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E Y E P I E C E V I E W S #319

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1. INTRODUCTION

Greetings All,

It is almost spring for our Northern Hemisphere observers while folks down under are looking forward to welcoming another magical season, fall.

Speaking of spring, don’t forget to check the AAVSO spring meeting announcement at:

http://www.aavso.org/aavso/meetings/spring07.shtml

We have more articles in the accompanying March issue of Eyepiece Views than we have had for a long time. All of them are scientifically satisfactory and fun to read. Enjoy!

Thanks and good observing!
Gamze Menali, AAVSO Technical Assistant

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2. LEGACY VARIABLE STARS - Mike Simonsen

Many observers come to the AAVSO because they have decided they would like to contribute to science in some modest way. Two obvious ways to contribute to science are to discover something new, or to collect data that astronomers will actually use somewhere down the line to ‘do science’.

Discovering comets, asteroids and new variable stars has been largely taken over by the multitude of surveys monitoring the sky daily. Many supernovae and novae are still discovered by amateurs, but the search requires investing hundreds of hours and special techniques to prove fruitful. Even then, not all of these objects will prove to be of great interest to professional astronomers or scientists.

Contributing observations that will become part of the data most often requested by professional astronomers is much easier. The only thing you need to know before putting together a program is ‘which stars are astronomers interested in?’

You could poll all the professional astronomers you know, or look up the number of scientific papers written on all the variables you can think of, or ask AAVSO which stars they get data requests for most often, or you could simply observe what I call “Legacy Variable Stars”.

Legacy Variables are stars that have been observed for decades and whose data can be plotted as light curves describing the behavior of the star over extended periods. Some of them have been observed for over one hundred years! In some cases, it has taken decades to demonstrate the behavior scientists are interested in studying. Legacy Stars will never go out of style, and it is precisely the long time line of visual observations that makes many of them important or of particular interest.

Many of these stars are among the first variable stars to be discovered, so they tend to be bright and have large enough amplitudes to be observed visually. Many of them are the prototypes of their particular class of variable stars, being the first to be explained or the first to be discovered as such. By contributing to the body of historical observations you are sustaining the legacy of these distinguished stars.

Mira: 02 19 20.79 -02 58 39.5 (2000)- Omicron Ceti, the first known periodic variable star, may be the star that most embodies the heart and spirit of the AAVSO. There are observations of Mira going back to the very first days of the AAVSO. There are historical observations going back to the 1600’s.
“Mira the Wonderful” as she is known, still manages to surprise and engage us in the 21st century. Changes in the UV spectrum of Mira indicate she is an active, evolving system and studies have been made from x-ray to radio wavelengths, utilizing Chandra, HST and the Very Large Array. As recently as 2005, Karovska et al reported the discovery of x-ray emissions from Mira.
This prototypical long period variable (LPV) varies from 9th magnitude to naked eye visibility (2nd or 3rd magnitude) in around 331 days on average. At declination –02 she is observable in both hemispheres for extended periods each year. Observations as Mira approaches conjunction with the Sun and immediately after conjunction, as a morning object, are always highly valued.

Chi Cygni: 19 50 33.92 +32 54 50.6 (2000) Another LPV that attains naked eye brilliance is Chi Cygni. When at or near maximum, it becomes the fifth star delineating the body of the Swan from a dark sky site. Normally, Chi ranges from 5^{4h} magnitude to 13th magnitude, but has been observed as bright as 3rd magnitude and as faint as 14th magnitude. The average time from maximum to minimum and back is 408 days.

R Aql: 19 06 22.25 +08 13 48.0 (2000) Discovered in 1856, R Aquilae is a well-known Mira with an ever-decreasing period. It varies from 6th magnitude to 11th magnitude in a period that has shrunken from over 300 days to around 270 days currently. The fact that there are observations going back more than a hundred years has allowed this decrease in period to be discovered. There is some evidence that its amplitude may also be decreasing.

R Hya: 13 29 42.78 -23 16 52.8 (2000) R Hydrae has been observed regularly since its discovery in 1704. For decades its period remained constant at 495 days. From the 1770’s to the 1950’s the period slipped to 395 days and then suddenly stopped decreasing. The period has been steady at just under 400 days since the 1950’s. Whatever process in the evolution of R Hya that began the period decrease has apparently stopped working.

T UMi: 13 34 40.50 +73 25 56.0 (2000) Discovered in 1902, this Mira was quite happy with a stable period of approximately 316 days until the 1960's. Then something, (and who knows, it was the 60's), put this poor star into a tailspin it has yet to recover from. The current period is around 240 days with no signs of leveling off. T Ursae Minoris is also noted as being one of a handful of stars with a hump in its light curve on the descending branch. Speculation as to what causes that phenomenon remains just that…speculation.

R Leo: 09 47 33.49 +11 25 43.6 (2000) Not all Miras exhibit period changes in the existing data. Some are well behaved and perform as expected within the framework of LPV behavior. R Leo is a fairly typical Mira with a period averaging 310 days, and a range of 5.8 to 10.0. Once you have observed R Leo you will never forget the small triangle it forms with two 9th magnitude comparison stars, almost due west of Regulus. Archival observations of R Leo go back 150 years or so, including AAVSO data from the early 1900's to the present. Some of the AAVSO's most prominent observers, including Leslie Peltier, observed R Leo for their entire careers.

R Cyg: 19 36 49.38 +50 11 59.5 (2000) Discovered by Norman Pogson in 1852, R Cygni has been a staple of the AAVSO observer diet since 1902. Even a cursory look at the light curve for R Cygni will show that it does not behave like typical Miras. The maxima of R Cyg alternate between bright and fainter maxima. There is a correlation between the brightness of maxima and the time interval from the previous one. Fainter maxima occur slightly behind schedule and bright maxima rush slightly ahead of the average period. Ranging from 6.2 to 14.6v, R Cygni can be a challenge to observe when it approaches minimum. There is a 4th magnitude star parked due west in the same high power field of view. Once you get over being dazzled by the beautiful star field and contrast in magnitudes, I think you'll see why it is an all-time favorite.

T Tau: 04 21 59.43 +19 32 06.4 (2000) On the other side of the spectrum, literally, we have the unpredictable, irregular variability of T Tauri. Discovered in 1852 by J. R. Hind, T Tau is the prototype of a class of low mass, young stars that are entering stellar adolescence after condensing from a cloud of dust and gas. Their uneven light variations may arise from activity in the stellar atmosphere or from instabilities or line of sight effects of the accretion disk associated with most of the stars of this type.

R CrB: 15 48 34.41 +28 09 24.3 (2000) Another of the prototypical stars of its class, R Coronae Borealis stars are supergiants with atmospheres lacking in hydrogen and rich in dusty carbon. They spend most of their time at maximum light and then without warning will begin to fade dramatically, up to 8 magnitudes! This precipitous drop in light output is usually very steep and quick, while recovery back to pre-fade output may be a long drawn out process with several recoveries and declines before making a long, slow, steady climb back to maximum. Astronomers are keen to study R CrBs because they represent a short-lived period in stellar evolution and they create copious amounts of dust. As such they are living laboratories for studying stellar evolution and dust production in stellar atmospheres. They are favorites for observers because of their complete unpredictability and large amplitude variations.

FG Sge: 20 11 56.06 +20 20 04.4 (2000) FG Sagittae is a unique star evolving in real time before our eyes. Described in one paper as the 'Born Again" star, FG Sge is embedded in an old planetary nebula. This dying central star apparently began re-shedding its atmosphere in a steady wind in 1992. It is cooling steadily, but maintains an essentially constant luminosity in infrared, while exhibiting irregular large amplitude variations visually. It may be related to or be a form of R CrB star, based on spectral studies and models indicating a hydrogen deficient atmosphere that would strengthen its link to the R CrB class.

Z And: 23 33 39.95 +48 49 05.9 (2000) Symbiotic systems are a mixed bag of binary stars involved in a close stellar dance inside a common nebular envelope. In the case of Z Andromedae we have a cool red giant and a compact, hot, dwarf star in orbit around each other, engulfed in nebulosity. The dwarf component is accreting mass via a stellar wind emanating from the red giant. During quiescence, Z Andromedae exhibits small, irregular variations. Every 10 to 20 years the system goes into a state of increased activity and brightens by three magnitudes. These large-scale outbursts are then typically followed by a string of smaller and smaller outbursts leading eventually back to quiescence. AAVSO observers have been monitoring this activity since 1917.

CH Cyg: 19 24 33.07 +50 14 29.1 (2000) Z Andromedae may be the prototype of the symbiotic class of stars, but CH Cygni may be the most observed and researched of the 150 or so known symbiotics. CH Cygni was first thought to be a red semi-regular with an M6-M7 spectrum, 90-100 day period, and a one-magnitude amplitude. This classification fit most of the facts until 1976 when the star erupted, then faded slightly before outbursting to magnitude 5.6! This "blue outburst" state lasted ten years. In 1986 the star faded by 2.5 magnitudes, and has been declining continuously, if erratically, ever since. Recently, CH Cyg has declined from 8th magnitude to approximately 10th magnitude, so it has gone from being a binocular object to requiring a small telescope to observe. Who knows, with continued monitoring we may again witness CH Cyg approach naked eye visibility.

The history of variable stars is full of interesting stories and stellar personalities. There are many more interesting Miras, R CrB and Symbiotic stars to observe that have a rich and varied history you can contribute to. In the next issue, we'll discuss some Legacy Cataclysmic Variables and their impact on the history and development of variable star research.

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3. BOOK REVIEWS – Kate Hutton

BOOK REVIEW 1: *Variable Star* by Robert Heinlein and Spider Robinson, Tom Doherty Assoc, New York.

In case you don't know about this, if you go to the bottom of the www.aavso.org home page, you will find a link to www.amazon.com. These are my two favorite web sites, by the way. Anyway, if you order something via that on-line path, the AAVSO gets a small part of the money. Good cause, huh?

But that's not my point. My point is that the www.amazon.com page comes up having activated a search for the subject line "variable star". For most of last year, the first book on the search list was not astronomy, but science fiction: *Variable Star* by Robert Heinlein and Spider Robinson. I have no idea how many suckers there are in the AAVSO, but there is at least one. For the rest of you, here is a brief review.

It's a good book, in Robert Heinlein's young adult genre. In his early writing days, Heinlein wrote such books as *The Red Planet* and *Rocket Ship Galileo*, featuring young people coming of age in the environment of space. His later works, such as *Stranger in a Strange Land*, were more adult oriented, but those early ones are also among the classics of the sci-fi genre in general. Although *Variable Star* was just released in 2006, Heinlein died three years before that. In the preface, the story is told about detailed notes for the unwritten book, found among his papers. By popular demand from fans, Spider Robinson was recruited to develop these notes into a book. Spider Robinson is himself an excellent writer (*Telempath* for example), so it's not surprising that *Variable Star* held my attention.

The characters come to life and, especially the first-person main character, develop through the plot. Without giving too much away, I can set up the beginning scenario. A young man, at his senior prom, discovers that his fiancée is not quite as she has been representing herself. Although she expects her boyfriend to be overjoyed by the revelation, he is actually so disgusted that he goes on the mother of all drinking binges and signs onto a starship. The sort of starship that colonizes some distant world.

Life aboard the "relativistic tin can", its propulsion, and methods of communication are imaginative, entertaining, and very much Spider Robinson.

There are a few loose ends, however. First, although there is a variable star, after a fashion, directly involved in the plot, there is nothing of the science of variable stars in this book. So don't expect anything approaching

Brotherton's descriptions of SS Cyg in *Star Dragon* (which references the appropriate VSOTS in its preface). The reader is left hanging, also, as to why the destination star for the colony ship (the RSS Charles Sheffield, in case you have read *Aftermath*) is named Peekaboo. Is it an eclipsing binary, or some other variable? One never learns.

I found the ending a little sudden, arbitrary, and open ended. It's the sort of book that leaves the reader waiting for a sequel, but who's to write it? I'm sure Spider Robinson is up to the task, but his awe for Heinlein may prevent him from actually undertaking it. Only time will tell.

BOOK REVIEW 2: *From a Changeling Star* by Jeffrey A. Carver

Science fiction these days can be divided into "soft" and "hard" varieties, along the line of the boundary between fantasy and true science fiction. Fantasy normally involved at least one dragon & often some swords. Hard science fiction involves interstellar travel, nanotechnology, cybernetics, artificial intelligence, alien races, etc. Enhanced mental capability (ESP) and totally made up physics necessary for interstellar travel do not generally detract from hard science fiction, if these enhancements are described in a way that allows the reader to suspend disbelief.

From a Changeling Star is so hard that it has an iron core, although only very briefly. The star (type SRc) involved is one of the AAVSO favorites.

I would rate this book about one third good plot & characters, one third nanotechnology & enhancement to the laws of physics, one third just plain astrophysics. The protagonist is an astrophysicist. It's a fun read.

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4. VISUAL MONITORING OF TRANSIENT VARIABLES – Dr. Matthew Templeton

Variable star astronomy is a multifaceted enterprise, and everyone has their own unique reasons why they participate. Past contributors to Eyepiece Views have written about the excitement of watching stars change over a matter of a few moments at the eyepiece. Watching a dwarf nova outburst or flare in progress can be awe-inspiring, particularly when one realizes the enormous power being unleashed in a matter of minutes so many light years away from us. Others have written about the fantastic value of observations made by observers -- often months, years, and decades after the observation is made. Observing variable stars not only allows amateur astronomers to contribute to science, but to contribute to history as well. The observations you make at the telescope tonight will be of value far beyond our lifetimes. Sometimes, however, important science can come from just one person, in a moment's glance through the eyepiece.

There are phenomena that occur on very short timescales, and sometimes the greatest contribution you can make is to let the community know something is happening. Those of you who have been with the AAVSO for many years know the contributions amateur variable star astronomers have made to science, particularly in partnership with large ground- and space-based observatories. Many of you may even be personally familiar with the astronomers who build, operate, and use these facilities since many of them are AAVSO members themselves. Astronomers who use satellites like the Hubble Space Telescope, the Far Ultraviolet Space Explorer, and the Rossi X-Ray Timing Explorer have often called upon the amateur astronomical community to contribute to their research programs. Their research often involves the same objects that AAVSO observers have spent years and decades observing, and it is likely that your observations have played some part in the research that they do. And while much of this science can and will continue to be done far into the future, sometimes your dedicated monitoring and rapid responses play an even more critical role.

In order to understand the physics behind the variability we see, we have to catch these objects in the act, sometimes within minutes. But observing time on these satellites is too precious for them to stay on one target and wait for things to happen. The ideal solution is for observers on the ground to monitor these objects, and alert the satellite controllers when something exciting is happening. But like satellite time, it's often hard to schedule ground-based observatories for the large blocks of time required to monitor objects of interest. And that's where the amateur community can play its unique role; when a call for real-time monitoring of variable stars is required, visual observers are often the first ones to answer.

Visual observers have one important benefit over most other observers -- you "reduce your data" as soon as you take it! Visual estimation is a matter of comparing the variable to comparison stars in the field, and experienced observers knowledgeable of the fields they're observing can make estimates in just a few moments. Although visual estimates may be less precise and less well-calibrated than instrumental photometry, visual observers make up for this with speed, simplicity, and consistency. A visual observer with a telephone or Internet connection can literally tell the entire world within minutes of an important event, and often that is all it takes to put in motion the great observatories that view the multiwavelength sky. Your observations can provide the rapid time response so critical for getting at the heart of why variable stars do what they do.

One famous campaign in AAVSO history was organized by Dr. Janet Mattei on behalf of Drs. Chris Mauche of Lawrence Livermore National Laboratory and Peter Wheatley of the University of Leicester in 1996. Mauche and Wheatley wanted to study dwarf novae at their most energetic, in ultraviolet and X-ray light. They wanted to see what was happening close to the white dwarf's surface in those few moments when a dwarf nova outburst first begins. To do so they asked for time on the Rossi X-Ray Timing Explorer and the Extreme Ultraviolet Explorer Satellites to observe the famous SS Cygni. But they wanted to catch SS Cyg "in the act" of an outburst, to observe those few short hours when the outburst first turns on. To do that, they needed the amateur community to provide the continuous coverage and rapid notification they needed to make their observing program work. Through the work of Dr. Mattei, Elizabeth Waagen and the AAVSO staff, and you the observers, Mauche and Wheatley were able to trigger satellite observations of SS Cygni within just a few short hours of SS Cyg first entering an outburst. These observations showed very complicated behavior in the ultraviolet and X-ray regions of the spectrum, and shed light on the physics of these energetic objects. The results of their observations and yours were published in Monthly Notices of the Royal Astronomical Society in 2003, where you can see your visual observations plotted against the X-ray and ultraviolet data.

The campaign on SS Cygni was just one of many over the years. Others have included: monitoring of Sloan Survey dwarf novae to enable HST to observe them safely in quiescence; monitoring of CVs for coincident observations by the IUE, EUVE, ASCA, ORFEUS-SPAS, and Astro-2 satellites; and monitoring of R CrB and R CrB stars in partnership with IUE and Kitt Peak observers. Visual observers have played a unique and vital role in cutting-edge science programs, and continue to do so today. Right now, AAVSO observers world-wide are being asked to provide monitoring and rapid notification of dwarf nova outbursts to trigger radio observations with the Very Large Array and MERLIN radio telescopes. Your observations may prove vital in this enterprise, and all AAVSO observers are encouraged to participate in this and other observing campaigns. Your dedication, enthusiasm, and skill are key to their success.

Clear skies & good observing

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5. SIDERAL TIME - Tim R Crawford

Sidereal (pronounced, Sigh-dear-ee-uhl) time is based upon a Sidereal day, which is the time it takes the earth to make one rotation and return the stars to the same place in the sky. The PEP manual (Jeff Hopkins) defines the local Sidereal time (LST) as: “the instantaneous hour angle of the Vernal Equinox”

Our "normal" (standard time) time system is really solar time and is based upon the solar day, which is the time it takes the earth to make one rotation and return the sun to the same place in the sky.

A mean Sidereal day is about 23h 56m 4.1s in length. The reason a Sidereal day is shorter than a Solar day is because the earth is also moving around the sun, as well as turning, and it must turn just a bit further each day to return the sun to the same place in the sky.

Now the really neat thing about using Sidereal time is that any given Sidereal time objects with that corresponding R.A. are passing the local Meridian (transiting).

If an object has a R.A. (right ascension) of, for example, 08h 24m 16s then we know that an object with that R.A. will transit (pass the local Meridian - imaginary line running North to South in the sky) at a Sidereal time of 08:24:16.

Depending upon the time of year, a typical location will have objects visible about three hours either side of the transit time. Using the example Sidereal time of 08:24:16 then objects from approximately a RA of 05h 24m 00s to 11h 24m 00s should be visible (unless possibly of negative declinations from mid north locations) if dark enough.

Please keep in mind that how many R.A. hours either side of an object currently passing the Meridian might be available for viewing is going to depend upon your location, the time of year, the objects declination and, most importantly, Darkness.

A few of the options available for us to know the Sidereal time include the following:

Local Sidereal time is readily available with a freeware program for PeeCee's, titled "Astronomer's Digital Clock:"

http://users.zoominternet.net/~matto/

This software "tool" also shows the UT time and the Julian date along with other useful information.

The observing list program, "Astroplanner," also lists local Sidereal time as well as the objects coordinates, altitude and time of transit and will let you alter the time and date to a future period along with a lot of other useful information about your target [I am a long time user and big fan of this software, which runs on both the Mac and PeeCee as well as connecting to most scope platforms]:

www.ilangainc.com/ASTROPLANNER/

In addition, there is at least one manufacture, BRG Precision Products, that manufactures clocks that show and maintain the local Sidereal time:

www.brgprecision.com/opsc.html

Another solution to knowing and being aware of the Sidereal time is to simply purchase a "military" style 24 hour clock to hang on the wall (which will require time adjustments) similar to two of the models on this link:

www.franklinclock.com/franklinquartz.htm

I did purchase one of these 24 hour clocks so I could have something large hanging above my computer desk; but ,every few days I have to re-adjust the clock to current local Sidereal time, which advances about four minutes faster than solar time each day (I use the Astronomer's Digital Clock pgm for this purpose).

Knowing that local Sidereal time provides us with the Right Ascension of all Celestial Objects transiting (crossing the local Meridian) enables us to then estimate which variable star objects we can plan on observing during a given nights session

As an additional example, as I write this the local Sidereal time is about 01:30:00. As local PST is about 4:30pm I know that if I have a clear sky tonight that at the estimated dark time of 7:00pm, which is 2.5 hours from now that the local Sidereal time will then be about 04:00:00 which means that all objects with a R.A. of approximately 04h 00m 00s will then be crossing the Meridian (transiting).

This also tells me that when I open objects with a R.A. of about 01h 00m 00s could still be visible in the West (possibly excepting those with negative or very low declinations from my mid northern latitudes) while objects with a R.A. of about 07h 00m 00s could be visible in the East.

If I were to then stay open until 1AM PST I could project from the current 1:30:00 Sidereal time (and PST of 4:30PM) that when I closed objects with a R.A. of about 10h 00m 00s would be passing the meridian which would also tell me that I could have access to objects, at that time, with R.A.'s of from about 07h 00m 00s to 13h 00m 00s.

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6. THE STARS BELOW – Kate Hutton

There are magnitudes and then there are magnitudes.

Of course, we all know visual magnitude, apparent magnitude, absolute magnitude, bolometric magnitude, and so forth. How about Richter magnitude?

Come again!?

Aside from both astronomical and seismological magnitudes both being logarithmic scales, how could the two be related? They are about as opposite as you can get, with larger earthquakes and fainter stars both having the higher numbers assigned to them.

Recently, however, I have learned that there may have been a closer historical connection than one might think. Susan Hough has recently published a biography of Charles Francis Richter, going by the title of *Richter's Scale: Measure of an Earthquake, Measure of a Man*. Her approach is mainly psychological, with a minor in scandal, which is not hard as both Charles and his wife Lillian were poets, nudists, and free thinkers a few decades ahead of their time. (If you are now curious, go read the book.) However, on p. 14, I gleaned something subtler, maybe an insight into the historical origin of earthquake magnitude.

It turns out that an introverted, young transplant from Ohio did not have a lot of friends in crowded Los Angeles, so he looked upwards for companionship of sorts.

The teenage Charles Richter was a variable star observer!

A quick inquiry with AAVSO headquarters got me the following information: observer "RCF" contributed 7,260 estimates from 1914 through 1917!

Even for a stereotypically intense, focused, fanatic "variable star fiend", that is well more than a respectable total. For a teenager, it's pretty much incredible. Assuming a period of four years with some clear weather every week, it means he would have had to carry 35 stars on his observing list in any given season. I know some adults who do that, but most people who joined the AAVSO as teens recall having submitted only dozens of observations, not thousands.

My first thought upon reading this was, okay, there is the detail-oriented character trait that can allow someone to analyze paper seismograms with a ruler and magnifier for 50 years, and locate all the earthquakes graphically. I have done that, not for 50 years, thank goodness, but I know enough to know that not everyone can do it. It takes a certain stubbornness, maybe, and certainly a tolerance for repetitious work.

The next thought was, of course. No-one has a better gut-level relationship with magnitude than a visual variable star observer! Maybe this familiarity just came in handy later in life.

Now, here's the real kicker! He did this from his back yard in the Wilshire district, in what is now Koreatown, near the very filament in the light bulb called Los Angeles. Times change.

Richter was a young Ph.D. in theoretical physics when he was hired in 1927 by the Seismological Laboratory in Pasadena. At its beginning the "Seismo Lab" was, like Mt. Wilson Observatory, a child of the Carnegie Institution. Caltech only took it over in 1934. In Richter's early days on the job, he found the first seismographic stations just being installed. His job was the data analysis. By 1932, five seismic stations existed (at Pasadena, Mt. Wilson, Santa Barbara, Riverside, and Haiwee Reservoir). Operations were smooth enough and clocks accurate enough to start routinely locating the earthquakes and publishing a historical catalog of said earthquakes. The problem was, as with stars I guess, how does one denote the different sizes in the catalogs? Sue Hough suggests that it was the Seismo Lab's director Beno Gutenburg, an import from Germany, who suggested using logarithms. In any case, logarithms make sense for any application where values range over several orders of magnitude (so to speak). We will never know the relative importance of Gutenburg versus the AAVSO, because Richter never apparently commented about it, but in any case he jumped right in with a famous 1935 paper called "An Instrumental Earthquake Scale". Gutenburg collaborated on later papers extending and generalizing the resulting magnitude scale.

Richter could have labeled each earthquake in the catalogue small, medium, or large (or extra-extra-large?). Or he could have defined arbitrary categories, as meteorologists now do with hurricanes. But he didn't. He used magnitude.

Unlike stellar magnitude, earthquake magnitude was instrumental from the start. The humanly perceptual side of earthquakes was already covered by various "intensity" scales, the level of which was determined by what people reported feeling and how much damage there was at a particular location. Intensity fills the role of apparent magnitude, but was and is based on arbitrary categories and not logarithms.

Richter's instrumental scale filled the role of absolute magnitude and was based on logarithms. These two fundamentally different scales confuse students even today.

One key to Richter's success was the recently invented Wood-Anderson torsion seismometer, one of the world's first small, even portable, and also accurate instruments for recording small local earthquakes. Most seismographs up until that time weighed tons and were designed to record long-period waves from distant world-wide earthquakes. If ever there was a device that fitted the public perception of "the Richter scale", it was the Wood-Anderson seismometer. Each of southern California's new stations had two, one for north-south motion and one for east-west motion.

One could say that the Wood-Anderson was the "1P21" of seismology, but historically is probably should be the other way. The "1P21" (the photomultiplier tube that gave birth to the UBV color system) was the Wood-Anderson of astronomy.

Basically, if the quake he was analyzing originated 100 km away from the Wood-Anderson seismometer and the peak amplitude on the record was 1 mm, the quake was a 3.0. By definition. If the peak amplitude was 10 mm, it was a 4.0, and so on. If the quake was not obliging enough to locate itself 100 km from the station, there was an empirically determined attenuation function to correct for that, which covered geometric spreading of the waves, absorption, and scattering. This was Richter's scale, now known to seismologists as "local magnitude" or ML.

The magnitude scale was such a success that it spawned many others, for larger quakes, more distant quakes, different instruments, and so forth. All were calibrated to match the Wood-Anderson at 100 km as best as was possible. Today, the most highly regarded of these is the so-called "moment magnitude" or Mw, which is actually based on physics (more or less "how much rock moved how far") and is computed from recordings by broadband, high-dynamic-range digital seismometers. Even moment magnitude, however, is calibrated so that it's a pretty good match with ML on a southern California earthquake in the applicable size range.

The only problem with moment magnitude is that it usually does not work very well for local quakes smaller than about 4.0. The relatively long-period waves needed are pretty much lost in the Earth's ambient noise. So guess what gets used for the small quakes! The output of the broadband seismometer is convolved with the response function of the Wood-Anderson seismometer and the peak amplitude is used to compute the local magnitude! At least this is the way we do it in southern California, where we have a very long history of consistent use of ML.

If anyone tries to tell you that modern seismologists don't use the Richter scale, you now know better.

And you also have at least read that the Richter scale may trace part of its origins back to an obscure organization of … you fill in the blank.

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7. WHAT'S IN A NAME? PART DEUX – Mike Simonsen

The following is an updated, reorganized and more complete version of an article originally published in Eyepiece Views, July, 2002.

The conventional system for naming variable stars is archaic, but has served us for over 150 years now.

In order not to get variables confused with stars assigned Bayer lower case letters a-q, Friedrich Argelander began naming variables with the letters R-Z. After those were used up RR-RZ, SS -SZ, etc. were assigned. Then they start over with AA-AZ, BB-BZ, etc. all the way to QZ (skipping the J's). This allows for 334 names. After the letters are used up the stars are simply named V335, V336, V337 and on and on.

As if that weren't confusing enough, there are now a host of other prefixes and numbers assigned to variable stars and objects. The following is a guide to help the reader understand what these names mean and where they came from.

NSV xxxxx - These are stars in the Catalog of New and Suspected Variable Stars, produced as a companion to the Moscow General Catalog of Variable Stars (GCVS) by B.V. Kukarkin et al. All stars in the NSV have reported but unconfirmed variability, in particular, lacking complete lightcurves. Some NSV stars will eventually prove truly variable; others will be spurious. Information about this and the General Catalog of Variable Stars can be found at:
http://www.sai.msu.su/groups/cluster/gcvs/gcvs/intro.htm

Many stars and variable objects are assigned prefixes based on astronomer, survey or project names. Many are temporary designations until they are assigned a conventional name in the GCVS.

3C xxx - These are objects from the Third Cambridge (3C) catalog (Edge et al. 1959), based on radio-wavelength observations at 158 MHz. There are 471 3C sources, numbered sequentially by right ascension. All 3C sources are north of -22° declination. The 3C objects of interest to variable star observers are all active galaxies (quasars, BL Lacs, etc.).

Antipin xx- Variable stars discovered by Sergej V. Antipin, a junior researcher working for the General Catalogue of Variable Stars Group.

HadVxxx - This represents variables discovered by Katsumi Haseda. Haseda's most recent discovery was Nova 2002 in Ophiuchus, V2540 Oph.

LD xxx - Variables discovered by Lennart Dahlmark, a Swedish retiree living in southern France are given this prefix. Dahlmark has been conducting a photographic search for new variable stars; discovering several hundred to date.

He-3 xxxx - Variables from Henize, K. G. 1976, "Observations of Southern Emission-Line Stars", Ap.J. Suppl. 30, 491.

HVxxxxx - Preliminary designations of variables discovered at Harvard Observatory.

Lanning xx - Discoveries of UV-bright stellar objects by H. H. Lanning from Schmidt plates centered primarily on the galactic plane. In all, seven papers entitled "A finding list of faint UV-bright stars in the galactic plane" were published.

Markarian xxxx - These are active galaxies from lists published by the Russian astrophysicist B.E. Markarian. Markarian looked for galaxies that emit unusually strong UV radiation, which comes from either pervasive star-formation HII regions or from active nuclei. In 1966, Markarian published 'Galaxies With UV Continua'. Around that time, he started the First Byurakan Spectral Sky Survey (FBS), which is now completed. In 1975, Markarian initiated a Second Byurkan Survey (SBS). The SBS was continued by his collaborators after his death.

For more information see ‘Active Galactic Nuclei’, by Don Osterbrock,
http://nedwww.ipac.caltech.edu/level5/Osterbrock3/Oster_contents.html

MisVxxxx - The stars are named MisV after MISAO Project Variable stars. The MISAO Project makes use of images taken from all over the world, searching for and tracking astronomically remarkable objects. The number of variables discovered so far reached 1171 on May 15, 2002. Few of these stars have lightcurves, and the type and range of many are still undetermined. The project website url is:
http://www.aerith.net/misao/

S xxxxx - These are preliminary designations of variables discovered at Sonneberg Observatory.

SVS xxx - Soviet Variable Stars, indicates preliminary designations of Soviet-discovered variables.

TKx - TK stands for T.V. Kryachko. The TK numbers of new variables continue a numbering system first introduced in Kryachko and Solovyov (1996). This acronym was invented by the authors.

Another group of objects is labeled with the prefix O, then a letter, then a number (OJ 287 for example). These objects were detected by the Ohio StateUniversity radio telescope "Big Ear" in a series of surveys known as the Ohio Surveys.
http://www.bigear.org/ohiosurv.htm

Many variables are named with prefixes associated with surveys or satellites, combined with the coordinates of the object.

2QZ Jhhmmss.s-ddmmss - Objects discovered by the 2dF QSO Redshift Survey.
The aim is to obtain spectra of QSOs out to redshifts so high the visible light emitted by these objects has shifted into the far infrared. The observations are actually of the ultra-violet part of the spectrum that has been redshifted into the visible. As with most QSO surveys, a serendipitous byproduct is the discovery of CVs and other blue stars.
A description and awesome pictures of the equipment can be found here:
http://www.2dfquasar.org/Spec_Cat/basic.html
Home site:
http://www.2dfquasar.org/index.html

ASAS hhmmss+ddmm.m - This is the acronym for All Sky Automated Survey, which is an ongoing survey monitoring millions of stars down to magnitude 14. The survey cameras are located at the Las Campanus Observatory in Chile, so it covers the southern sky from the pole to about +28 degrees declination.
http://archive.princeton.edu/~asas/

FBS hhmm+dd.d - Stands for First Byurakan Survey and the coordinates of the object. The First Byurakan Survey (FBS), also known as the Markarian survey, covers about 17,000 square degrees.

EUVE Jhhmm+ddmm - These are objects detected by NASA's Extreme Ultraviolet Explorer, a satellite dedicated to studying objects in far ultraviolet wavelengths. The first part of the mission was dedicated to an all-sky survey using the imaging instruments that cataloged 801 objects. Phase two involved pointed observations, mainly with the spectroscopic instruments. One of the highlights of the mission was the detection of Quasi Periodic Oscillations (QPOs) in SS Cyg.
http://heasarc.gsfc.nasa.gov/docs/euve/euve.html

FSVS Jhhmm+ddmm - Discoveries from the Faint Sky Variability Survey, the first deep wide-field, multi-color, time-sampled CCD photometry survey. It was specifically aimed at detecting point sources as faint as 25th magnitude in V and I and 24.2 in B. Targets were faint CVs, other interacting binaries, brown dwarfs and low mass stars and Kuiper Belt Objects.
http://www.psi.edu/~everett/fsvs/

HS hhmm+ddmm- The Hamburg Quasar Survey is a wide-angle objective prism survey searching for quasars in the northern sky, avoiding the Milky Way. The limiting magnitude is approximately 17.5B. The taking of the plates was completed in 1997.
http://www.hs.uni-hamburg.de/DE/For/Exg/Sur/hqs/index.html

PG hhmm+DDd- Palomar Green Survey conducted to search for blue objects covering 10714 square degrees from 266 fields taken on the Palomar 18-inch Schmidt telescope. Limiting magnitudes vary from field to field, ranging from 15.49 to 16.67. The blue objects detected tend to be quasars and cataclysmic variables. The CVs were documented in Green, R. F., et al. 1986, "Cataclysmic Variable Candidates from the Palomar Green Survey", Ap. J. Suppl. 61, 305.

PKS hhmm+ddd - This was an extensive radio survey (Ekers 1969) of the southern sky undertaken at Parkes (PKS), Australia, originally at 408 MHz and later at 1410 MHz and 2650 MHz. These sources are designated by their truncated 1950 position. For example 3C 273 = PKS 1226+023. This is still the most common, and useful, system of naming quasars.

ROTSE1 thru 3 Jhhmmss.ss+ddmmss.s - The Robotic Optical Transient Search Experiment (ROTSE) is dedicated to the observation and detection of optical transients on time scales of seconds to days. The emphasis is on gamma-ray bursts (GRBs). Objects detected by this survey are designated with positions to 0".1 precision.
http://www.umich.edu/~rotse/

ROSAT is an acronym for the ROentgen SATellite. ROSAT was an X-ray observatory developed through a cooperative program between Germany, the United States, and the United Kingdom. The satellite was designed and operated by Germany, and was launched by the United States on June 1, 1990. It was turned off on February 12, 1999.

Prefixes for x-ray sources detected by ROSAT include, 1RXS, RXS and RX. The J2000 coordinates for the source are then stated according to the accuracy of the X-ray position and the density of stars in the field.
arcsecond accuracy ---> RX J012345.6-765432
tenth-arcmin accuracy ---> RX J012345-7654.6
arcmin accuracy ---> RX J0123.7-7654

Distressingly, these can all refer to a single object!

Rosino xxx or N xx - Variables discovered by Italian astronomer L. Rosino, primarily in clusters and galaxies through photographic surveys.

SBS hhmm+dd.d - Indicates objects discovered by the Second Byurakan Sky Survey, plus the coordinates of the object.

SDSSp Jhhmmss.ss+ddmmss.s - These are discoveries from the Sloan Digital Sky Survey. The positions of the objects are given in the names. SDSS- (Sloan Digital Sky Survey), p- (preliminary astrometry), Jhhmmss.ss+ddmmss.s (the equinox J2000 coordinates). In subsequent papers on CVs detected by SDSS (Szkody et al) the p was dropped and the names became simply SDSS Jhhmmss.ss+ddmmss.s.

TAV hhmm+dd - The Astronomer Magazine, in England, has a program that monitors variable stars and suspected variable stars. TAV stands for The Astronomer Variable, plus the 1950 coordinates.

TASV hhmm+dd - TASV stands for The Astronomer Suspected Variable, plus the 1950 coordinates. The Astronomer Variable star page can be found at this url:
http://www.theastronomer.org/variables.html

XTE Jhhmm+dd - These are objects detected by the Rossi X-Ray Timing Explorer Mission. The primary objective of the mission is the study of stellar and galactic systems containing compact objects. These systems include white dwarfs, neutron stars, and possibly black holes.
http://xte.mit.edu/

With more and more surveys being conducted, and more new variables being discovered, this list of non-conventional names will undoubtedly grow. I hope this explanation has helped to demystify the existing names and prepares you for the onslaught of names yet to come.

There is a CDS Web page where you can find details about specific acronyms.
http://vizier.u-strasbg.fr/cgi-bin/Dic

The GCVS also has a list of catalog abbreviations-
http://www.sai.msu.su/groups/cluster/gcvs/gcvs/abbrev.txt

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Good observing!

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