Binocular Universe:

Hitting Below the Belt

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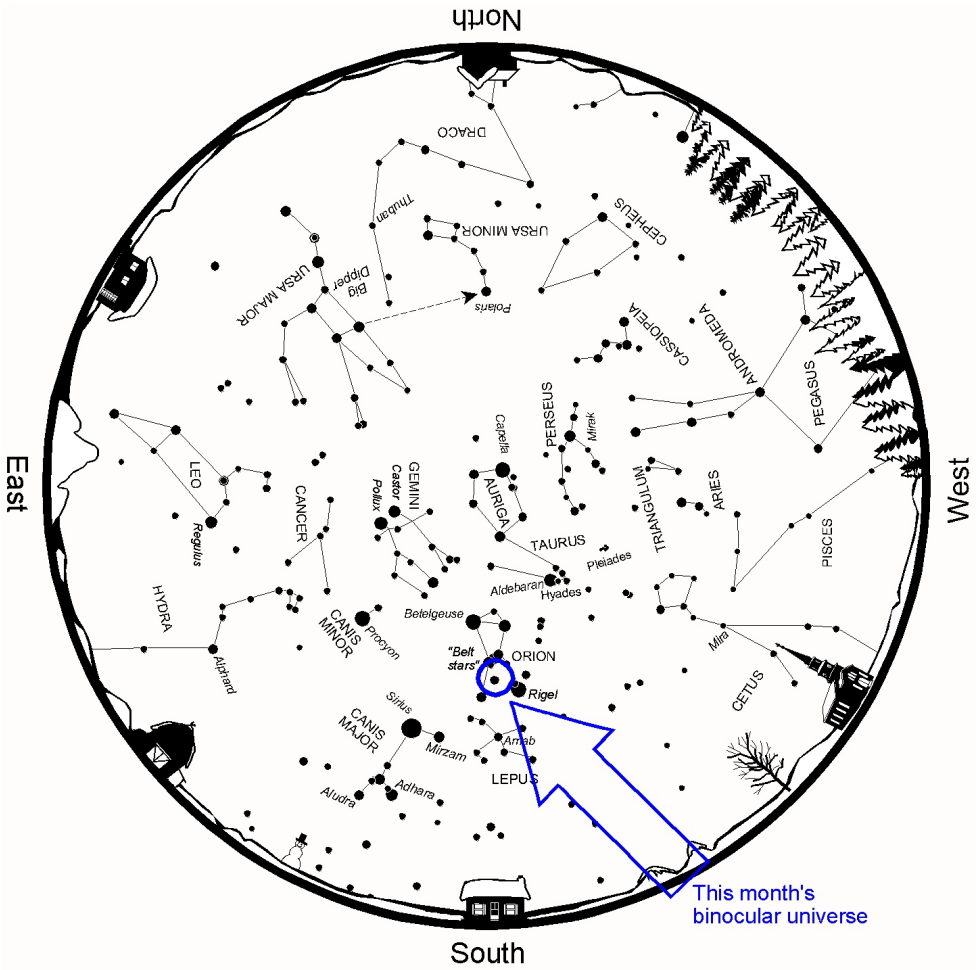
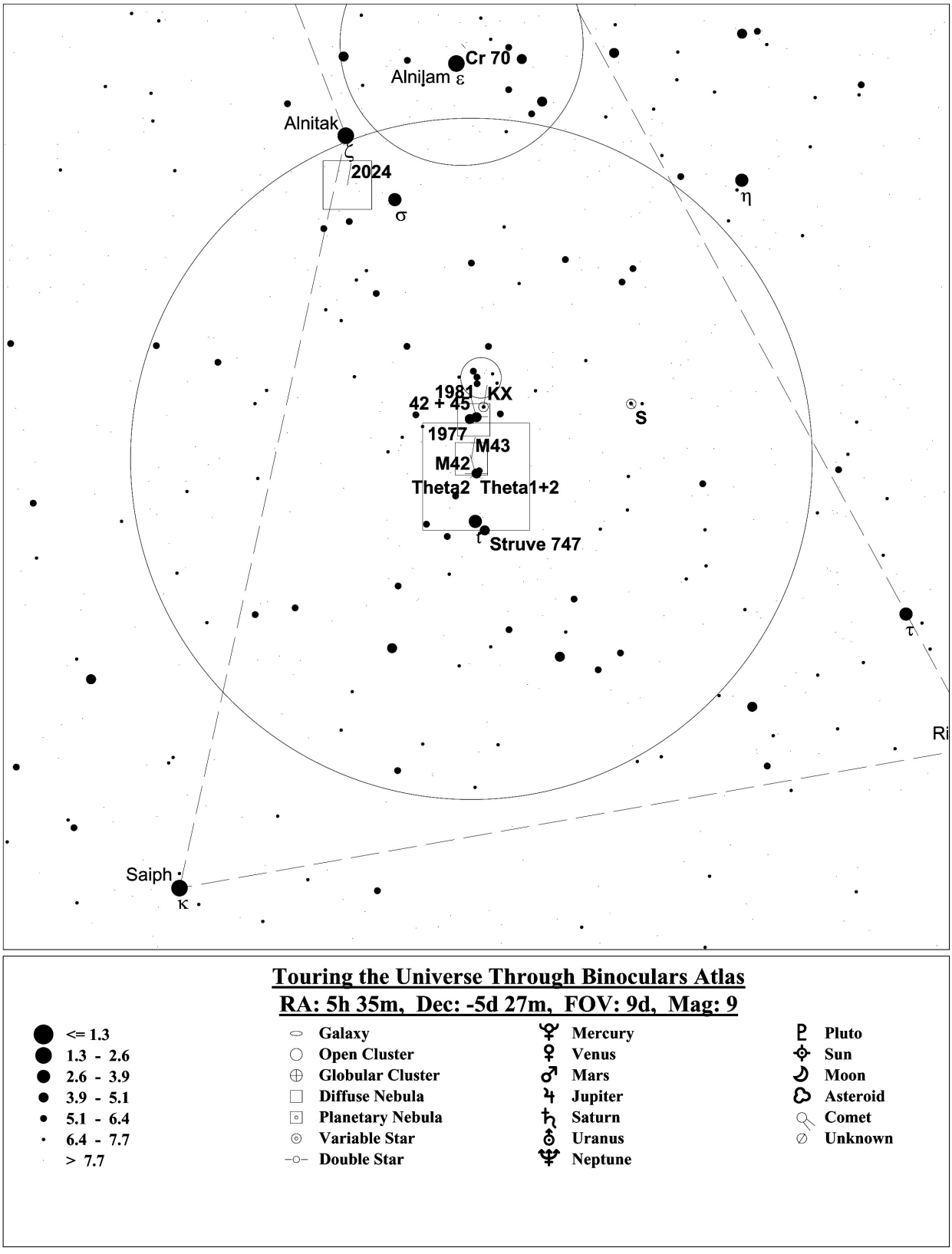
Normally, hitting below the belt is considered a low blow. But in our case this month, hitting below the belt is exactly on target. This month, we are going to visit the sword of Orion, one of the most popular binocular tourist traps in the entire sky.

To enjoy this installment of Binocular Universe, I'd recommend mounting your binoculars onto some sort of support, since you aren't going to have to move them, save for compensating for Earth's rotation.

Let's begin with everyone's favorite winter target, the **Orion Nebula, M42**. The nebula will look like a soft glow surrounding Theta-1 (θ-1) and Theta-2 (θ-2) Orionis. To the unaided eye, Theta-1 and Theta-2 combine to form the middle point in the Hunter's 3-star sword.



Winter star map from Star Watch by Phil Harrington



Touring the Universe Through Binoculars Atlas

RA: 5h 35m, Dec: -5d 27m, FOV: 9d, Mag: 9

<= 1.3	Galaxy	Mercury	Pluto
1.3 - 2.6	Open Cluster	Venus	Sun
2.6 - 3.9	Globular Cluster	Mars	Moon
3.9 - 5.1	Diffuse Nebula	Jupiter	Asteroid
5.1 - 6.4	Planetary Nebula	Saturn	Comet
6.4 - 7.7	Variable Star	Uranus	Unknown
> 7.7	Double Star	Neptune	

Finder chart for Orion's Sword. Chart from TUBA, www.philharrington.net/tuba.htm

Even the smallest pocket-size opera glass begins to unravel some of the intertwined irregularities that characterize the complex structure of the Orion Nebula. In my 10x50 binoculars, the familiar outline of the nebula is unmistakable. Even at that low magnification, M42 reminds me of an outstretched hand reaching southward and holding the Theta stars in the palm.

Continuing the hand analogy, Theta-1 sits near the tip of what looks like the outline of a finger silhouetted in front of the palm. That dark cloud is called the **Fish's Mouth**, and is visible only because it lies in front of the brighter area that lies beyond.

Theta-1 is better known to telescope viewers as the **Trapezium**, a family of four suns neatly gathered in a trapezoid. The Trapezium's stars are designated with letters (A, B, C, and D) according to their location. The system's primary star, the brightest of the bunch at magnitude 5.1, is known as Theta-1C and marks the trapezoid's southern corner. The western star (Theta-1A) and the northern star (Theta-1B) are both known to be eclipsing binaries, with a smaller companion star alternately passing in front of and behind the larger primary star. These eclipses cause both stars to vary slightly in brightness, although they usually shine at magnitude 6.7 and 7.9, respectively. Theta-1D also shines at magnitude 6.7. The four main stars in the Trapezium are stellar infants. Each has come into being between 300,000 and one million years ago. Contrast this with our own, middle-aged Sun, which astronomers tell us was created some 4.5 *billion* years ago.

What is the lowest magnification that can resolve all four? I'd be interested in finding out. I tried for myself recently and found that my 10x and 12x binoculars show that Theta-1 is not a perfect point, but I could not resolve the stars themselves.

To find out what others think, I recently put forward this question on the Cloudynights Binocular Forum and received many replies. You can read them all here. The general consensus was that 20x is likely the lowest power that will show all four, since the group's faint northwestern star, Theta-1B, is just 9" from Theta-1A. Forum members reported seeing three of the stars at 15x-18x, which mirrors my own experiences. How about you? Post your observations in that thread and see how they compare with your fellow binocularists.

Just north and slightly east of M42 is a second, much smaller puff of nebulosity that Charles Messier cataloged separately as **M43**. Even 10x binoculars can separate it from M42. Look for a small, circular patch around the 8th-magnitude star SAO 132328. Look carefully through giant binoculars 20x and up, and you may notice that M43 is not perfectly symmetrical. Instead, it looks like a comma hooking toward the north. In reality, M43 is an extension of the Orion Nebula and only looks "separated" because of a rift of dark nebulosity slicing between the two.

The Orion Nebula is the sky's best-known example of an emission nebula or hydrogen-II region. Think of it as a stellar maternity ward. Hidden among the

tufts and eddies of nebulosity, protostars are rotating and compressing as they continue on the road to stardom. The stars of the Trapezium are among the youngest, hottest suns visible through backyard telescopes, but there are more stars within the Orion Nebula than meet the eye. Buried inside, a cluster of 1,000 stars remains obscured behind clouds of opaque dust. They are only visible in infrared images, which can penetrate the dust.

Left: The skilled eye and talented hand of Rony De Laet sketched this wonderfully realistic view of Orion's sword through 15x70 binoculars. Visit his web site for more of his superb sketches.

Ultraviolet radiation from these hot, newly born stars, in turn, *ionizes* the surrounding atoms of hydrogen gas by breaking the bonds between the atoms' nuclei and the circling electrons. When hydrogen is ionized, the neutral atom is split into a positive hydrogen ion (a proton) and a free electron. That free electron won't stay free for long, however. Instead, it will be captured by another hydrogen ion to form neutral hydrogen once again. In the process, the hydrogen gas emits red (called hydrogen-alpha) and green (hydrogen-beta) light. In a sense, M42 is a cosmic neon sign, since the process that causes it to glow is very similar to what happens as electrical current passes through a neon sign here on Earth.

The brightest star in the sword is 3rd-magnitude **Iota (ι) Orionis**. Iota is also known by the proper name **Na'ir al Saif**, Arabic for "the Bright One in the Sword." Iota marks the sword's sharp southern tip and forms a very pretty binocular pairing with 4th-magnitude **Struve 747** to its southwest. If you have a good eye, you may notice that Struve 747 is actually a true binary star in its own right. Just over half an arc-minute separates the 4.8-magnitude primary star from its 5.7-magnitude companion. Together, these blue-white sparklers make a great resolution test for 8x and lower power binoculars.

The sword's handle, set north of M42, is actually a wide pair of 5th-magnitude stars. Both **42 Orionis** and **45 Orionis** are separated through just about any pair of binoculars from just about anywhere on Earth.

Just to the north of 42 and 45 Orionis is a faint scatter of stars known as **NGC 1981**. Many of us have probably looked right past this little-appreciated open cluster while ogling M42 without ever knowing it. The three brightest stars in the group form a distinctive arc, with a fourth star just to the east completing the allusion of a pyramid. A few fainter points to the west also belong to the group, bringing the total number of stars visible through my 10x50s to ten.

Wow, hard to believe that all of this is crammed into just one field of view. It's enough to make me forget just how cold it is, and grab those binoculars for a night under the stars. How many of the objects listed here can you find through your binoculars?

This month's binocular universe:

Object	Con	Type	R.A. (2000)	Dec	Mag	Size/Sep/ Period	Notes
S	Ori	Vr	5 29	-4 42	7.5-13.5	419.20 days	Long Period Variable
Struve 747	Ori	**	5 35	-6 0	4.8,5.7	36"	223°;4182
KX	Ori	Vr	5 35.1	-4 44	6.9-8.1p		Irregular
1981	Ori	OC	5 35.2	-4 26	4.6	25'	*TUB page 192*
42 + 45	Ori	**	5 35.4	-4 50	4.7,5.3	6'	
Theta1+2	Ori	**	5 35.4	-5 25	4.9,5.0	135"	*TUB page 192* 314°;4188;(Theta1=Trapezium
Theta2	Ori	**	5 35.4	-5 25	5.2,6.5	52"	*TUB page 192* 92°;4188
M42	Ori	DN	5 35.4	-5 27	2.9	66'x60'	*TUB page 192,193* NGC 1976 Orion Nebula!
1977	Ori	DN	5 35.5	-4 52	4.6	20'x10'	
M43	Ori	DN	5 35.6	-5 16	6.9	20'x15'	*TUB page 192-194 NGC 1982 NW part of M42
Cr 70	Ori	OC	5 36	-1 0	0.4	150'	*TUB page 194* Belt stars
2024	Ori	DN	5 40.7	-2 27		30'x30'	

Have a question, a comment, or a suggestion for future columns? I'd love to hear it. Drop me a line at phil@philharrington.net .

Next month, we return to enjoy more of the magnificent winter sky, but until then, remember that two eyes are better than one.

About the Author:
Phil Harrington is the author of Touring the Universe through Binoculars. Visit his web site at www.philharrington.net