Chapter 2

Jupiter's Place in the Solar System

Whether our study of Jupiter is casual or serious, it will be helpful to understand some basic facts about the planet, including simple nomenclature. This knowledge will help us in our own study, and it will allow us to understand what others say and write about the planet. As I have found over the years, there is always something new and exciting to learn, something new to be discovered and revealed, but we must understand the language.

So, where does Jupiter stand in the scheme of things? Our solar system is comprised of many bodies, large and small. We were taught about the nine planets in school, and their order in distance from the Sun. Recently, the International Astronomical Union changed the classification of Pluto, and it is no longer officially classified as a planet in the simple sense. Now we have eight planets and all manner of other bodies.

2.1 Physical Characteristics

Jupiter displays a series of bright zones and darker belts, generally running parallel to its equator. Figure 2.1 illustrates the globe of Jupiter with the belts and zones that are usually visible. Not all features will be visible at all times, as belts and zones are prone to brighten, darken, become larger or smaller, or even disappear from time to time.

Jupiter is the fifth planet from the Sun. It is a gas giant, having no surface as we think of on Earth. Its volume is so large, that if it were a hollow sphere, all the other planets would fit easily inside with room to spare. Even mighty Saturn is only about one-third its mass. However, Jupiter's density is so low that if there were a water ocean large enough, Jupiter would float on its surface!

Jupiter's large mass is of extreme importance to the solar system and especially to Earth. Jupiter's mass perturbs the orbit of nearly every planet in our solar system. It also influences the orbits of smaller bodies that come into the inner solar system from the Kuiper Belt and the Ort Cloud. Jupiter's mass and strong gravitational influence has a tendency to either sweep up small bodies that cross its orbit, or to eject them from the solar system entirely. This solar system 'vacuum cleaner' made it possible for Earth to survive long enough for life to form and evolve. Without this protection, the bombardment of Earth would occur too frequently by bodies

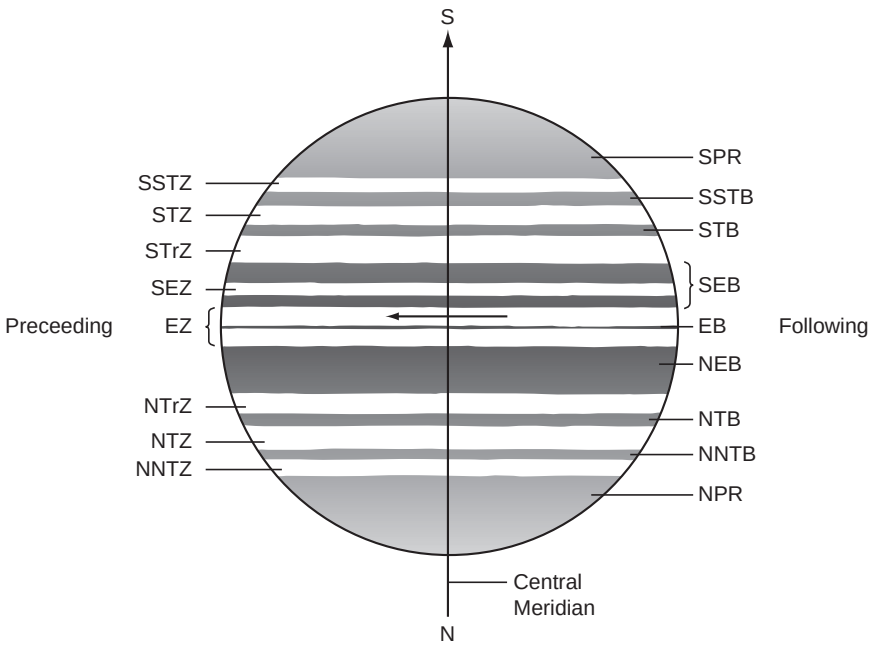


Fig. 2.1. The belts and zones of Jupiter (Credit: John W. McAnally).

Table 2.1. Jupiter's physical and orbital characteristics compared to Earth

	Jupiter	Earth
Equatorial diameter (km)	143,082	12,756
Polar diameter (km)	133,792	12,714
Rotation periods		
		23h 56m 4s
System I	9h 50m 30.003s (877.90°/day)	
System II	9h 55m 40.632s (870.27°/day)	
System III	9h 55m 29.711s	
Axial tilt	3.12°	23.44°
Mass	1.899×10^{27} kg	5.974×10^{27} kg
Density	1.32g cm^{-3}	5.52g cm^{-3}
Surface gravity	2.69g	1.00g
Mean distance from Sun	5.20280AU	1.00000AU
Orbital eccentricity	0.04849	0.01671
Period (sidereal)	4,332.59 days	365.26 days

1 astronomical unit (AU) = 149,597,870km [2]

too large for Earth to survive as we see it today. The recent 1994 collision of Comet Shoemaker-Levy 9 with Jupiter is a great example of Jupiter as protector of the solar system.

Jupiter exhibits differential rotation; that is, different latitudes of the planet have different rotation rates. Generally, System I includes the latitudes from the north edge of the south equatorial belt, all of the equatorial zone, to the south edge of the north equatorial belt. System I also includes the south edge of the north temperate belt. System II includes the rest of the planet. Since amateurs in the past have observed Jupiter in visible wavelengths, it has been common practice for them to refer to System I and II. Professional astronomers have generally used a third rotation system, System III. The System III rotation rate is related to a radio source on Jupiter that rotates with the planet at a specific rate. Since these three rotation rates are different, we must designate which system we are referring to when we speak of longitudinal positions on Jupiter. Depending upon the latitude at which a feature appears on Jupiter, amateurs refer to System I or II longitude. This usage will become more apparent in the section of this book dealing with transit timings. Table 2.1 summarizes Jupiter's physical data and orbital characteristics.

2.2 A System of Basic Terminology and Nomenclature

Like most sciences, planetary astronomy comprises a language of special terms and nomenclature. Understanding those associated with Jupiter will facilitate our discussions and explanations, since this scientific shorthand can actually help to keep our discussions simple and unambiguous. Years ago, A.L.P.O. Jupiter Section Coordinator Phil Budine suggested a simple, straightforward system that we can still use today. There are abbreviations for the terms and nomenclature of dark and bright features, and for the belts and zones; so, some of the more common terms and abbreviations are shown in Tables 2.2 and 2.3. Various dark and bright features can be seen in the belts and zones at any given time. Some of the features most often seen are illustrated in Table 2.4. These illustrations are modeled after illustrations used by past A.L.P.O. Jupiter Recorder Phillip Budine.

A simple example can help us understand how we put this terminology into use. Figure 2.2 shows a large condensation, or barge, on the north edge of the north equatorial belt. This feature would be described as, 'Dc L cond N edge NEB'; which literally means 'dark center, large condensation, north edge, north equatorial belt.' So, you see how in simple, straightforward notation we have completely described the feature and where it resides. If we were describing a bright feature we would use the designation 'W', instead of 'D'. Later, when we discuss central meridian transit timings, you will see how we combine this description with the longitudinal position of the feature to turn this kind of observation into real, meaningful data.

As we will see in Sect. II of this book, your observations are only valuable if they are properly recorded and notated. The system of nomenclature presented here should allow anyone to accomplish this task. Organizations such as The Association of Lunar and Planetary Observers (A.L.P.O.) and the British Astronomical Association (BAA) have standard observing forms that the observer can use to record observations. Many other organizations around the world also have standardized forms. Standardized observations greatly facilitate the gathering

Table 2.2. The basic nomenclature and abbreviations for Jupiter's belts and zones

SPR	South Polar Region
SSTB	South South Temperate Belt
STZ	South Temperate Zone
STB	South Temperate Belt
STrZ	South Tropical Zone
SEB	South Equatorial Belt
SEZ	South Equatorial Zone
EZ	Equatorial Zone
EB	Equatorial Band
NEB	North Equatorial Belt
NTrZ	No rth Tropical Zone
NTB	North Temperate Belt
NTZ	North Temperate Zone
NNTB	North North Temperate Belt
NPR	North Polar Region

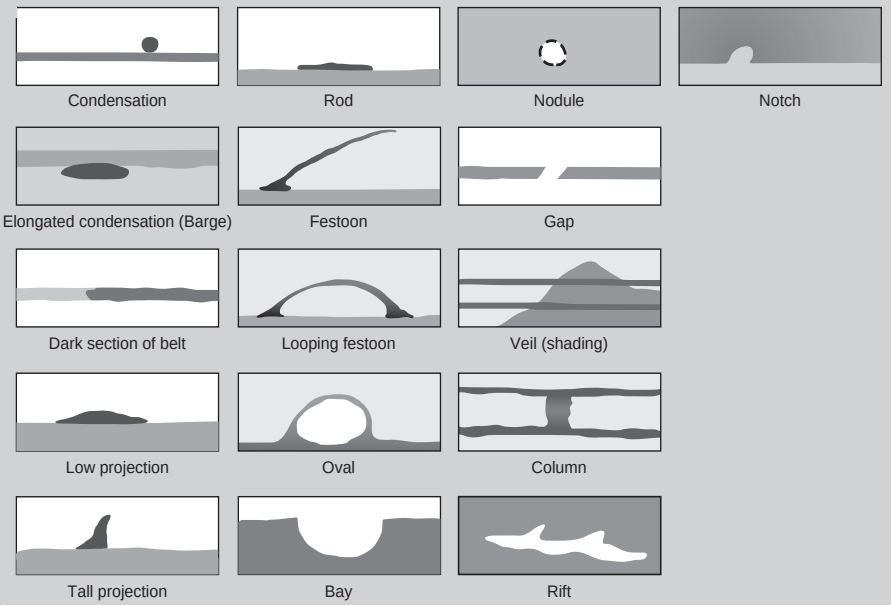
Table 2.3. Basic nomenclature used for transit timing observations

Dark marking	D
White or bright marking	W
Center	C
Preceding	P
Following	F
North	N
South	S
Large	L
Small	Sm
Projection	Proj
Condensation	Cond
Central Meridian	CM
System I	(I) or CM1 or L1
System II	(II) or CM2 or L2
System III	(III) or CM3 or L3

and recording of data and its subsequent use by the professional community and other amateurs.

I strongly encourage you to use this standard system of notation. Not only will its use make you a better planetary astronomer, it can even add some anticipation and excitement to your endeavors. What features are you going to be able to record tonight? Will they be the same tomorrow night, or next week? I think you will find it fascinating to learn that some features are long-lived and some are not! You are going to learn so much about Jupiter, and you will be amazed at how easily you retain what you have learned when you observe in this fashion!

Table 2.4. Basic nomenclature for dark and bright features commonly seen on Jupiter (Credit: John W. McAnally)



From standard nomenclature proposed by Phillip W. Budine.

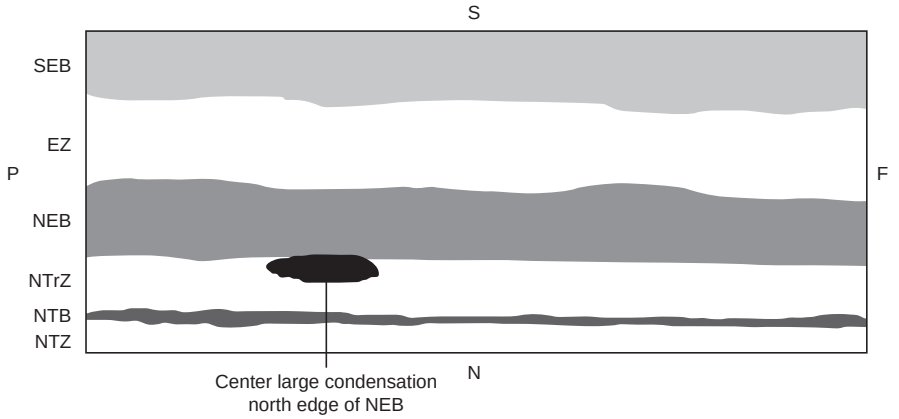


Fig. 2.2. Example of a large condensation depicted on the northern edge of Jupiter's North Equatorial Belt (Credit: John W. McAnally).