Star Hopping

By Art Russell

It wasn't too long ago that only the largest telescopes, typically in a permanent installation, had setting circles accurate enough to assist in location of deep sky objects. Certainly, many amateur telescopes had analog setting circles, but because of poor design, poor understanding of their use, and an all too often poor polar alignment, they typically contributed to many hours of frustration, instead of serving as an aide to observation. However, within only the last ten years or so, inexpensive digital setting circles and computer-controlled telescopes have become commonly available. Indeed, it's often difficult to find an observing field without some form of computer assisted telescope. However, I'd like to suggest that the art of star-hopping is not dead. Indeed, if anything, its mastery is more important than ever.

So Why Star-Hopping?

Star-hopping offers the deep sky, and even an outer planets (Uranus, Neptune and Pluto) or comet observer, a convenient method to locate their desired target without computer mediated assistance. More importantly, star-hopping offers the best way to provide the deep sky observer with an understanding and familiarity with the night sky that can only be gained as one spends time under the stars.

Once learned, star-hopping is much like riding a bicycle, you never forget. As such, it remains a valuable tool long after it was mastered. Never quite forgotten, it is quickly recalled by those whose electronic wonder of a digital setting circle or computer-controlled telescope conveniently fails at just the wrong time as they are enroute to a particularly interesting object. Count on it. Murphy's Law was written by an amateur astronomer.

More over, for many objects in a given evening, the experienced star-hopper has often already found and observed many of prominent deep sky objects before a computer mediated scope can be set up and brought to the proper field of view for the evening's first object in that telescope.

Basic Requirements

Lets be honest. Star-hopping is not for the faint of heart. Like any new skill, it takes time, perseverance and practice. If you aren't a self starter and willing to take the steps necessary to learn how to star-hop, and aren't interested in discovering the secrets of the night sky only available as one takes time under the heavens, star-hopping may not be for you. However, it is certainly not a new subject, having been the subject of numerous articles in any number of astronomy magazines [1, 2, 3].

The first requirement that any star hopper needs is a basic understanding of each seasons' prominent constellations. If you can find the major constellations and their brighter stars, you can use them to find the lesser known constellations [4]. Moreover, its also a pleasure to recognize old friends who've been absent for the season as they first rise from the eastern horizon. It also provides the opportunity to relearn those constellations they've forgotten during their absence and learn a few new ones each season as well. The bottom line is to use the constellations and bright stars that you do know as a stepping off point to find those constellations and stars that you don't know. Most importantly, its by knowing where the constellations and their prominent stars are located, that you can locate any deep sky object.

Equipment

Naked eye star-hopping. One of the first questions often asked by beginning star-hoppers is "What kind of equipment do I need?" Fortunately, the answer is very simple for most people because we are already prepared to be superlative star-hoppers. All you need is your eyes, arms and fingers to do basic star-hopping. Without optical aides, you can find many naked eye deep sky objects under dark skies. Describing locations of objects to others is often problematic. This is because how I see the sky is not exactly how you see the sky unless we have a common reference. However, using the same references of distance, such as the width of a finger, hand, or fist held at arms length (see Table 1), we can describe the location of objects in terms easily understood by all participants. Determining the direction is also easy if we use a common reference in addition to constellations and prominent stars. One of the most common references is to use a "clock" reference for the direction to or from an object (example: it is located 2 finger widths away at the 7 o'clock position from …). These methods of referencing the night skies are often useful when starting beginners in star-hopping. However, they are of little use when tracking down the many more challenging deep sky objects of interest to the more experienced star-hopper. This type of star-hopping requires the use of view finders, telescopes, and other aides.

Distance spanned by the little finger	1 degree
Distance spanned by three fingers held together	5 degrees
Distance spanned by the closed fist	10 degrees
Distance spanned between the little fingerand in pointing finger when spread apart	15 degrees
Distance spanned between the little finger and thumb when spread apart	25 degrees

Table 1: Common Measures of Distance with the hand held at arm's length [5].

View finders. Most telescopes are equipped with some sort of view finder which has been collimated to the main telescope. Where the view finder points, so points the telescope. One form may be a zero-power finder typified by the "Telrad" design which projects an illuminated reticule "bullseye" pattern against the sky. Where ever the bullseye is pointed, the telescope is also pointed, allowing for quick acquisition of bright stars and deep sky objects. The other typical viewfinder is a finder scope. Very simply, a finder scope is a small, low power, wide field telescope used to aim a larger telescope at a remote object. As a general rule, most astronomers find it much easier to point a telescope using some form of aide because telescopes typically have very restricted fields of view, even when using a wide-field eyepiece. Without the use of some form of pointing device, astronomers may spend an entire evening gazing through a very capable instrument, but without ever seeing anything of interest.

Very often, the typical finder scope will be a small 6X30 (6X = 6 power = magnifies 6 times, with a 30mm objective) which most amateurs find to be too small to be of much use. Mind you, this is not to say that the 6X30 finder scope is without its uses. Mine makes an acceptable paper weight. Indeed, experienced deep sky observers will generally mount the largest possible finders on their telescopes, sometimes several, often with objectives up to and larger than 100mm (4 inches) in order to use fainter stars as an aide to tracking down more difficult deep sky objects [6]. As a general rule, when star-hopping, I'll often use both a Telrad and finder scope to take advantage of the strengths of both view finders. In this way I can quickly orient on a prominent field star close to the deep sky object of interest with the Telrad, and then switch to the finder scope to help finally zeroing in on my quarry. Stumped as to what size to consider? Nothing less than a 8X50 finder scope should be considered. They are cheap and readily available.

A final word about finder scopes, and by association telescopes and the orientation of their fields of view. You need to take the time to determine both the field of view of your finder scope and that of your telescope's eyepieces. Knowing the size of your field of view will allow you to know how much of the sky you can see with what ever combination of finder scope, telescope and eyepiece you may choose [7]. In star hopping, one typically starts with a finder scope with its wider field of view, finds the correct location, and then zeros in on the selected object with a lower powered (but typically wider field of view) eyepiece before going to higher powers for observation. A key point to note is the orientation of the field of view in your finder scope and telescope eyepieces. Very often they are different and may lead to difficulty in switching between the finder scope and the telescope. Most telescopes (remember that the finder scope is a small telescope, the Telrad not being a telescope is not a problem here) change the orientation of the image as it is magnified and passed through the eyepiece. Generally, refractors and catadioptric telescopes (Schmidt-Cassegrains) used with standard star diagonals produce mirror reversed images. Newtonian telescopes typically present inverted images. This is an important fact to remember, and when forgotten or poorly understood, has been the cause of much frustration among even experienced observers [8].

Star Charts. In amateur astronomy, much like driving a car cross-country, you are only as good as your road maps. The better the map, the better the job you'll be able to do when you try to locate your destination. Instead of mapping out terrestrial roads, star charts map out the heavens in greater or lesser detail. In a sense, you might also say there is a hierarchy of star charts. At the lower level of resolution, star charts might map out the constellations and bright stars, and often the Messier objects such as found in "Planning A Messier Marathon" [9] or in several of the popular astronomy magazines such as Astronomy or Sky and Telescope [1, 2]. In greater detail, thus offering a greater selection of deep sky objects and stars to 6th magnitude as well, is Wil Tirion's "Bright Star Atlas 2000.0 [10]. Stepping up to Wil Tirion's Sky Atlas 2000.0, represents a significant jump in detail with 43,000 stars to 8th magnitude plotted along with 2,500 non-stellar objects on 26 charts [11]. Sky Atlas 2000.0 is often the first "serious" star atlas an amateur moves into when they decide its time to really start chasing down objects beyond the "big and bright" or Messier objects. However, experienced amateurs often quickly find themselves exceeding the limits of Sky Atlas 2000.0 and needing to go farther. The next step, and arguably the current standard, is Uranometria 2000.0, which in its two volumes, charts some 300,000 odd stars to magnitude 9.5 as well as 10,300 non-stellar objects[12]. Recently, the three volume "Millenium Star Atlas" has been published with more than a million stars to 11th magnitude and about the same number of non-stellar objects as Uranometria [13]. However, at $249 for the set, a price which begins to approach that of a used 486 note-book computer, many advanced amateurs have opted instead to use one of the now popular computer sky atlases.

Computer Star Charts. Once the province of only the well heeled or drop dead serious professional astronomer working in UNIX, computer based star atlases have in many ways eclipsed the capabilities of a traditional, paper bound star atlas, in that they can be customized to meet the needs of the user. Need a customized finder chart specifically set up for your telescope and unique selection of eyepieces? Computer based star charts can offer a chart reflecting the "zoomed in" field of view of your favorite eyepiece for those instances wherein you are trying to identify the individual members of galaxy groups and clusters. Popular computer star atlas programs include "Megastar"[14], "The Sky"[15], "Pluto Guide"[16], "Earth Centered Universe"[17], and others.

Putting it all together:
Star-hopping to Pal 13

Buried beneath the "Great Square of Pegasus" is one of a series of globular clusters previously unknown until discovered by chance on photographic plates taken as a part of a National Geographic sponsored sky survey in the 1950's, the Palomar Sky Survey (POSS) [19]. Dubbed the Palomar (Pal) globular clusters, these 15 globular clusters represent some of the largest (^{3} 220 parsec diameter) and most distant (between 93 and 130 kiloparsecs) globular clusters in the galaxy [18, 20]. Taken all together, they represent an observing challenge for even the most accomplished observer.

Pal 13 is conveniently located for star-hopping near Alpha (a) Pegasi, the star marking the southeastern corner of the “Great Square of Pegasus.” However, Pal 13 may prove to be a difficult target. It is very small, only .7 arc minutes in apparent diameter. More importantly, it is relatively dim. With a 13.8 total visual magnitude, its brightest stars are less than 17th magnitude [21, 22], suggesting that even under the darkest skies it will be a difficult target and will require high power. It is here that we begin our star hop.

A quick check of Sky Atlas 2000.0 reveals that Pal 13 is not plotted. You’d have to plot its location by hand if you wanted to use Sky Atlas 2000.0. Uranometria 2000.0 is my preferred star atlas when I’m not using Megastar to prepare finder charts. Turning to the back pages of Uranometria, 2000.0, Volume 1, The Northern Hemisphere, presents an azimuthal equal area projection of the constellations superimposed over a grid representing the Uranometria’s 259 charts in Volume 1, where we find that Alpha Pegasi is located on chart 213 (Figure 1). Turning to chart 213, we find that Pal 13 is located below and slightly to the left of Alpha Pegasi (Figure 2). Here, I have superimposed an approximate 1 degree field of view, which when centered on Alpha Pegasi, just touches the star SAO 108393. By sweeping 2 more fields of view to the south, Pal 13 will appear in the field of view. Be sure to check the field stars (Figure 3), as a small galaxy, NGC 7479 is located about 1/2 degree to the southwest of Pal 13. However, at 4 X 1 arc minutes in size, it should be easily distinguishable. Additionally, an even smaller galaxy, NGC 7495, is located a little less than a degree to the southeast. Be careful in this case. NGC 7495 is about the same size as Pal 13 and about the same magnitude, so check your field stars to confirm your observation.

Well, there you have it. The nuts and bolts of star-hopping. These same basic techniques can be used to find the “big and bright,” or the “dim fuzzies.” Most importantly, unlike electronic aides, star-hopping, once mastered, will never fail.

Object	RA	Dec	Dia (')	Mag	Star Chart
Pal 13	23 06 44	+12 46.3	0.7	13.8	Uranometria 213

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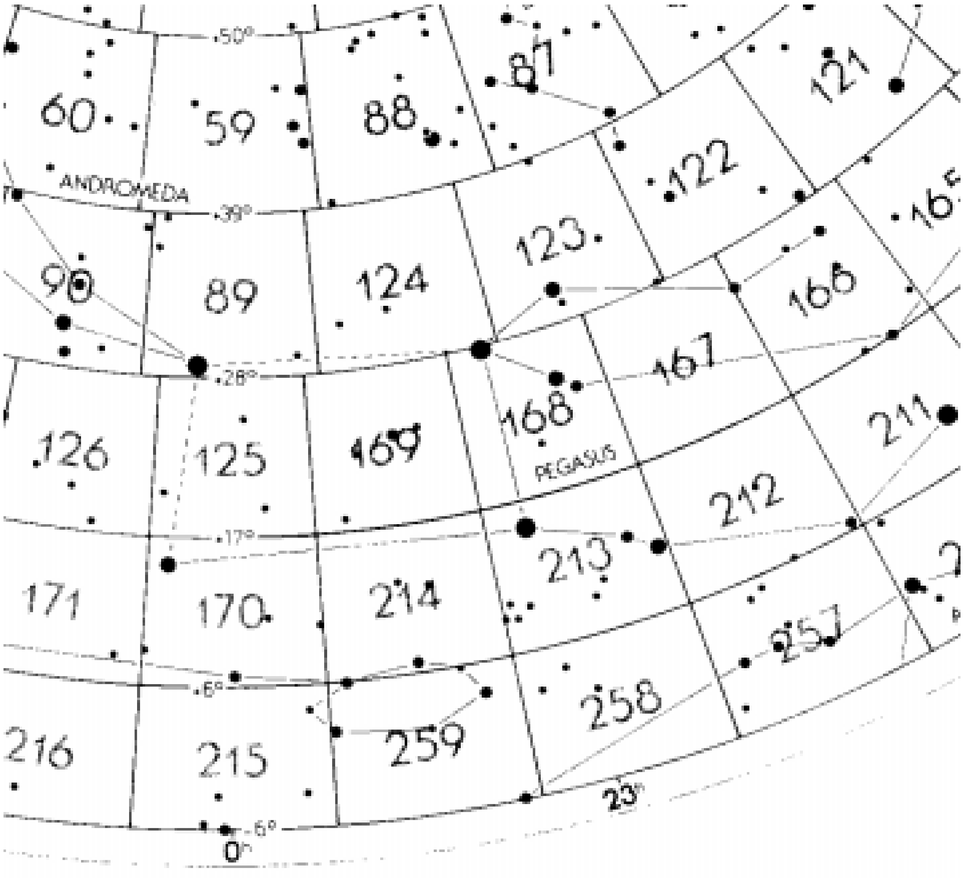

Figure 1.
Uranometria guide to charts.

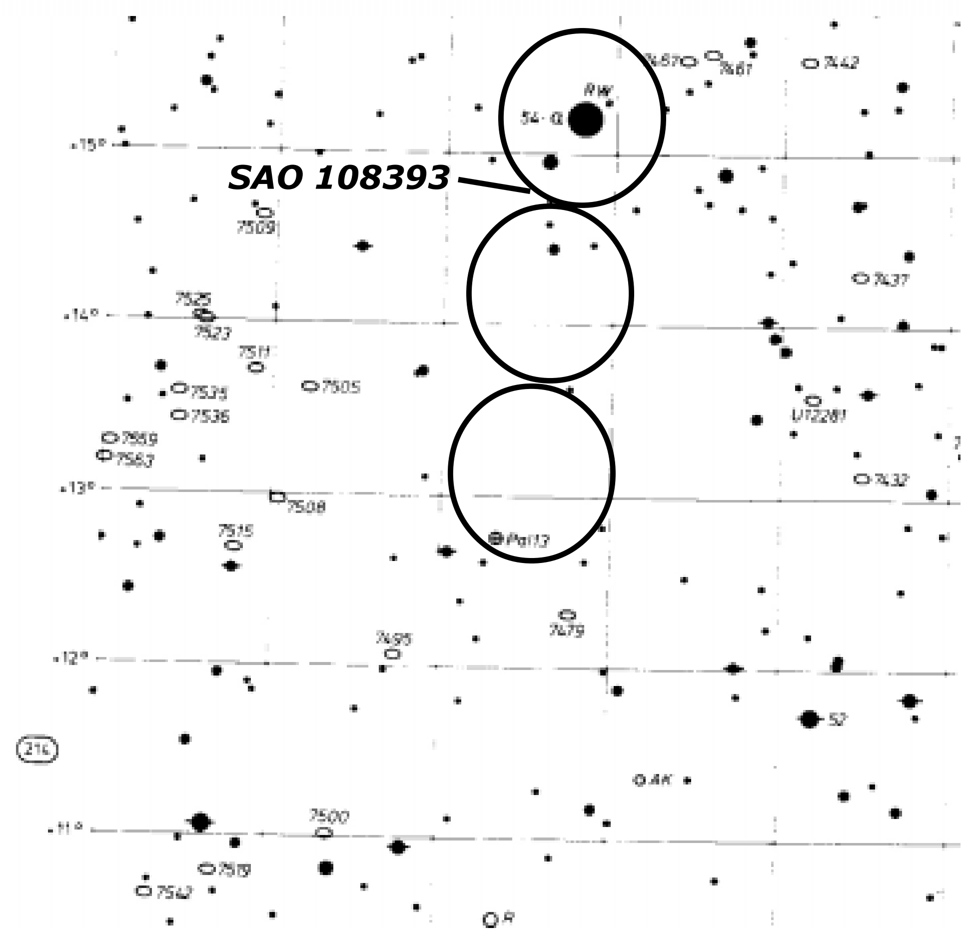

Figure 2.
Uranometria Chart 213 abstract with superimposed 1 degree fields of view.

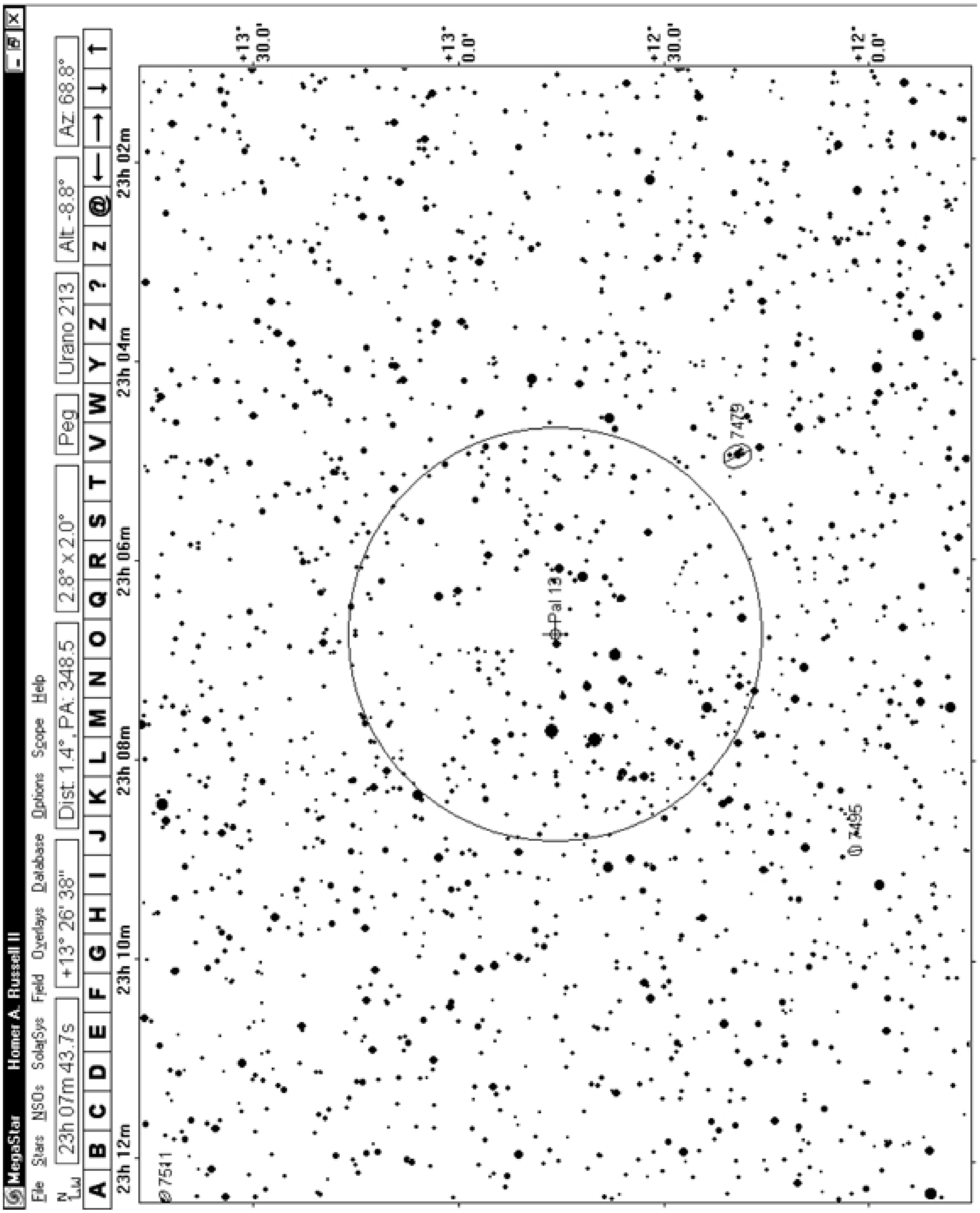

Figure 3. Megastar Finder Chart with superimposed 1 degree field of view.