point it is 234 million miles away. When nearest it is a conspicuous fiery red color, but when farthest it is no brighter than the Pole Star. Unlike Venus, Mars' atmosphere is very thin and the features on its surface are distinctly visible. Its diameter, 4,200 miles, is little more than half the Earth's. The Martian day is about the same as ours, but its year is equal to 687 earthly days. Mars has two tiny moons, only 18 and 23 miles in diameter. A "morning star" early in 1960, Mars will rise about midnight by August and earlier each night until by mid-autumn it will be prominent all night, and much brighter than usual. It reaches opposition to the Sun on December 30 at which time is will be 56 million miles from Earth. It remains an "evening star" during most of 1961.

Jupiter, the Giant

Jupiter is the giant of the Sun's family. With a diameter of 87,000 miles, it has a volume about 1,300 times that of Earth, but weighs only 318 times as much. This is still nearly three times as much as all the other planets put together. It revolves around the Sun in just under 12 of our years, and spins on its axis in less than 10 hours; hence its day is much shorter than ours, and there are 10,494 days in the Jovian year. The velocity of rotation at Jupiter's equator—27,800 miles an hour—is more than 26 times as fast as

ROYAL ASTRONOMICAL SOCIETY OF CANADA

The Society, organized in Toronto in 1890, now has local groups known as Centres in 13 cities across Canada, from Halifax to Victoria. Centres in Ontario, besides Toronto, are located at Ottawa, Hamilton, London and Windsor. Membership is open to any person interested in Astronomy, professionally or as a hobby, and there are no academic requirements or age limits.

The Society publishes a bi-monthly **Journal** with articles on astronomical topics and reports of the Society's meetings; also the annual **Observer's Handbook** which presents a vast amount of information of particular interest to the amateur astronomer.

The Toronto Centre holds regular lecture meetings from October through April, and sponsors a special group for members interested in making their own telescopes. It also sponsors monthly summer "Star Nights" with telescopes on the University of Toronto Campus, and extra public observation meetings in parks and at the Canadian National Exhibition. Occasional meetings for members are held at the David Dunlap Observatory at Richmond Hill. There is a well-stocked Library and reading-room for members at the Society's national headquarters at 252 College Street, Toronto.

Annual dues of $5.00 for the membership year commencing October 1 include subscription to both the Society's **Journal** and **Observer's Handbook** for the next calendar year, as well as privilege of attending all meetings, use of the Library and, if desired, membership in the Telescope Makers Group. Student membership, including all privileges, is available at $3.00 a year to those under 16 years of age, and to full-time students in secondary schools or university above that age. Non-members may obtain the 1960 **Observer's Handbook** for 75 cents. (Price of the 1961 edition will be $1.00.) Application-for-membership forms may be obtained upon request addressed to:

F. L. Troyer, Secretary, Toronto Centre, R.A.S.C., 53 Woodlawn Ave. E., Toronto 7

Earth's. Jupiter's dense atmosphere contains deadly methane and ammonia gases. Because of its distance from the Sun, an average of 483 million miles, Jupiter receives only about 1/27th as much light and heat as Earth, and its surface is intensely cold.

Of Jupiter's 12 moons, the four largest—Io, Europa, Ganymede and Callisto (all except Europa being larger than Earth's moon)—may be seen readily in small telescopes, and their changing positions in relation to the planet make an interesting study for the amateur. Some nights all four are on one side, sometimes three on one side and one on the other, sometimes paired. At other times they are eclipsed by the planet or are seen passing across Jupiter's disc, casting a tiny shadow on the cloudy surface. Noticeable also in the telescope is the banded effect revealed by the colored cloud envelope which hides the planet's real surface.

In May, 1960, Jupiter rises about midnight, then a little earlier each night until by midsummer it will be well up at sunset. By September it will set before midnight and by the end of 1960 will be too close to the Sun for observing. After conjunction with the Sun on January 5, 1961, it returns to the pre-dawn sky until midsummer.

Saturn's Rings Unique

Saturn, with its unique ring system, is one of the most interesting objects for the amateur astronomer with a small telescope. Saturn, at an average distance of 886 million miles from the Sun, takes nearly 30 years to complete one revolution. Second only to Jupiter in size, it is 72,000 miles in diameter and weighs about 95 times as much as Earth. Like Jupiter, it spins on its axis very swiftly, its day being about 10¼ hours long. Of Saturn's nine satellites or moons, only one, Titan, is readily seen in a small telescope. Saturn's exquisite ring system may, astronomers believe, be the remnants of one or more moons which have disintegrated, with the matter spread out in a circular band.

In the constellation of Sagittarius all year (not far from Jupiter), Saturn rises about midnight in May, 1960, and after opposition to the Sun on July 7 will be visible in the evening sky until November. It passes the Sun on January 11, 1961, returning a little later to the pre-dawn sky until August of 1961.

Comets and Shooting Stars

Comets are visible briefly, sometimes for a few weeks, often for months, as they swim by in space, the bright nucleus usually surrounded by nebulous material often extended as a "tail" in the direction away from the Sun. Some are periodic, returning at regular intervals and known to be permanent members of the Solar System; others make only a single appearance and pass off again to distant space. Few comets attain enough brightness to be seen with the naked eye.

Meteors are much more common. A few may be seen almost any clear night, but at certain times of the year they come in "showers." Ordinarily, shooting stars are very tiny bits of matter, like grains of sand, which are rendered briefly visible as they are drawn toward Earth by its gravitational pull and burned up by the heat generated as they swiftly pass through our upper atmosphere. Usually they are completely melted and transformed into a briefly lingering streak of vapor. Very rarely a larger meteoric body enters Earth's atmosphere and partially survives the fiery ordeal, and a portion of the solid mass falls to Earth. Two notable meteor showers are the Perseids (about Aug. 12 each year) and the Leonids (about Nov. 16).

Beyond the Sun's Ken

Under exceptionally good conditions, the naked eye may see as many as 2,000 stars at one time, but the larger telescopes reveal there are billions of these distant suns in our galaxy. Many stars are twins—known to astronomers as "binaries." Other stars appear as doubles merely because one lies behind the other in the line of sight, although they are separated by vast distances. Albireo or Beta Cygni, the star at the foot of the Northern Cross (not far from the bright star Vega), is an especially interesting binary, one of the twins being whitish-blue, a very hot star, and the other a beautiful golden or orange color, a star of lower temperature.

Star clusters, such as the highly condensed conglomeration of suns to be seen in the constellation Hercules, or the widely separated group, the Pleiades, are examples of interest.

Other telescopic objects of beauty are the nebulae—of which one type is the huge chaotic mass of glowing gas to be seen in Orion's belt and the other the galactic nebulae or "island universes" such as that in Andromeda. The latter, although nearly two million light-years distant, is sometimes visible to the unaided eye as a fuzzy patch, the farthest thing the naked eye can see—more than ten million million million miles off in space.

Two Kinds of Telescopes

Telescopes used by astronomers—professional and amateur—fall into two main groups, depending on their optical systems. The refracting telescope is a single long tube with sets of lenses at each end. The reflecting type, which can be easily made by the amateur in a home workshop—with inexpensive materials but much loving care—uses a silvered or aluminized mirror (coated on the top surface) to gather in the light which then is reflected through a magnifying eyepiece lens to the observer's eye or camera. Most of the bigger telescopes in the largest observatories are of the reflecting type, such as those at Palomar Mountain and Mount Wilson in California, and at the David Dunlap Observatory of the University of Toronto, at Richmond Hill, Ont.