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CONFUSED PERSON'S GUIDE TO ASTRONOMICAL JARGON

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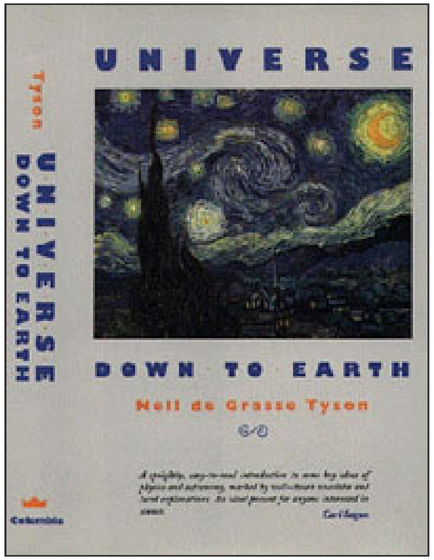

This chapter might possibly belong at the end of the book as a glossary, but our discussion of the methods of science would be incomplete without paying homage to the invention, development, and usage of jargon. An academic discipline that is sufficiently mature will have normally assembled for itself a jargon-filled lexicon. But before you get indignant about this, consider that academic researchers are not exclusively guilty. When was the last time you understood your car mechanic

when you were duly informed of what was wrong with
your car? And if baseball were not your passion, then the following plausible scenario would sound completely meaningless: “The DH, who had homered in each of his first two at-bats, reached first on a pitcher’s balk, and two outs later advanced to third on a ground-rule double. He then scored to win the game on a payoff pitch to a batter who laid down a bunt for the squeeze-play with two outs in the bottom of the tenth.” Yes, we all have our jargon, and we all use it to communicate with others in our field. But in my (possibly biased) opinion, astronomy has the most entertaining jargon of any discipline—enough to warrant a chapter of its own.

CONFUSED PERSON’S GUIDE TO ASTRONOMICAL JARGON

TERMS OF ENTEARMENT

To a botanist, the North American rose is a Rosa nutkana. To a marine biologist, a household goldfish is a Carassius auratus. To a medical doctor, a bruise on your jaw is a mandibular contusion. To a sociologist, your next-door neighbor is your residential propinquitist. These professions, and many others, are replete with polysyllabic terms that are precise yet devoid of romance. To Juliet Capulet (of Romeo and Juliet fame), “...a rose by any other name would smell as sweet.” But what Juliet neglected to mention is that a rose by a five syllable term would make its way into much less poetry.

Astronomers, however, get the award for creating the most diverse set of terms ever assembled to communicate science. There are romantic-sounding words, words that mean something different from what they say, words that are intentionally misspelled, words that sound like diseases, words that are historical relics, and most importantly, household words that mean exactly what they say. Consequently, terms of astronomy can be enlightening as well as mind-scrambling, but never boring.

SOME TERMS THAT MEAN EXACTLY WHAT THEY SAY

Red Giants:

This is what we call big red stars. It is an evolutionary phase through which nearly all stars pass.

White Dwarfs:

This is what we call little white dead stars. Only rarely is "dwarfs" spelled as "dwarves." Not to be confused with "dwarf " stars, which are main sequence stars such as the Sun, that burn hydrogen for fuel in their core.

Black Holes:

This is what we call gravitational holes in space and time that look black. A black hole's surface gravity is so high that the speed one needs to escape from them is greater than the speed of light. Since light, itself, cannot escape then all hope would be lost for you if you happened to stumble upon one. Unlike a simple hole in the floor, you can fall into a black hole from any direction. Yes, the properties of black holes would make good script material for a sci-fi horror story.

Big Bang:

This is the technical term we use to describe the beginning of the universe. It must have been a really big explosion, even if nobody was around to watch or listen. It is estimated to have occurred about 15 gigayears (15×10^9 years) ago.

Missing Mass:

This refers to material in the universe that we have good reason to believe ought to be out there, but we cannot see it. We are still looking for it.

Star Cluster:

This is a cluster of stars that are held together by their collective gravity. One variety of cluster contains relatively few (up to 1000) stars, and has an open appearance. We call these “open clusters”. Another variety is globular in appearance, and can contain up to hundreds of thousands of stars. We call these “globular clusters”.

Star Formation:

This is the official term we use when we discuss the formation of stars.

SOME FAMOUS NAMES THAT PRECISELY DESCRIBE THE OBJECT’S APPEARANCE

Jupiter’s Red Spot:

There is a large circular red region on Jupiter’s cloudy surface. It is a raging anti-cyclone several times larger than Earth, which was discovered by Galileo over 350 years ago. It is officially called the Red Spot. Incidentally, the planet Neptune has a big (dark) spot of its own, which is officially called Neptune’s Dark Spot.

Sunspots:

On the Sun’s visible gaseous surface there are small areas that are cooler than the surrounding regions. Relative to the rest of the Sun these spots look dark. Ignoring the fact that they are periodic magnetic storms that move in pairs across the Sun’s disc, we simply call them sunspots.

Ring Nebula:

The tenuous outer envelope of what was formerly a red giant star has escaped into interstellar space. It is nebulous and it looks like a ring. We call it the Ring Nebula.

Crab Nebula:

There are no claws, no roaming eyeballs, and no antennae, but this nebulous explosive remnant of the famous supernova of A.D. 1054 resembles what an impressionist artist might draw as a crab.

Horsehead Nebula:

In a corner of the constellation Cygnus there is a dark cloud that obscures part of an illuminated gaseous region behind it. The dark cloud bears a remarkable resemblance to the silhouette of a horse’s head.

Milky Way:

If thoroughfares of ancient times were called “streets” instead of “ways” then our galaxy might have been named Milky Street. Without a telescope, the billions of stars that compose our galaxy are distant enough, and dim, enough to blend together in what resembles a milky path across the sky. The milk theme exists in the word “galaxy”, itself—the Greeks called the Milky

Way the galaxias kuklos, which translates to milky circle.

SOME TERMS THAT SOUND MYSTERIOUS

Albedo:

Pronounced “al-bee-dough”. It is a measure of how much light a surface reflects. A perfectly white surface will reflect all light and have an albedo of exactly 1.0, while a perfectly black surface will absorb all light and have an albedo of 0.0.

Zone of Avoidance:

The solar system is embedded in the star-filled, gas-rich and dusty disk of our Milky Way galaxy. We must look above and below this galactic pancake to see other galaxies and the rest of the universe. A map of all objects in the sky will readily show that galaxies seem to “avoid” this zone where our own galaxy’s disk is in the way.

Event Horizon:

This is the boundary between what is in our universe and what is not in our universe. For example, it is the horizon that separates us from the undetectable galaxies that recede with the speed of light at the “edge” of the universe. Additionally, the event horizon of a black hole is what separates us from the region where light (and anything else) cannot escape. Indeed, the size of black holes and the size of the universe are defined by their event horizons.

Roche Lobe:

In the mid-19th century, the astronomer E. Roche studied the detailed gravitational field in the vicinity of a binary system. The Roche lobe is an imaginary, dumbell-shaped, bulbous envelope that surrounds any two orbiting objects. What makes the Roche lobe special is that if material from one object passes across its own envelope, then the material is no longer gravitationally bound. This peculiar-sounding event is actually common among binary stars where one star swells to become a red giant as it overfills its Roche lobe. The material then spirals toward the second star, which adds to its mass, thereby hastening its evolution. When the second star becomes a red giant, the mass-transfer will reverse thus creating a modelling nightmare for binary star theorists.

SOME TERMS THAT SOUND LIKE NAMES ONE MIGHT GIVE TO AN ALIEN

Perigalacton:

For anything in orbit around a galaxy (inclusive of another galaxy), it is the point of closest approach. The farthest orbital point is, of course, apogalacton.

Boson:

What at first sounds like the name given to residents of planet "Boso", is actually the collective name given to particles with a specific quantum mechanical property in common. This includes all photons (massless particles of light), and all mesons (elementary particles with masses that fall between that of the electron and proton). Bosons are named for the Indian physicist Jagadis Chandra Bose.

Baryon:

Another group of particles. These are neutrons and protons and all heavier particles that decay to become them. From the Greek barus meaning heavy.

Omega Centauri:

Surely there must have been a person, place, or thing on the Star Trek television and film series that was an "Omega Centauri." In astronomy, however, it is the name given to the titanic globular cluster of stars that appears in the southern constellation Centaurus.

SOME TERMS THAT LOOK LIKE TYPOGRAPHICAL ERRORS

Gnomon:

A vertical stick in the ground (not in the mud) that was used by the ancients to measure the angle of the Sun above the horizon. By knowing the height of the stick, and by measuring the length of the shadow, one can determine the altitude of the Sun with great precision. It is the same term used for the raised pointer of a sundial. A gnomon is useless on a cloudy day.

Analemma:

If you place marks on the ground at the top of your gnomon's shadow at exactly the same time of day, for every day of the year, then the pattern of marks will trace a figure "8". This is a simple demonstration that the Sun does not always return to the same spot in the sky at the same time each day. The figure "8" is called an analemma, and is often inscribed in sundials, or drawn on globes of the Earth—usually somewhere in the Pacific Ocean.

Syzygy:

This is the less-than-elegant term to describe the moment when three cosmic bodies have aligned. For example, during full moon and new moon, the Earth, Moon, and Sun are in syzygy.

Gegenschein:

A faint glow seen in the nighttime sky 180 degrees away from the sun. It is the reflection of sunlight back to Earth from particles in the plane of the solar system. Gegenschein translates from the German as simply “reflection”.

Ylem:

The American physicist George Gamow suggested this name for the high-temperature primordial cosmic soup that preceded the big bang. George Gamow is no longer with us, and neither is his word.

Orrery:

Any mechanical model of the solar system where planets can actually revolve around the Sun. The better models also display the various moons that revolve around the planets.

SOME TERMS THAT CARRY EMOTIONAL OR INTELLECTUAL STIGMA

Mean Sun:

Here “mean” means “average”. Because of Earth’s elliptical orbit, and because the Sun does not traverse the sky along the celestial equator, the Sun does not always take 24 hours to reach its highest point in the daytime sky. Sometimes it takes less, sometimes it takes more. Also, atmospheric refraction makes the Sun appear to move through the sky more slowly than it otherwise would. To render the Sun more friendly to time keepers, we define the average Sun as simply the one that moves uniformly through the sky so that it always takes 24 hours to reach its highest point. All the clocks of society are set to the mean Sun and grouped, for convenience, into time zones.

Inferior Planet:

Any planet that is found between Earth and Sun (i.e. Mercury and Venus).

Superior Planet:

Any planet that is found beyond Earth’s orbit (i.e. the rest of the planets).

Major Planet:

Any of the nine (i.e. Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, and Pluto).

Minor Planet:

Any asteroid.

Unstable isotope:

One of the few properties of atomic nuclei that is modified with a word that is also used by psychopathologists. The identity of a chemical element is set by the number of protons in its nucleus. The number of neutrons, however, can vary. Each variation in the number of neutrons is called an isotope of that element. But deep in the world of atomic nuclei, life is not always tranquil. Some elements have isotopes that are decidedly unhappy about the number of neutrons they contain. These elements can transmutate (decay) into another element by converting one of their neutrons into an electron and proton pair. Such disgruntled elements are quite sensibly referred to as “unstable isotopes”.

Great Circle:

This is, quite simply, the shortest distance between two points on the surface of a sphere. There is nothing especially great about it, and it normally refers to only segment of a circle, such as the path an airplane might take between two cities.

Eccentricity:

The term “eccentricity” is the mathematical measure of the shape of an orbit. A perfect circle has zero eccentricity. An ellipse can have an eccentricity anywhere between zero and one. A parabola has eccentricity equal to one, and a hyperbola can have any eccentricity greater than one. Eccentric orbits are easier to understand than eccentric people.

Degenerate Star:

Any star that is supported from collapse by an inter-particle pressure that prevents electrons from getting too close to one another. This “electron degeneracy” supports all white dwarfs from further collapse. Neutrons can also support a star from collapse by a similar mechanism. This “neutron degeneracy” supports all neutron stars (inclusive of pulsars). White dwarfs and neutron stars contain some of the densest known matter in the universe.

Greatest Brilliancy:

Used almost exclusively for the planet Venus, it refers to the moment when the planet, in its orbit around the Sun, is brightest as viewed from Earth. When this happens, Venus is likely to be near the horizon and brighter than any airplane in the sky. Since Venus is not “coming in for a landing” people who do not know better tend to call police departments to claim they see a glowing and hovering UFO.

SOME TERMS THAT SOUND LIKE DISEASES

Inferior Conjunction:

When an inferior planet passes between Earth and the Sun. This is not a very interesting event because it is the other side of the planet that is illuminated with sunlight.

Superior Conjunction:

When a planet (inferior or superior) passes to the other side of the Sun from Earth. If for no other reason, inferior and superior conjunction are worth noting because they are the moments in a planet’s orbit that signals the transition between when a planet is visible in the evening sky and morning sky. For both inferior and superior conjunctions, the Sun, Earth and the planet are in syzygy.

Occultation:

When a foreground object passes in front of a background object. The term is typically used when an asteroid or the Moon passes in front of either a planet or a star. Strictly speaking, a solar eclipse is an occultation.

Obliquity of the Ecliptic:

This is simply the tilt angle of Earth’s axis. More complicatedly put: when the plane of the solar system (the ecliptic) and Earth’s equator are each projected onto the sky, they will intersect at an angle called the obliquity of the ecliptic.

Bok globules:

What sounds like malignant tumors is actually the name for small, opaque regions of gas and dust in the Galaxy that are the sites of upcoming star formation. They are named for the pioneering Dutch astronomer Bart Bok.

SOME TERMS THAT RESEMBLE ROCK GROUPS

Shadow Bands:

These are fleeting ripples of shadows that are noticed during a solar eclipse just before and just following totality. With the Sun as a skinny crescent, the atmospheric optics are ideal for revealing the fluctuations in density within Earth’s lower atmosphere.

Kirkwood Gaps:

Regions in the asteroid belt between the planets Mars and Jupiter where orbits are unstable and almost no asteroids are found. Named for the 19th century American astronomer Daniel Kirkwood, who first explained the effect. A gaps with similar dynamical origin is found in the rings of Saturn, except that it is called Cassini’s division, after the 17th century Italian astronomer Giovanni Domenico Cassini.

G-Band:

A region of a star’s spectrum that has a strong absorption feature from the presence of the two-atom molecule, carbon hydride (CH) in the star’s atmosphere.

Atmospheric Band:

A region of a star’s spectrum that has a strong absorption feature from the presence of the oxygen molecule (O2) in Earth’s atmosphere. All starlight that is observed from Earth’s surface must pass through the atmosphere. Consequently, this band sneaks into the spectrum of every star.

SOME TERMS THAT HAVE TOO MANY SYLLABLES

Magnetohydrodynamics:

In the Germanic tradition of slapping together word parts to make an even bigger word, magnetohydrodynamics is the study of the effects of a magnetic field (“magneto”) on the behavior and motion (“dynamics”) of a fluid (“hydro”) that is hot enough for electrons to be separated from their host atoms. Such a gas is called a plasma and is often considered to be the fourth state of matter.

Thermonuclear Fusion:

It takes very high temperatures (“thermo”) to merge (“fusion”) positively charged atomic nuclei (“nuclear”) against their natural force of repulsion to create heavier atomic nuclei. The core of the Sun merges hydrogen atoms to form the heavier helium atom with an enormous energy dividend. This nuclear reaction powers the Sun and, in a less-contained way, also powers H-bombs.

Spectroheliograph:

A device that solar astronomers use to observe the Sun in a narrow part of the spectrum. Often the intent is to isolate a single emission or absorption feature.

Orthoscopic ocular:

One of many different varieties of telescope eyepieces. This one is relatively expensive and is good if you want excellent image quality. It is also one of the few eyepieces that work well with bespectacled observers.

SOME TERMS THAT SOUND LIKE ROMANTIC PLACES

Coudé Room:

It sounds romantic as long as the English translation of the French coudé is not revealed. Some telescopes have secondary and tertiary mirrors that can swing into places that considerably extends the path of starlight before it comes to what is then called the coudé focus. En route to the detector, the starlight is directed out of a hole in the telescope’s side and focuses in a separate room—the coudé room—where high resolution spectra are recorded.

Ascending Node:

The spot in space where a tilted orbit crosses a pre-established plane. going north. When the orbit crosses the plane going south the node is descending. It is a common term when planet orbits and binary stars are discussed.

Lagrangian Point:

What ought be the name of one of those erogenous spots on the human anatomy is actually any one of five points in the vicinity of two orbiting bodies where all centrifugal and gravitational forces balance. It is named for the 18th century French mathematician J. L. Lagrange. One of the five Lagrangian points, “L-5”, was adopted as the name of a space exploration society that seeks to promote, among other things, the construction of a space station at this location of the Earth-Moon system.

If you are still wondering, the English translation of coudé is elbow.

SOME TERMS THAT ARE HISTORICAL RELICS

Spectral Lines:

In the old days of astronomy, when photography was the standard means of detection, it was common to publish photographs of stellar spectra. A typical stellar spectrum produced by a prism or a diffraction grating will display an elongated rectangle of light that is marked with narrow emission and absorption features, which indicates (among other things) the chemical composition and temperature of the star’s atmosphere. In a photograph, these features look like lines that segment the rectangle—hence the term “spectral lines”. Nowadays, with modern digital detectors, spectra are commonly published as graphs of intensity versus wavelength (or something equivalent to wavelength). In these displays the word “line” loses its descriptive meaning. The emission features look like peaks and the absorption features look like crevasses—but they are still called “lines”. It is not a singular tragedy, however. There are plenty of examples where word meanings have changed due to technology. For example, some people still call the refrigerator an “ice-box” and many people still say they “dial” a telephone number even though they are simply pushing buttons.

Redshift:

Can lead to confusion if taken literally. Formerly two separate words, it soon became hyphenated. In its current use, “redshift” has finally lost its hyphen. When used among astronomers who study galaxies, it refers to the shift in spectral features (absorption or emission lines) toward longer wavelength that is the consequence of a galaxy’s motion away from us. In an expanding universe, where distant galaxies recede faster than nearby galaxies, the redshift is frequently taken to be an indicator of distance. All the spectral lines that were first used to measure this shift had shorter wavelengths than red light. A measured red shift therefore had the unambiguous meaning that the spectral features shifted toward the longer wavelengths of the red part of the spectrum. Yet infrared, microwaves and radio waves have longer wavelengths than red light. A feature in these parts of the spectrum, if it experienced what is called a redshift, would still shift to longer wavelengths. But to do so will move the feature away from the red part of the spectrum, not toward it. A non-confusing (though non-historical) name might be "longshift".

SOME FAMOUS ACRONYMS

Laser:

Laser, like "scuba" and "radar", is one of those acronyms that has achieved greater status than the words for which the letters stand. Certain atoms and molecules, when excited, can be made to emit photons of visible light upon being stimulated by photons of the same energy. The remarkable result is an amplified "coherent" pulse of photons with all the same energy. With a specially designed cavity, this unusual property can be exploited to sustain a narrow beam of coherent photons. The process was dubbed "Light Amplification by Stimulated Emission Radiation" or laser, for short.

Maser:

Identical to a laser except microwave light is emitted rather than visible light. The molecules OH (hydroxyl), H_20 (water), and SiO (silicon monoxide) have each been discovered to be a source of maser energy in gaseous regions of our galaxy.

Pulsar:

Quite obviously, a pulsing star. Many types of stars pulse. The term "pulsar", however, is reserved for rapidly rotating neutron stars where their magnetic field axis is tilted from their axis of rotation. As the magnetic pole sweeps past our field of view we detect pulses of radiation. Not all neutron stars have the favorable geometry to be called pulsars, yet all pulsars are neutron stars.

Quasar:

A loose assembly of letters from the phrase "quasi-stellar radio source". With few exceptions, quasars look like ordinary stars on ordinary photographs. Their enormous redshifts and their staggering energy production make them some of the most curious objects in the sky. The first of these quasi-stellar objects to be discovered were strong radio sources. Later discoveries showed that some were radio weak. To be fair to these quasars, the "radio source" was changed to "object" to now read "quasi-stellar object", or QSO, for short.

SOME TERMS THAT HAVE NOTHING TO DO WITH PUNCTUALITY

Early Galaxy / Late Galaxy:

Early-type galaxies are elliptical and late-type galaxies are open-pattern spirals. The original "tuning-fork" galaxy classification diagram of Edwin Hubble displayed elliptical galaxies on a tuning fork's handle (extending to the left) with normal spiral galaxies placed along one tine, and spiral galaxies with a bar-pattern in their center placed along the other tine (each extending to the right). The spiral pattern became less tightly wound as you moved along the tines. Hubble postulated an evolutionary sequence among the galaxy shapes but it was later found that no obvious connection exists. If you will have difficulty remembering early from late, then imagine you are a snail on a page where the tuning-fork diagram is drawn. If you started a left-to-right page trek you would pass the elliptical galaxies early and the spiral galaxies late.

Early Stars / Late Stars:

Early-type stars are hot and late-type stars are cool. The original Hertzsprung-Russell (H-R) diagram plots luminosity versus temperature with the hotter part of the scale on the left and the cooler part of the scale on the right. Our page-trekking snail, moving once again from left-to-right (across an HR diagram), will pass the hot stars early and the cool stars late.

SOME TERMS THAT HAVE NOTHING TO DO WITH TEXTURE

Soft X-rays:

Low energy X-rays. Nobody has ever squeezed them to verify that they are indeed soft.

Hard X-rays:

High energy X-rays. Considerably more deadly than soft X-rays.

SOME TERMS THAT HAVE NOTHING TO DO WITH DISTANCE

Near infrared:

If our peripatetic snail actually lived on the visual interval of a map of the electromagnetic spectrum (violet-indigo-blue-green-yellow-orange-red), and if our snail wanted to visit the infrared part that was just beyond the red, then it would consider the destination to be near.

Far infrared:

The snail would have to go far if it wanted to go beyond the near infrared to the part that was on the border with microwaves. Far infrared photons have much lower energy and longer wavelength than near infrared and visual photons.

SOME TERMS THAT HAVE NOTHING TO DO WITH ETIQUETTE

Proper motion:

This is the motion of a relatively nearby star when measured against the background of "fixed" stars.

Peculiar velocity:

For a star, this is the velocity that is left over after you have accounted for the larger scale motion of the Milky Way galaxy's rotation. For a galaxy, it is the velocity that is left over after you have accounted for the larger scale motion of the expanding universe. There is nothing peculiar about either of these.

A TERM THAT HAS NOTHING TO DO WITH JESUS CHRIST

Right Ascension:

As lines of longitude are used to locate east-west positions on Earth, so is right ascension used to locate positions of stars east-west on the sky.

SOME TERMS THAT LIE TO YOU

Metals:

Contrary to the tenets of a chemist, metals to an astronomer are all elements other than hydrogen and helium in the Periodic Table of Elements. There is actually a practical utility to this scheme. The big bang endowed the universe with primarily hydrogen and helium. Everything else is “pollution” that was forged in the thermonuclear furnaces of stellar cores. Furthermore, in most environments that are astrophysically interesting (such as stars), the temperatures are so high that elements are vaporized and ionized into the free floating charged particles of the stellar soup we call plasma. The traditional laboratory concept of a metal loses its meaning and significance.

Hydrogen Burning:

This term is used by nearly all astronomers to describe energy production in the Sun’s core. Conventional usage of the word “burn” refers to the breakup and rearrangement of molecular bonds with a release of chemical energy. But nothing actually burns in the Sun. Not that all your possessions wouldn’t vaporize if you tossed them there. It’s just that the thermonuclear fusion of hydrogen in the Sun’s core has no resemblance to any traditional understanding of the word “burn”. Hydrogen fusion unleashes what is aptly called nuclear energy, which is not normally released in your household fireplace.

Planetary Nebulae:

Everybody (who owns a telescope and has looked skyward with it) knows that stars do not look much different through a telescope than with the unaided eye—they are simply twinkling points of light. Planets, however, look like points of light only with the unaided eye. Through a telescope they become distinctive circular disks. The sky also contains fuzzy-looking things like galaxies, star clusters, and genuine gaseous nebulosities. One variety of nebulosity, (the lost, over-puffed spherical envelope of a dead red giant star) often appears disk-like through a telescope. The visual resemblance to planets led to the unimaginative and misleading term “planetary nebulae”.

Amateur Astronomer:

If you put the word “amateur” in front of most professions you would probably doubt whether a person with such credentials would be of any use to you. For example, it is not likely that an “amateur” neurosurgeon, or an “amateur” attorney could attract much business. Amateur astronomers, however, are indispensable. Let it be known that the average amateur astronomer knows more about the appearance of the sky than the average professional astronomer. Furthermore, in almost all cases, the professional astronomer who knows the sky probably started as an amateur. The advantage to knowing what the sky looks like is that you also know when it looks different. Many supernovae, most comets, and nearly all asteroids are discovered by amateur astronomers upon noticing that a familiar region of the sky has a visitor.

WHAT DO YOU CALL SOMETHING THAT IS BIG?

In the business of astronomy, if you dare call something big or bright you are at risk of exhausting your vocabulary of superlatives if you discover something even bigger or brighter. With open arms, astronomers have welcomed the word-prefix “super” into the dictionary of cosmic jargon. It endows astronomers with the power to create terms like super-giant, super-cluster, super-bubble, and super-nova, and it gives physicists terms such as super-collider, super-symmetry, super-string, super-conductivity, super-fluid, super-sonic, and super-luminal.

This penchant for using the word super has adequate precedent in 20th century society. Comic book characters with trans-human powers were always called super heroes. There are markets and supermarkets. There are highways and super highways. There are ordinary bowls, and then there is the Super Bowl. The engines of some cars are charged while those of other cars are super charged. And we can credit Walt Disney's Mary Poppins for the "super" version of cali-fragil-istic-expi-ali-docious. A notable exception to this trend was the Boeing 747, which was spared being "super" in favor of the alliteration offered by Jumbo Jet.

In astronomy, giant stars are called giants. But when even bigger giants were discovered we were forced to call them super-giants. These are objects that we now know to be the bulbous evolutionary fate that awaits high mass stars. Normal main sequence stars such as the Sun, are officially called dwarfs, which is clearly what they would look like to a giant—dwarf stars have a million times smaller volume than many giants. Yet let us not confuse normal dwarfs with the hot degenerate stellar corpses that we call white dwarfs, which have a million times smaller volume than normal dwarfs.

Note the rapid loss of descriptive adjectives at the "dwarf end". I am convinced that it is the result of the relative scarcity of English words that describe what is smaller than normal when compared to words that describe what is bigger than normal.

The day that “super” becomes an insufficient modifier, astronomers will be armed and ready. We have reserved “super-duper” for the occasion.

ALPHABET SOUP

Astronomers have always had a penchant for lettering things. Ever since Joseph Fraunhofer lettered major features in the solar spectrum in the early 1800s, astronomers have been lettering things from stellar surface temperature to galaxy shapes. Some of Fraunhofer’s nomenclature is still used today to identify the strong absorption features: atmospheric “A” and “B” bands, sodium “D”, calcium “H & K”, and the “G” band of calcium hydride.

As is detailed in Chapter 9, the lettering tradition continued across the turn of the century when Annie Jump Canon at the Harvard Observatory classified and sequenced stellar spectra according to the strength of an absorption feature due to hydrogen. The stars with the strongest features were lettered “A”, the stars with the next strongest features were lettered “B”, and so forth. It was later found that a temperature (color) sequence revealed more stellar physics than a spectral line strength sequence. Some lettered categories were discarded. Others were combined. What remains is the famous spectral classification sequence that is still used today to classify all stars. In order of decreasing temperature we have: O B A F G K M. This sequence has occupied, and will continue to occupy, the minds of mnemonic writers for decades.

Star that vary in luminosity are no strangers to lettering schemes. Omitting A through Q, the first variable star discovered in a constellation is noted by R followed by the genitive of the constellation name. Clearly, only a few variable stars can be discovered before one exhausts the alphabet. By convention, after Z comes RR, then RS, and so forth, all the way to RZ. If that’s not enough, then the scheme resumes at SS, then ST, and so forth all the way to SZ. This continues until ZZ. If the constellation is big, and has many stars, then it may need even more letter combinations than those up to ZZ. When this happens, the scheme continues at AA, then AB, through to AZ. Next comes BB, then BC, through to BZ. The last possible lettered variable star is QZ, because afterwards you would hit RR, which was already used after Z. This naming scheme, for no particular reason, insures that the first letter is always earlier in the alphabet than the second letter—unless the letters are the same. One final criterion is that the relatively modern letter 'J' is never used. If you were counting, then you should have obtained 334 combinations.

If a constellation has the audacity to exhaust this many letters and letter-pairs then stars are simply numbered (not from one, but from the number that is appropriate if all previous variables in the constellation were numbered instead of lettered) with a prefix of “V” for variable. For example, the star V471 Tauri is a well-studied variable that can change its brightness abruptly. If a variable star is discovered to be the prototype of a new class of variable stars then the entire class is named for that star. The famous star RR Lyrae, (discovered after, of course, Y Lyrae and Z Lyrae), in the constellation Lyra, defined the properties of what are now called “RR Lyrae” variables.

Letters are also used to convey shapes. In 1925, the American astronomer Edwin Hubble classified the appearance of galaxies in a lettering scheme that still bears his name. It is this lettering scheme that one follows as you move from “early galaxies” to “late galaxies” along Hubble’s tuning fork diagram. Preserving the I-call-them-as-I-see-them tradition of astronomers and baseball umpires, Hubble identified elliptically-shaped galaxies with the letter 'E’; the most round among them was labeled E0 (pronounced “E-zero”), while the most elongated among them was labelled E7. Hubble labelled flat, spiral-shaped galaxies with an 'S'. If the spiral arms were connected by a straight bar-like section in the middle of the galaxy (as is true for nearly half of all spiral galaxies), then a 'B' was appended to the 'S'. Some spirals were so puffy-looking that they resembled elliptical galaxies. These became their own category called S0 (pronounced “S-zero”). Tightly wound spirals were sub-labelled 'a'. Intermediate spirals 'b'. Loosely wound spirals 'c'. In modern times, this three tiered scale was expanded to describe really loose spirals, which are sub-labeled 'd'. And of course, irregularly shaped galaxies were labelled “I”. If you are curious, the family photo of the Milky Way galaxy and its nearest neighbors would show: Milky Way–Sbc (a cross between types b and c); Large Magellanic cloud–I; Small Magellanic cloud–I; Andromeda Galaxy–Sb; and NGC205 (a satellite galaxy to Andromeda)–E5; Hubble’s original scheme is now extended to describe all sorts of galaxy morphology. My favorite among them is the letter “p”, which you add to the classification if, no matter how you describe it, the galaxy just looks peculiar.

The first asteroid or comet or supernova discovered in a year is designated by the year followed by the letter “a”. For example, the famous supernova that was discovered in the Magellanic Clouds in 1987 was the first supernova to be discovered in 1987. Its official name is SN1987a. Subsequently discovered supernovae are assigned, in sequence, the rest of the twenty six letters of the alphabet. When the alphabet runs out (as it does frequently with asteroids and supernovae) you simply double-up. The twenty-seventh supernova of 1991 was named SN1991aa. The twenty-eighth was named SN1991ab. Earth had a close encounter with a 200 million ton asteroid 1989fc; the hundred and fifty-ninth asteroid discovered in 1989. Unlike supernovae, which keep their lettered identification forever, asteroids and comets graduate to “name” status after their orbits and identities are confirmed. They can be named by their discoverer after any person, place, or thing.

ROMAN NUMERAL SOUP

There are Type I and Type II supernovae; there are Seyfert galaxies of Type I and

Type II; there are Population I and Population II stars; and there are stellar luminosity classes of Type I through VII. There is nothing mysterious about these classifications. They are the product of a humble attempt to distinguish more than one variety of object in a given category.

All supernovae have at least one property in common: a star explodes. If you wish to understand supernovae in detail, however, then further classification is warranted. Type I supernovae have weak hydrogen absorption features in their optical spectrum while in Type II supernovae these features are strong. Recently, Type I supernovae, based on closer examination of the class, have been split into two categories, Type Ia and Type Ib. This schism helped to reveal that Type Ib and Type II owe their origin to the explosive death of an isolated high mass star. A Type Ia supernova, however, is the consequence of mass transfer in a binary system where a white dwarf recipient explosively unbinds from a thermonuclear runaway.

Seyfert galaxies are normal-looking spiral galaxies with remarkably luminous nuclei. Carl Seyfert first identified the class in 1943 as part of a larger survey of spiral galaxies. Once again, the class subdivision is based on the appearance of hydrogen in the spectra. Type I Seyfert galaxies have much stronger hydrogen emission than Type II Seyferts.

The light from elliptical galaxies is dominated by old red stars while the light from spiral galaxies is dominated by young blue stars. This simple observation leads to the idea that ellipticals and spirals have different stellar populations. The most recently formed stars are called Population I. They have been enriched (or polluted, if you prefer) by heavy elements that have been scattered through space by previous generations of supernovae. The oldest stars, however, were born before significant enrichment could occur—they are called Population II. Ellipticals are generally considered to be Population II while spirals have a mix of Population II and Population I. The population concept is only a convenience that actually clouds the reality of transitionary populations within spiral galaxies. To confuse matters further, note that Type II supernovae are found only among Population I systems.

Luminosity class is one of the few intuitive Roman numeral classification schemes. In basic terms it is an indicator of how big a star is. Class I are super-giants. These are stars that can get as big as the orbit of Mars. (That’s why they are called super-giants.) Class III are normal red giants, and Class V are main sequence “dwarf” stars, like the Sun. The smallest are among Class VII, which are exclusively white dwarfs. The three other classes are intermediate in size: Class II contains sub-supergiants, Class IV contains sub-giants and Class VI contains sub-dwarfs.

GREEK SOUP

The 88 constellations in the sky have their brightest stars lettered in order of brightness. The squiggly-looking, lower case, 24-letter Greek alphabet (α β γ δ ε ζ η θ ι κ λ μ ν ξ ο π ρ ς σ τ υ φ χ ψ ω ϑ ϒ ϖ) has been endowed with this honor. The brightest star in any constellation is named with the first Greek letter α (alpha) followed by the genitive case of the constellation name. Dimmer stars are named in sequence down the alphabet. Some famous stars are α-Centauri in the southern constellation Centaurus, which happens to be the closest star system to the Sun, and β-Cygni, which is also known as Alberio, a beautiful double star system in the northern constellation Cygnus. The well-known science fiction television and film series Star Trek borrowed this nomenclature and appended a Roman numeral to indicate a planet's number according to its distance from a star. One of their better known planets is α-Ceti-V to where Khan (the bad guy) was banished.

CATALOGUE QUERIES

The astronomer's cosmic laboratory contains billions of stars and galaxies. It should be no surprise that catalogues proliferate the profession. There are three basic naming formats. One scheme uses somebody's name followed by a number, like Messier 101, or Arp 337. These are objects that have simply been collected together in a list, and then numbered. The Messier catalogue happens to be a list of fuzzy objects in the sky that was originally intended to prevent confusion with what might otherwise be a newly discovered comet. The Arp catalogue is a list of peculiar-looking galaxies, most of which are gravitationally disturbed by a near neighbor. Occasionally, an astronomer (or an institution) will publish more than one freshly-numbered lists. These objects require an extra identifier. For example, II-Zwicky-70 (a compact, irregular galaxy) is the seventieth object on Zwicky’s second list of compact objects, and 3C273 (the brightest and first confirmed quasar) is the two hundred and seventy-third object in the third University of Cambridge catalogue of radio sources.

Another basic scheme uses a name followed by the approximate coordinates of the object on the celestial sphere. For example, IRAS 1243+30 is simply an object located at 12 hours 43 minutes in right ascension and +30 degrees in declination that was discovered by the Infrared Astronomical Satellite. Cosmic objects that are not fortunate enough to make it into anybody’s list are simply noted with their coordinates preceded by the letter A for “anonymous”. Among astronomers, this coordinate designation is affectionately referred to as the object's telephone phone number.

The third basic scheme is a hybrid of the first two. Here, all objects are listed in order of increasing right ascension and are numbered in this order. Famous (enormous) catalogues like the New General Catalogue of Non-stellar Objects (NGC) and the Smithsonian Astrophysical Observatory Star Catalogue (SAO) are well-known examples. Incidentally, NGC 224 is the Andromeda galaxy and SAO 000308 is Polaris, the North Star. And if you see a star labeled BS 1457 don’t be alarmed, it’s just a star (in the constellation Taurus) from the Yale Bright Star Catalogue.

EPILOGUE

Among its varied and numerous duties, it is the job of the International Astronomical Union (IAU) to establish rules of naming and nomenclature. In many cases, however, these rules are established after a naming scheme or term has already been widely used by professional astronomers. Consequently, typical rules of the IAU are simply the formal recognition of a naming trend. This approach to the jargon of a discipline tends to preserve the history, spontaneity, and novelty of the language of scientific discourse. These ingredients are likely to ensure that the discoveries of astronomy will forever remain attractive and accessible to the general public. It is also no surprise that astronomy, the second oldes profession, is the most frequently tapped discipline for science fiction literature and films. The subject, as well as the terms themselves, seem to capture the imagination and romance of scientific exploration.

May the terms be with you.