Orion & Lepus, circa 1720

Atlas Charts

Charts

Objects *by* Constellation

Objects

Introduction

The night sky was charted by western civilization a few thousands years ago to bring order to the random splatter of stars, and in the hopes, as a piece of the puzzle, to help "understand" the forces of nature. The stars and their constellations were imbued with the beliefs of those times, which have become mythology.

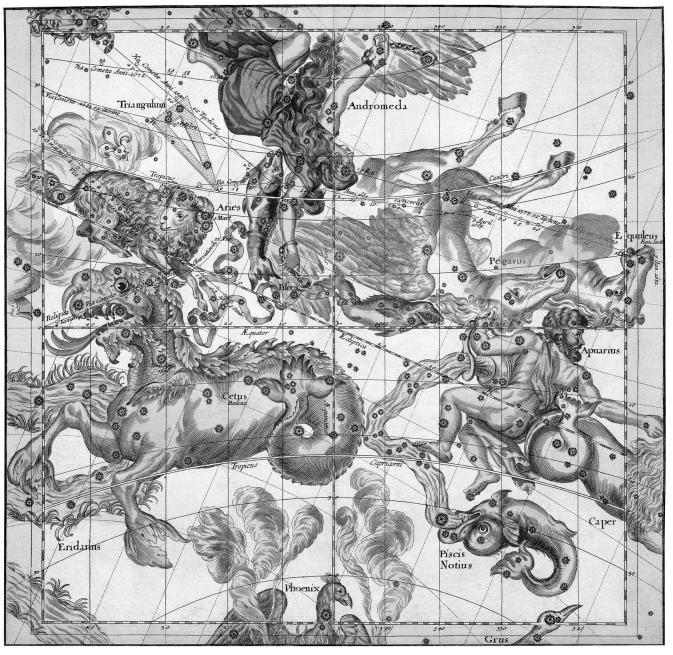
The oldest known celestial atlas is in the book, *Almagest*, by Claudius Ptolemy, a Greco-Egyptian with Roman citizenship who lived in Alexandria from 90 to 160 AD. The *Almagest* is the earliest surviving astronomical treatise—a 600-page tome. The star charts are in tabular form, by constellation, and the locations of the stars are described by the mythological part that they represent. For example, Castor, in Gemini, is described as, "The star on the head of the advance twin." This atlas was built on the foundations of traditions.

One of the first substantive celestial atlases featuring charts of stars was the 1603, *Uranometria* (roughly translates as, Measuring the Sky) by the German, Johann Bayer. His 51 charts included drawings of the mythological figures and it was Bayer who assigned the lower-case Greek letters to identify many stars.

The goal of celestial atlases has not changed over the centuries. They provide a charting of the night sky to serve as reference.

Celestial Atlas Menor was specifically designed for those wanting to enjoy the exploration of the heavens with their eyes, binoculars or a telescope. It's for both beginners and more experienced observers. The magnitude limit of the charted stars is about +5.5 which is the limit of the naked eye, but the magnitude limit for celestial objects is about +11.5, which is the limit for a 6-inch to 8-inch diameter telescope—popular-size scopes—under reasonably dark skies.

Now, the intent of this atlas was not to provide a step-by-step introduction to exploring the heavens but as an easy-to-use and intuitive guide, hence its organization and placement of pages as well as use of tabs. And, although the designations of the main charts might seem counterintuitive at first, you will find that it facilitates using the charts, while the numbers teach a little about the celestial coordinate system and movement of the heavens. Beginners will find explanations of terms and concepts throughout the atlas, and especially in the Glossary.



Star chart, circa 1720

Features of this celestial atlas include:

- A standard and convenient size for clipboards and one's lap.
- Tabs for the charts and listing of objects, smartly placed pages and cross-reference lists.
- Comfortable chart scale that keeps whole constellations on a single chart.
- Simplified constellation outlines for easy identification of patterns in the sky.
- Detailed close-up charts of deep sky objects (clusters of stars, nebulae and galaxies) hot-spots as well as other significant areas.
- 1,370 deep sky objects and 360 double stars (two stars—one often orbits the other) plotted with observing information for every object.
- Inclusion of many "famous" celestial objects, even though they are beyond the reach of a 6 to 8-inch diameter telescope.
- Expanded glossary to define and/or explain terms and concepts.
- Black stars on a white background, a preferred format for star charts.

Celestial atlases do not plot the position of the planets because they move through the constellations. But, the planets are always on or near the path on the charts labeled, "Ecliptic." The brighter planets, especially Venus and Jupiter, can cause confusion to those first learning the night sky because they might be mistaken for stars. Please visit my site, whatsouttonight.com (or others), to find the location and magnitude of the naked-eye planets.

The Earth slowly wobbles in a great circle on its axis, called precession. This results in the coordinates of the stars and all celestial objects to slowly change over time. This atlas has all coordinates set for the future year 2025, but the coordinates will be more than adequate to find these objects for a good 50 years beyond this date.

Unfortunately, the United States is one of the few remaining countries in the world to stick with English units of measurement. This atlas is geared mostly towards this crowd, to those who are less familiar with the near-universal metric system of measurement.

This atlas is mostly the work of me, Ken Graun. All of the charts were drawn by hand in drawing programs—every single star, line, letter and number. I like to improve my products, so if you have any corrections or suggestions, please contact me.

I encourage owners of this atlas to copy any pages for your nightly pursuits, and to share with small groups. Also, you might want to take the book apart and put it in a 3-ring binder for added convenience. Please contact me if you would like to distribute pages free-of-charge for large events because the stars are for everyone!

Ken Graun
July, 2015
Vail, Arizona

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Constellations *by* Chart

KEY

Constellation	Abbr.	Charts	Page
ANDROMEDA	And	**NCP**, **23N**, **2N**	15
ANTLIA	Ant	**11E**, **11S**, **SCP**	28
APUS	Aps	**14S**, **SCP**	32
AQUARIUS	Aqr	**23E**, **20E, 23S**	16
AQUILA	Aql	**20N**, **20E**, **20S**	17
ARA	Ara	**20S**, **17S**, **SCP**	26
ARIES	Ari	**2N**, **2E**	15
AURIGA	Aur	**5N**, **5E**	14
BOOTES or **BOÖTES**	Boo	**14N**, **14E**	11
CAELUM	Cae	**5E**, **5S**	30
CAMELOPARDALIS	Cam	**NCP**, **5N**	14
CANCER	Cnc	**8N**, **8E**	13
CANES VENATICI	CVn	**NCP**, **14N**, **11N**	11
CANIS MAJOR	CMa	**8E**, **8S**	21
CANIS MINOR	CMi	**8N**, **8E**	21
CAPRICORNUS	Cap	**20E**, **20S**	17
CARINA	Car	**11S**, **8S**, **SCP**	28
CASSIOPEIA	Cas	**NCP**, **23N**, **2N**	15
CENTAURUS	Cen	**14S**, **11S**, **SCP**	27
CEPHEUS	Cep	**NCP**, **23N**, **20N**	8
CETUS	Cet	**2E**, **2S**	23
CHAMAELEON	Cha	**11S**, **SCP**	32
CIRCINUS	Cir	**14S**, **SCP**	27
COLUMBA	Col	**5E**, **5S**	30
COMA BERENICES	Com	**14N**, **14E**	11
CORONA AUSTRALIS	CrA	**20S**, **17S**	25
CORONA BOREALIS	CrB	**17N**, **14N**, **17E**	10
CORVUS	Crv	**14E**, **11E**	20
CRATER	Crt	**11E**, **11S**	20
CRUX	Cru	**14S**, **SCP**	27
CYGNUS	Cyg	**NCP**, **20N**, **20E**	9
DELPHINUS	Del	**20N**, **20E**	9
DORADO	Dor	**5S**, **SCP**	30
DRACO	Dra	**NCP**, **17N**, **14N**	7
EQUULEUS	Equ	**20N**, **20E**	17
ERIDANUS	Eri	**5E**, **2E**, **5S**, **2S**	30–31
FORNAX	For	**2E**, **2S**, **SCP**	31
GEMINI	Gem	**8N**, **5N**, **8E**, **5E**	21
GRUS	Gru	**23S**, **SCP**	24
HERCULES	Her	**17N**, **17E**	10
HOROLOGIUM	Hor	**5S**, **2S**, **SCP**	30
HYDRA	Hya	**8N**, **14E**, **11E**, **8E**	19–21
HYDRUS	Hyi	**2S**, **SCP**	31
INDUS	Ind	**23S**, **20S**, **SCP**	25

Constellation	Abbr.	Charts	Page
LACERTA	Lac	**NCP**, **23N**	8
LEO	Leo	**11N**, **11E**	12
LEO MINOR	LMi	**NCP**, **11N**, **11E**	12
LEPUS	Lep	**5E**, **5S**	22
LIBRA	Lib	**14E**, **14S**	27
LUPUS	Lup	**17S**, **14S**	27
LYNX	Lyn	**NCP**, **8N**	13
LYRA	Lyr	**20N**, **20E**	9
MENSA	Men	**5S**, **SCP**	32
MICROSCOPIUM	Mic	**20S**, **SCP**	25
MONOCEROS	Mon	**5E**, **8E**	21
MUSCA	Mus	**11S**, **14S**, **SCP**	28
NORMA	Nor	**17S**, **SCP**	26
OCTANS	Oct	**SCP**	32
OPHIUCHUS	Oph	**17E**	18
ORION	Ori	**5E**	22
PAVO	Pav	**20S**, **SCP**	25
PEGASUS	Peg	**23N**, **23E**	8
PERSEUS	Per	**NCP**, **5N**, **2N**	15
PHOENIX	Phe	**2S**, **SCP**	31
PICTOR	Pic	**5S**, **SCP**	30
PISCES	Psc	**23N**, **2N**, **23E**, **2E**	16/23
PISCIS AUSTRINUS	PsA	**23E**, **23S**	24
PUPPIS	Pup	**8E**, **8S**	29
PYXIS	Pyx	**8E**, **8S**	29
RETICULUM	Ret	**5S**, **2S**, **SCP**	30
SAGITTA	Sge	**20N**, **20E**	9
SAGITTARIUS	Sgr	**20E**, **17E**, **20S**, **17S**	25–26
SCORPIUS	Sco	**17S**	26
SCULPTOR	Scl	**23E**, **2E**, **23S**, **2S**	24
SCUTUM	Sct	**20E**, **17E**	17
SERPENS[1] (Caput & Cauda)	Ser	**17E**	18
SEXTANS	Sex	**11E**	20
TAURUS	Tau	**5N**, **5E**	22
TELESCOPIUM	Tel	**20S**, **17S**	25
TRIANGULUM	Tri	**2N**, **2E**	15
TRIANGULUM AUSTRALE	TrA	**17S**, **SCP**	26
TUCANA	Tuc	**23S**, **SCP**	24
URSA MAJOR	UMa	**NCP**, **14N**, **11N**	12
URSA MINOR	UMi	**NCP**, **14N**	7
VELA	Vel	**11S**, **8S**, **SCP**	28–29
VIRGO	Vir	**14E**	19
VOLANS	Vol	**8S**, **SCP**	29
VULPECULA	Vul	**20N**, **20E**	9

• "BEST" charts are underlined •

[1] Serpens, the Snake, is the only constellation having discontinous boundaries since it is being held across Ophiuchus, the Healer's body. The Snake's head, Caput, is located on the western side of Ophiuchus and its tail, Cauda, is located on the eastern side of Ophiuchus.

Greek Alphabet

α alpha	ε epsilon	ι iota	ν nu	ρ rho	φ phi
β beta	ζ zeta	κ kappa	ξ xi	σ sigma	χ chi
γ gamma	η eta	λ lambda	ο omicron	τ tau	ψ psi
δ delta	θ theta	μ mu	π pi	υ upsilon	ω omega

Overview *of* Charts

KEY

The heart of any celestial atlas is its charts. On the next 31 pages are 41 charts, detailing the whole celestial sphere. There are 2 charts covering the celestial poles, 24 main charts and 15 close-up charts. The 24 main charts are divided into northern, equatorial and southern sections. Each section's Right Ascensions are in descending order so the chart's pages join together, allowing constellations to flow off one page and on to the next.

For explanations of terms, see the Glossary

Coordinate Grids & Reference Lines

Coordinate grids are overlayed on every chart. For the 24 main charts, the Right Ascension is noted along the tops and bottoms with Declination noted along the sides. The stars move from east to west in the sky, from lower to higher Right Ascensions. The Ecliptic and Galactic Center lines are also indicated.

Celestial Pole Charts

The two celestial pole charts are at a smaller scale than the 24 main charts in order to show more constellations and stars around the poles. Fewer deep sky objects are plotted on these charts compared to the main charts.

Names of Constellations and *Stars*

The names of constellations are in UPPERCASE letters, except when their 3-letter abbreviations are used. The names of stars are *italicized*.

Magnitude of Stars and Objects

The 24 main charts indicate stars as faint as magnitude 6, which is the limit of the naked eye under dark skies. The close-up charts go fainter.

The magnitude limit of the deep sky objects averages 11.5, the limit of a 6 to 8-inch diameter telescope under dark skies. The close-up charts go fainter. The section, "Objects *by* Constellation," provides magnitudes for all plotted objects.

Object Symbols, Designations and Scale

Each category of object (Cluster, Globular Cluster, Planetary Nebula, Nebula and Galaxy) has an identifying symbol—see legends on charts.

A 2 to 4 digit number next to an *object* indicates its NGC designation, that is, its *New General Catalogue* designation. An IC in front of a number indicates the supplemental *Index Catalogue* to the NGC catalogue. All Messier objects start with an M and because of their popularity, they are bolded. There are other designations, like Cr, Tr and PK, and information about these designations can be found in the Glossary.

NGC numbers are assigned to objects in order of Right Ascension, so these numbers increase from right to left.

Most objects are much smaller than their symbols, however, the actual size and shape of large objects are drawn to scale.

Explanations and examples of objects can be found in the Glossary.

Designations of Stars

Other than a name, stars may be designated with a Bayer letter (mostly Greek letters but some Roman letters, too) or a number, called a Flamsteed number. Stars lacking these designations may be indicated with the *double-letter* designation for a variable star, the *Bright Star Catalogue* designation (**HR**) or *Henry Draper Catalogue* designation (**HD**).

John Flamsteed was not entirely consistent in his assignment of designations. You will find instances of faint stars with Flamsteed numbers near much brighter stars without Flamsteed numbers.

Double Stars & their Designations

A double star is a star that "casually" looks like one star but separates into two or more stars with sufficient magnification. All double stars are indicated by a thin line drawn through their centers. The orientation of the thin line has no significance. In this celestial atlas, every double star has a designation for reference to its observing information in the section, "Objects *by* Constellation." However, the older, traditional designations of some double stars, which identified specific double star catalogues (designations starting with Σ, OΣ, β, Δ, etc.), have not been used. Instead, the **HR** (*Bright Star Catalogue*) and **HD** (*Henry Draper Catalogue*) stellar catalogue designations are used to provide greater consistency and avoid confusion by using additional symbols.

Variable Stars

A variable star is a star that changes brightness, usually cyclically, over a period of a few days to years. The size of the inner and outer circles denoting variable stars approximate the magnitude change. The emphasis of this celestial atlas is on deep sky objects and double stars, so only the brightest variable stars are described.

Red Stars

Red stars are pretty to observe. Most of them are faint variable stars. The ones noted in this celestial atlas are some of the brightest. To locate the red stars, it is easiest to find their designation and coordinates under their own heading in, "Objects *by* Constellation."

Telrad Reticle "Finderscope"

The Telrad is a popular pointing devise used on telescopes, so its reticle pattern is provided. See *Telrad* in the Glossary for more information.

Binocular and Telescope Field-of-View

A 5° circle, representing the arc-angle, field-of-view for typical binoculars is indicated on the main charts as well as a 1° arc-angle, field-of-view for a "regular" telescope eyepiece yielding a magnification of 50x. Any telescope using an eyepiece that will yield a magnification of about 50x will provide a field-of-view with at *least* a diameter of 1°, which is two Moon diameters. See *Telescope Magnification* in the Glossary.

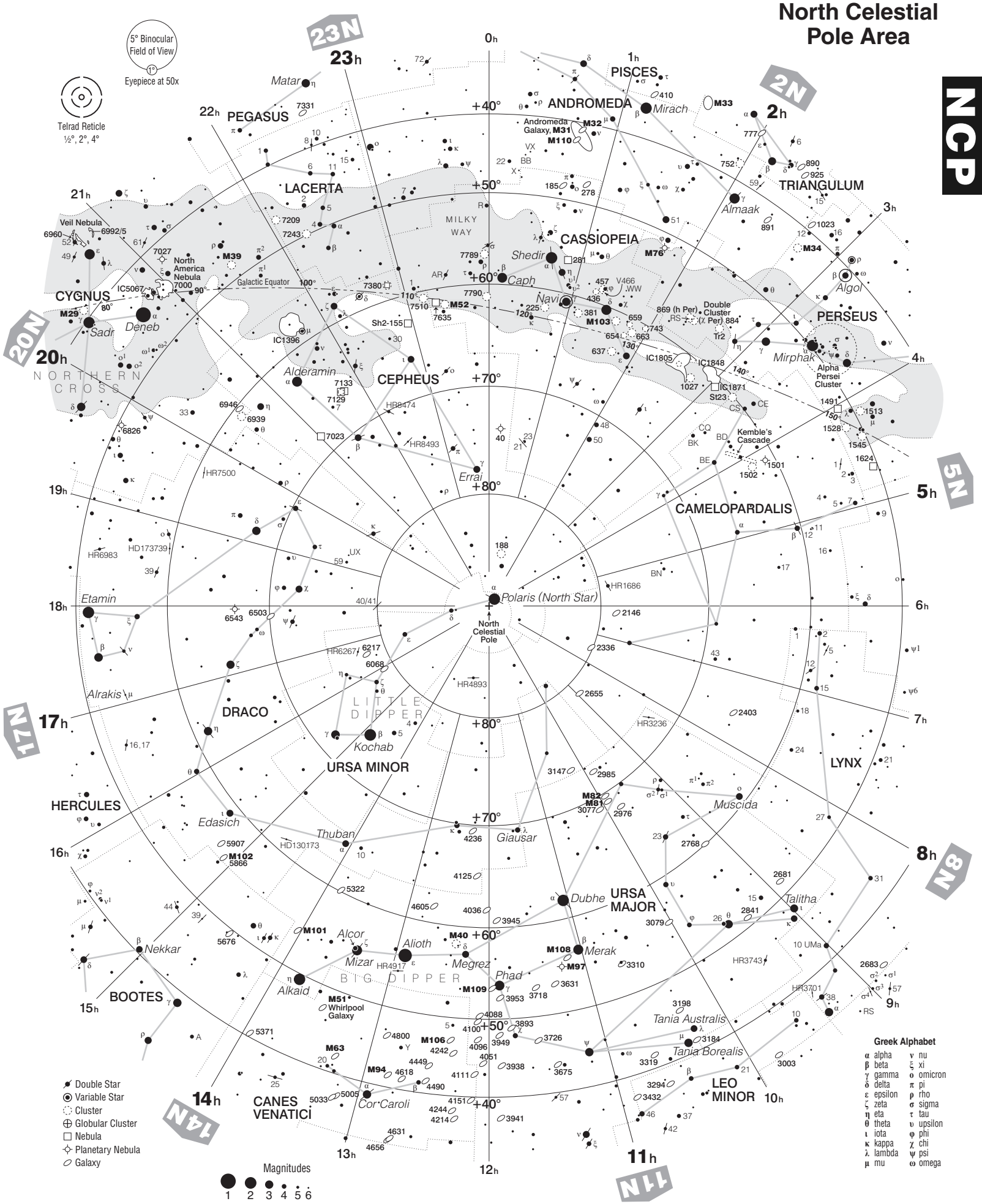
Close-up Charts

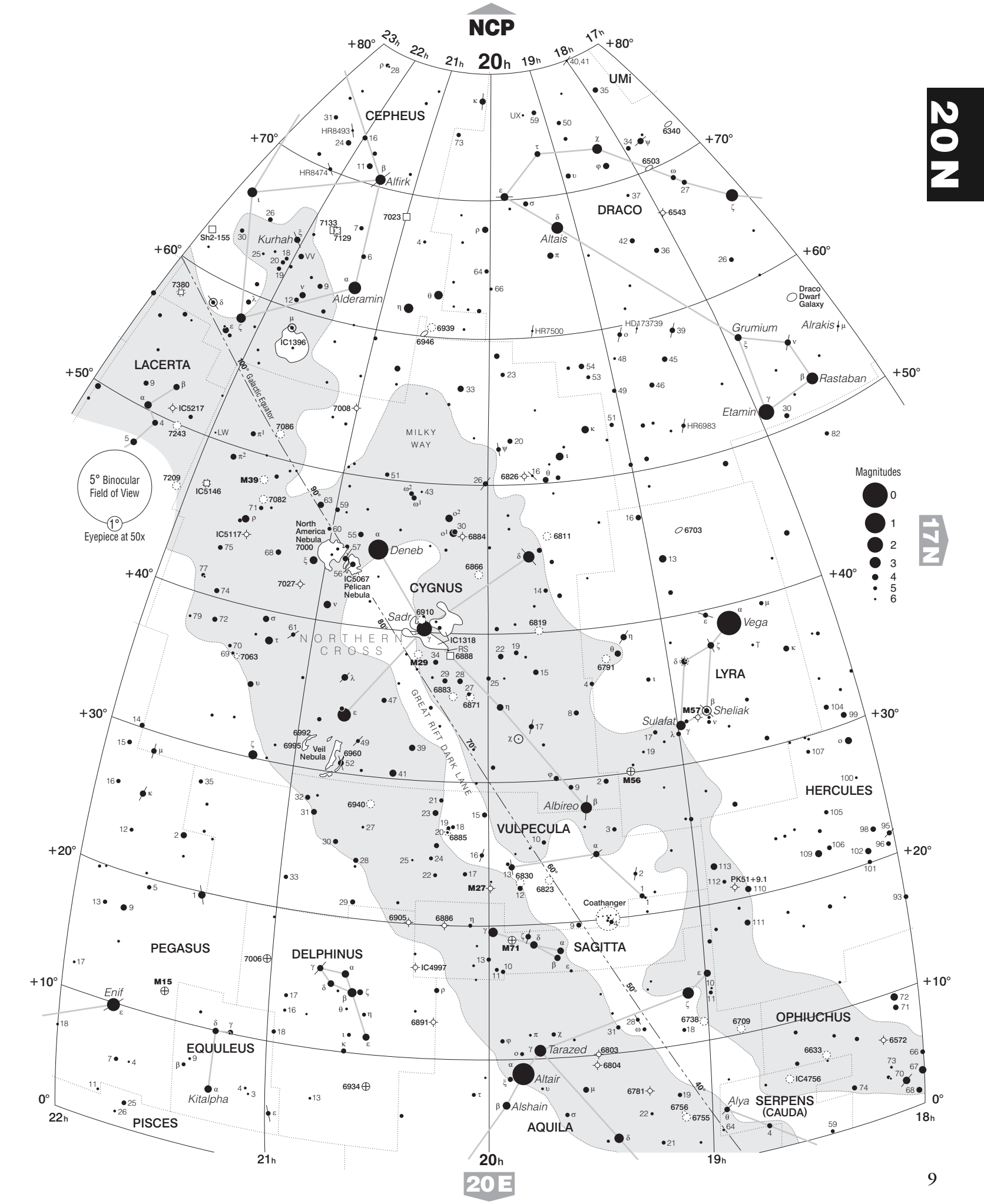
The close-up charts provide detailed charting of specific objects, areas of interest or congested areas. The magnitude of the stars and objects go fainter than in the main charts. Charts A-14 and A-14R are provided for those who want to manually find the set of Messier galaxies in the Virgo Cluster, a practice sometimes conducted during Messier marathons. Chart A-14R is a mirror-reverse image of chart A-14 for use with telescopes equipped with a 90° diagonal (refractors and SCTs). Although the 90° diagonal allows for comfortable viewing, it provides a mirror-reverse image of the sky. Reverse images are acceptable in astronomy because *we are just looking at stars.*

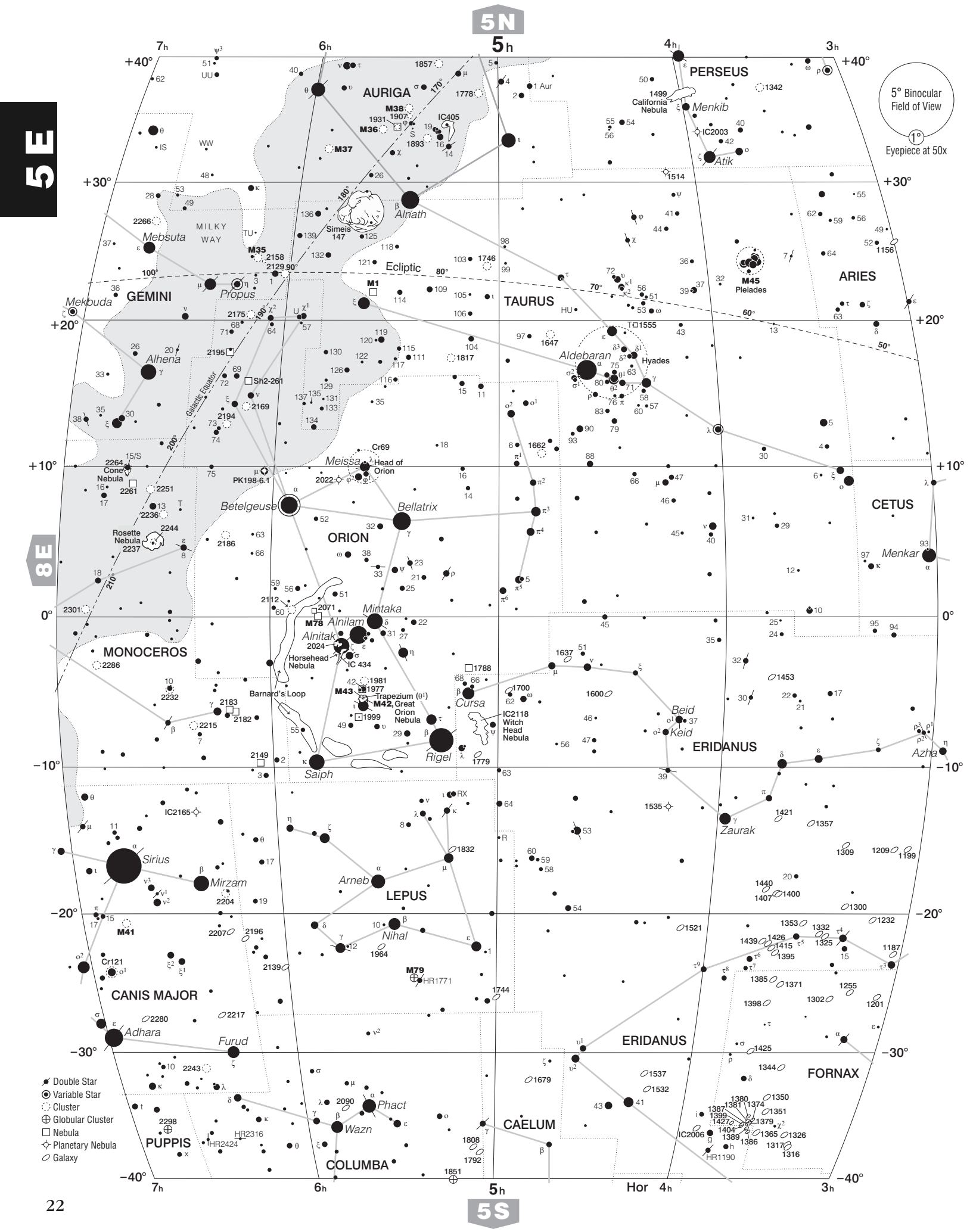
Locating Specific Stars & Objects

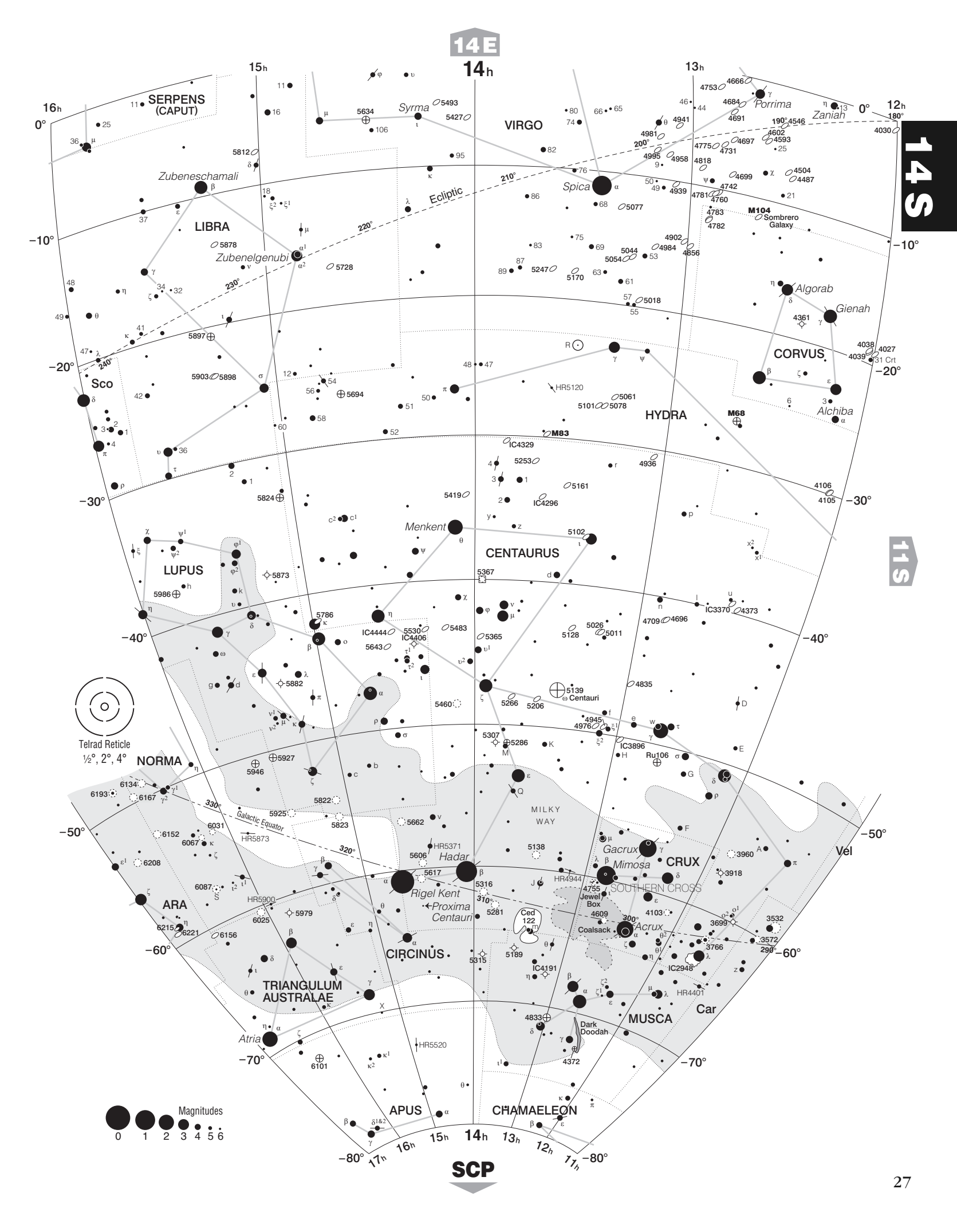
Locating a specific star or object on the charts may not always be easy. To facilitate finding them, the section, "Objects *by* Constellation" serves as a *master* list with the three supporting sections, "Objects *by* Number," "Objects *by* Type" and "Objects *by* Name" providing cross references. Once the constellation for an object is identified, to find it on the charts is a simple matter of looking it up on the master list and using its coordinates to nail it down.

NGC numbers are assigned to objects in order of Right Ascension, so these numbers increase from right to left.


North Celestial Pole Area
NCP
5° Binocular Field of View
1°
Eyepiece at 50x
Telrad Reticle
½°, 2°, 4°
23N
2N
20N
5N
17N
8N
14N
11N
0h
1h
2h
3h
4h
5h
6h
7h
8h
9h
10h
11h
12h
13h
14h
15h
16h
17h
18h
19h
20h
21h
22h
23h
+40°
+50°
+60°
+70°
+80°
PISCES
ANDROMEDA
PEGASUS
TRIANGULUM
LACERTA
CASSIOPEIA
PERSEUS
CYGNUS
CEPHEUS
CAMELOPARDALIS
NORTHERN CROSS
DRACO
LITTLE DIPPER
URSA MINOR
HERCULES
BOOTES
URSA MAJOR
BIG DIPPER
LYNX
LEO MINOR
CANES VENATICI
MILKY WAY
Polaris (North Star)
North Celestial Pole
Mirach
Almaak
Algol
Mirphak
Alpha Persei Cluster
Shedir
Caph
Navi
Sadr
Deneb
Alderamin
Errai
Kochab
Etamin
Alrakis
Edasich
Thuban
Nekkar
Alkaid
Mizar
Alcor
Alioth
Megrez
Phad
Merak
Dubhe
Talitha
Muscida
Giausar
Tania Australis
Tania Borealis
Cor Caroli
Matar
Veil Nebula
North America Nebula
Galactic Equator
Double Cluster (χ Per)
Kemble's Cascade
Whirlpool Galaxy
M31
M32
M110
M33
M34
M76
M103
M52
M39
M29
M81
M82
M101
M51
M63
M94
M106
M40
M97
M108
M109
M102
IC5067
IC1396
Sh2-155
IC1805
IC1848
IC1871
St23
Tr2
Double Star
Variable Star
Cluster
Globular Cluster
Nebula
Planetary Nebula
Galaxy
Magnitudes
1 2 3 4 5 6
Greek Alphabet
α alpha
β beta
γ gamma
δ delta
ε epsilon
ζ zeta
η eta
θ theta
ι iota
κ kappa
λ lambda
μ mu
ν nu
ξ xi
ο omicron
π pi
ρ rho
σ sigma
τ tau
υ upsilon
φ phi
χ chi
ψ psi
ω omega


NCP
20h
23h
22h
21h
19h
18h
17h
+80°
+70°
+60°
+50°
+40°
+30°
+20°
+10°
0°
22h
21h
20h
19h
CEPHEUS
UMi
DRACO
LACERTA
CYGNUS
LYRA
HERCULES
VULPECULA
PEGASUS
DELPHINUS
SAGITTA
EQUULEUS
PISCES
AQUILA
OPHIUCHUS
SERPENS (CAUDA)
MILKY WAY
NORTHERN CROSS
GREAT RIFT DARK LANE
100° Galactic Equator
90°
80°
70°
60°
50°
40°
Alfirk
Kurhah
Alderamin
Altais
Grumium
Alrakis
Rastaban
Etamin
Deneb
Sadr
Vega
Sheliak
Sulafat
Albireo
Coathanger
Tarazed
Altair
Alshain
Alya
Enif
Kitalpha
IC1396
IC5217
IC5146
IC5117
North America Nebula 7000
IC5067 Pelican Nebula
IC1318
Veil Nebula
IC4997
IC4756
Draco Dwarf Galaxy
M39
M29
M56
M57
M27
M71
M15
Sh2-155
HR8493
HR8474
HR7500
HD173739
HR6983
PK51+9.1
5° Binocular Field of View
1° Eyepiece at 50x
Magnitudes
0
1
2
3
4
5
6
20 N
17 N
20 E


5N
5S
5E
8E
7h
6h
5h
4h
3h
Hor
+40°
+30°
+20°
+10°
0°
−10°
−20°
−30°
−40°
5° Binocular Field of View
1° Eyepiece at 50x
AURIGA
PERSEUS
GEMINI
TAURUS
ARIES
CETUS
ORION
ERIDANUS
MONOCEROS
LEPUS
CANIS MAJOR
PUPPIS
COLUMBA
CAELUM
FORNAX
MILKY WAY
Ecliptic
Galactic Equator
Alnath
Menkib
Atik
Mebsuta
Propus
Mekbuda
Alhena
Meissa
Head of Orion
Betelgeuse
Bellatrix
Mintaka
Alnilam
Alnitak
Saiph
Rigel
Cursa
Beid
Keid
Zaurak
Azha
Menkar
Aldebaran
Hyacides
Pleiades
Sirius
Mirzam
Arneb
Nihal
Adhara
Furud
Wazn
Phact
Alnitak
Horsehead Nebula
IC 434
Barnard's Loop
Trapezium (θ1)
Great Orion Nebula
Witch Head Nebula
California Nebula
Cone Nebula
Rosette Nebula
Simeis 147
M1
M35
M36
M37
M38
M41
M42
M43
M45
M78
M79
IC405
IC2003
IC2118
IC2165
IC2006
Sh2-261
PK198-6.1
Cr69
Cr121
HR1771
HR2316
HR2424
HR1190
Double Star
Variable Star
Cluster
Globular Cluster
Nebula
Planetary Nebula
Galaxy


14E
14S
11S
SCP
15h
14h
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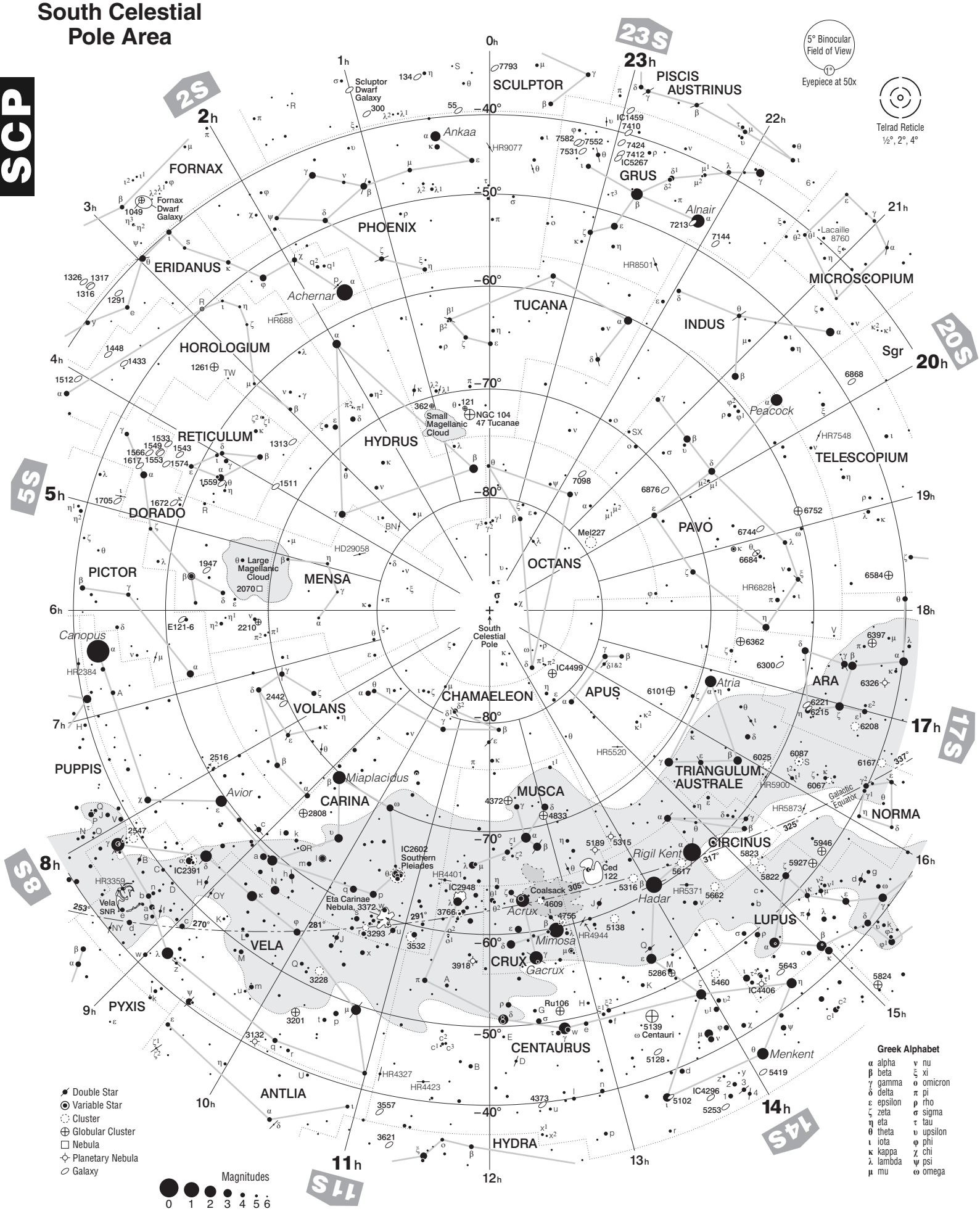
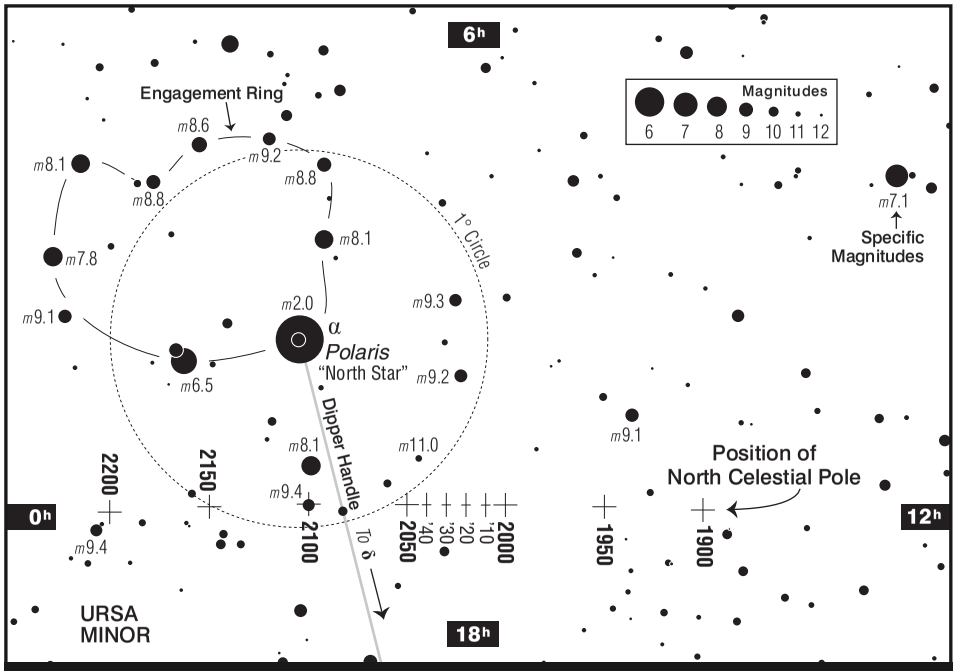
16h
12h
17h
11h
0°
−10°
−20°
−30°
−40°
−50°
−60°
−70°
−80°
180°
190°
200°
210°
220°
230°
240°
310°
320°
330°
290°
300°
SERPENS (CAPUT)
VIRGO
LIBRA
Sco
LUPUS
CENTAURUS
HYDRA
CORVUS
Crt
NORMA
ARA
TRIANGULUM AUSTRALAE
CIRCINUS
MUSCA
Car
CRUX
SOUTHERN CROSS
Vel
CHAMAELEON
APUS
Atria
Zubeneschamali
Zubenelgenubi
Spica
Syrma
Porrima
Zaniah
Algorab
Gienah
Alchiba
Menkent
Hadar
Rigel Kent
Proxima Centauri
Gacrux
Mimosa
Acrux
Ecliptic
Galactic Equator
MILKY WAY
Jewel Box
Coalsack
Dark Doodah
M104
Sombrero Galaxy
M68
M83
IC4329
IC4296
IC4444
IC4406
IC3370
IC3896
IC4191
IC2948
HR5120
HR5873
HR5371
HR5900
HR4944
HR4401
HR5520
Ru106
Ced 122
ω Centauri
Telrad Reticle
½°, 2°, 4°
Magnitudes
0 1 2 3 4 5 6

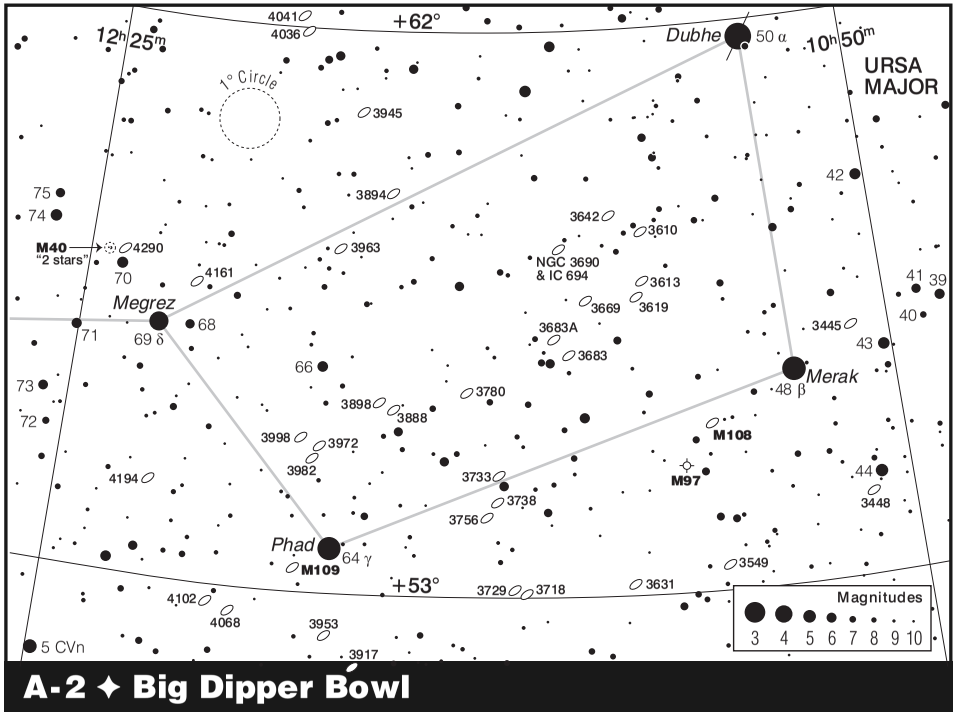
South Celestial Pole Area



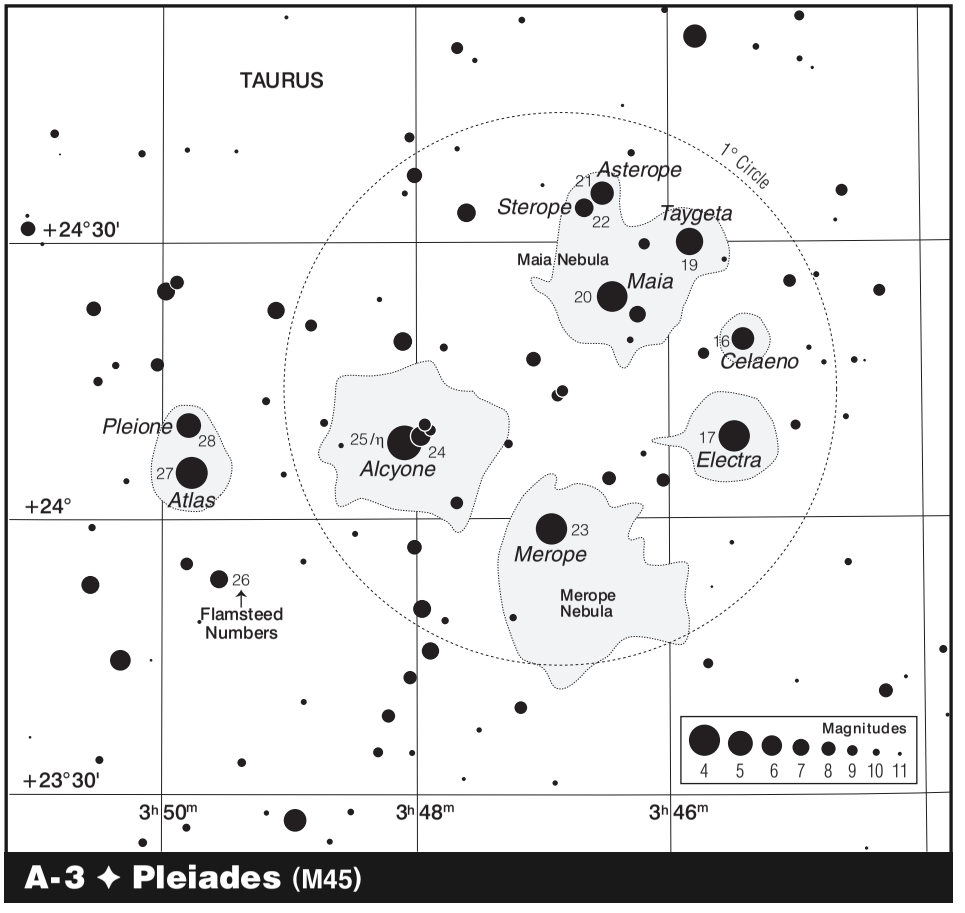
Greek Alphabet
α alpha
β beta
γ gamma
δ delta
ε epsilon
ζ zeta
η eta
θ theta
ι iota
κ kappa
λ lambda
μ mu
ν nu
ξ xi
ο omicron
π pi
ρ rho
σ sigma
τ tau
υ upsilon
φ phi
χ chi
ψ psi
ω omega



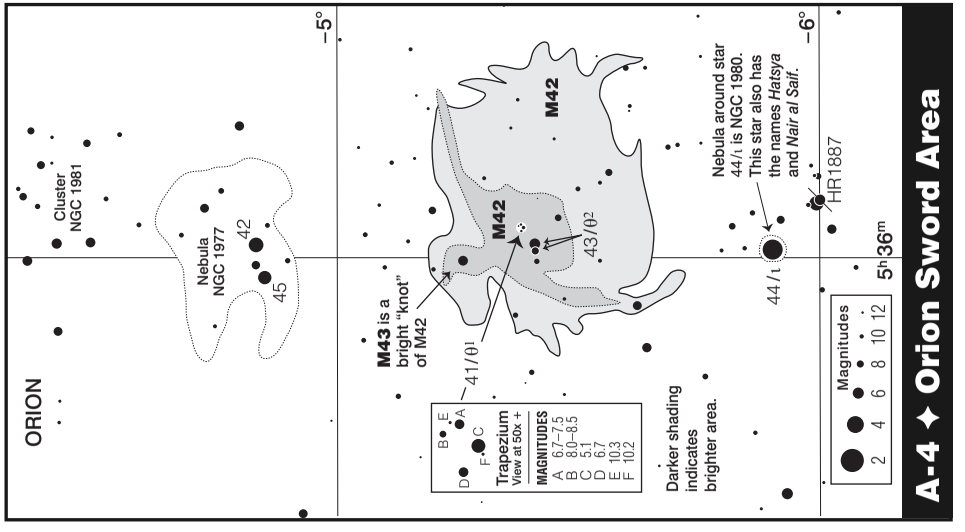
A-1 ✦ North Celestial Pole & Precession Path



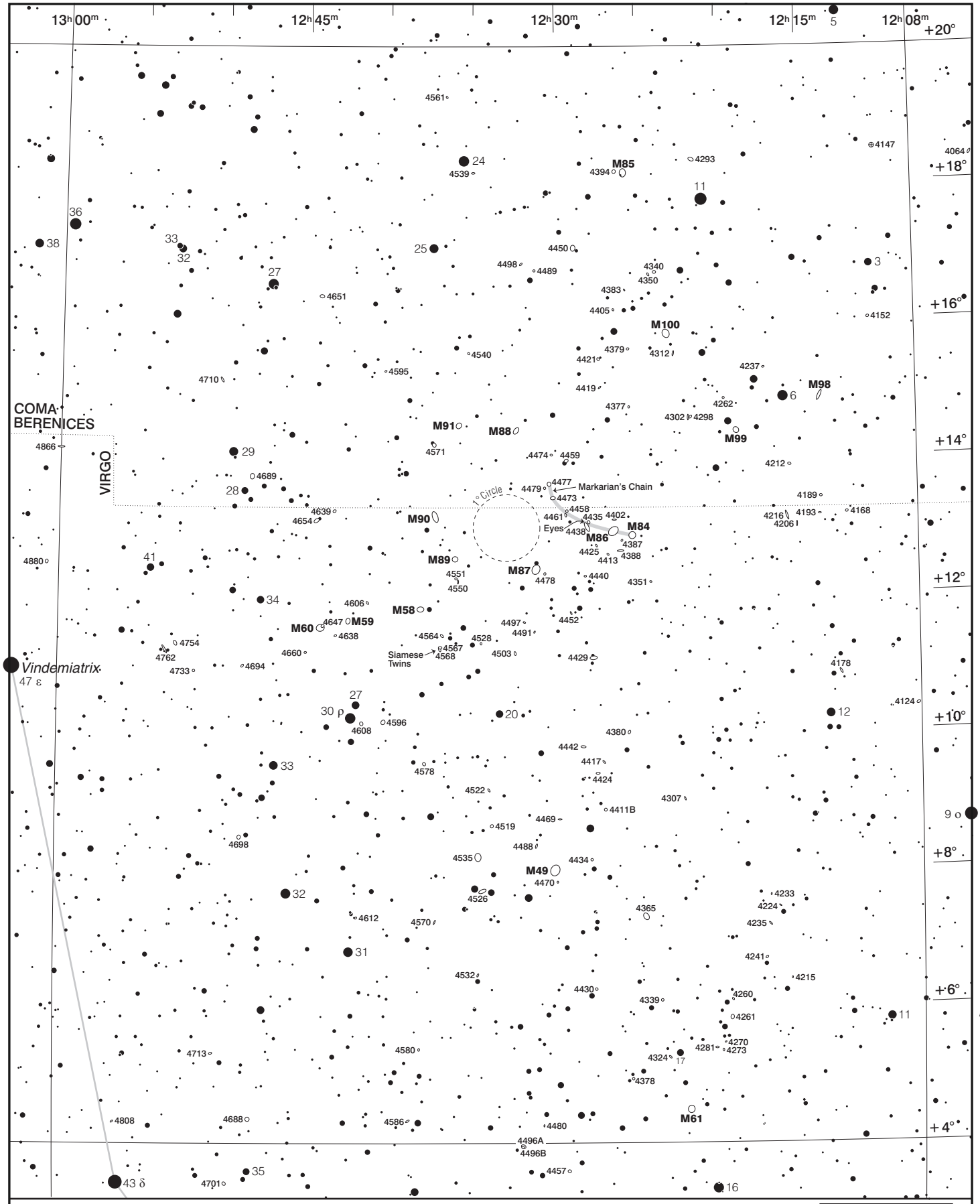
A-2 ✦ Big Dipper Bowl



A-3 ✦ Pleiades (M45)



A-4 ✦ Orion Sword Area



SPECIAL NOTES. Every object indicated is a galaxy except for the globular cluster NGC 4147. The size and shape of the galaxies are to scale.

A-14 ✦ Virgo Cluster of Galaxies Area

Order of brightness of the Messier Virgo Galaxies starting with the brightest: M64, M49, (M104), M87, M60, M85, M86, M84, M88, M61, M58, M59, M89, M90, M99, M100, M98, M91.

Greek Alphabet

α alpha
β beta
γ gamma
δ delta
ε epsilon
ζ zeta
η eta
θ theta
ι iota
κ kappa
λ lambda
μ mu
ν nu
ξ xi
ο omicron
π pi
ρ rho
σ sigma
τ tau
υ upsilon
φ phi
χ chi
ψ psi
ω omega

Objects *by* Constellation

KEYs

[Ori • *Orionis* • 8N, 5N, 8E, 5E, 5S, A-4]

- Ori: 3-letter abbreviation
- *Orionis*: Latin Genitive Spelling
- 8N, 5N, 8E, 5E, 5S, A-4: Charts (Underline = Best Chart)

NGC 4450 Galaxy (S). *m*10.1, 5x4', 50*, Sep=5", Period=144 days, [12h09m, +19°55']. **A-9**

- **Designation or Name**
- **Object Type**
- **Magnitude(s)** *Range indicated for variable, slash for double star.*
- **Class of Object** *For galaxies and nebulae. See below.*
- **Dimension in Sky** *Single number indicates a diameter. Expressed in Arc ° Degrees, ' Minutes or " Seconds.*
- **Number of stars in a Cluster**
- **Double Star Separation** *Expressed in Arc " Seconds or ' Minutes.*
- **Variable Star Period**
- **Right Ascension Coordinate** *Rounded up.* (Calculated for 2025)
- **Declination Coordinate** *Rounded up.* (Calculated for 2025)
- **Close-up Chart** *Indicated for objects plotted* solely *on close-up charts.*

This section provides observing information on every plotted deep sky object, double star and other objects of interest, including a few uncharted objects.

For an explanation of terms and abbreviations, see the Glossary.

Galaxies

S, **E** and **I** after a Galaxy designates its type or shape, that is, Spiral, Elliptical or Irregular, respectively. See *Galaxies* in the Glossary for more information.

Nebulae

Em, **R** and **B** after a Nebula designates its source of illumination, that is, Emission, Reflection or Bright, respectively. See *Nebula* in the Glossary for more information.

Listed Order of Deep Sky Objects (DSOs) and Stars

In the lists of DEEP SKY OBJECTs, objects with names are listed first followed by catalogues, from the brightest catalogue to the faintest. So, the Messier objects are listed before the NGC objects with IC objects following. Objects with other catalogue designations are at the bottom of the DEEP SKY OBJECTs lists. For the lists of DOUBLE, VARIABLE and RED STARs, stars with names are listed first, followed by those with Bayer letters and then Flamsteed numbers. The order of a few listings of stars may seem wrong, but they are listed in their catalogue order. So, for the RED STARs in Cygnus, RS does come before LW.

Clusters and Globular Clusters

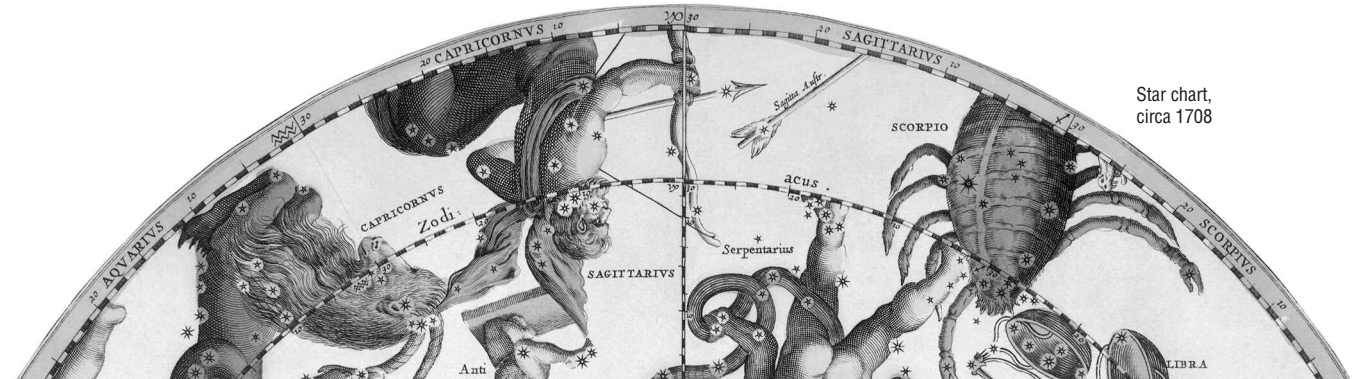
Throughout this celestial atlas, an Open Cluster, that is, a grouping of several to hundreds of stars, is referred to simply as a Cluster. Globular Clusters, which are groupings of thousands of stars, are always referred to as a "Globular Cluster" or "Globular" to distinguish them from Clusters. See *Cluster* in the Glossary for more information.

Magnitudes of Objects

The average magnitude limit of deep sky objects is 11.5, the limit of a 6 to 8-inch diameter telescope under dark skies. The close-up charts go fainter. Although the magnitude of stars can be measured with certainty, deep sky objects are not pinpoints of light, so their magnitudes are harder to ascertain. For this reason, you will find that the magnitudes for deep sky objects serve best as a guide. When observing these objects, some will be easier or harder to see than their magnitude indicates. Magnitudes listed with a long dash are faint and/or have not been quantified.

Arc Sizes of Objects & Telescope View

The size that every object extends in the sky is indicated in arc degrees, minutes or seconds. It takes some observing experience to get a "feel" for the size of objects when looking through a telescope especially since the magnification can be changed easily. The Moon is a popular gauge because its diameter extends about 30 arc minutes (30' or ½°). Most telescope eyepieces that provide a magnification of 50x will also provide a field-of-view of 1° in diameter, and an eyepiece providing a magnification of 100x will provide a field-of-view of ½° in diameter.



Star chart, circa 1708

Objects *by* Constellation

VARIABLE STAR

η Aquilae. *m*3.5–4.4, Period=7.177 days, [19h54m, +1°04'].

RED STAR

V Aquliae. *m*6.6–8.4, Period=353 days, [19h06m, –5°39'].

ARA

[Ara • *Arae* • 20S, 17S, 14S, SCP]

DEEP SKY OBJECTs

NGC 6188 Nebula. *See* NGC 6193, below.
NGC 6193 Cluster. *m*5.2, 15', 15*, [16h42m, –48°50'].
The nebula, NGC 6188 surrounds this cluster (19x12').
NGC 6200 Cluster. *m*7.4, 12', 40*, [16h46m, –47°30'].
NGC 6204 Cluster. *m*8.2, 5', 45*, [16h48m, –47°04'].
NGC 6208 Cluster. *m*7.2, 15', 60*, [16h51m, –53°46'].
NGC 6215 Galaxy (S). *m*10.9, 3x2', [16h53m, –59°02'].
NGC 6221 Galaxy (S). *m*10.0, 5x3', [16h55m, –59°16'].
NGC 6250 Cluster. *m*5.9, 7', 60*, [17h00m, –45°58'].
NGC 6300 Galaxy (S). *m*10.1, 5x3', [17h19m, –62°51'].
NGC 6326 Planetary Nebula. *m*11, 9", [17h23m, –51°47'].
NGC 6352 Globular Cluster. *m*8.0, 11', [17h27m, –48°27'].
NGC 6362 Globular Cluster. *m*7.7, 14', [17h35m, –67°04'].
NGC 6397 Globular Cluster. *m*5.5, 22', [17h43m, –53°41'].
IC 4651 Cluster. *m*6.9, 12', 80*, [17h27m, –49°57'].

DOUBLE STARs

γ Arae. *m*3.3/10.2, Sep=17.8", [17h28m, –56°24'].
HR 6416. *m*5.5/8.6, Sep=10.0", [17h21m, –46°40'].

ARIES

[Ari • *Arietis* • 2N, 2E]

DEEP SKY OBJECTs

NGC 680 Galaxy (S). *m*11.9, 2x2', [1h51m, +22°06'].
NGC 691 Galaxy (S). *m*11.4, 3x3', [1h52m, +21°53'].
NGC 772 Galaxy (S). *m*10.3, 7x5', [2h01m, +19°08'].
NGC 821 Galaxy (E). *m*10.7, 3x2', [2h10m, +11°07'].
NGC 972 Galaxy (S). *m*11.4, 3x2', [2h36m, +29°25'].
NGC 1156 Galaxy (I). *m*11.7, 3x3', [3h01m, +25°20'].

DOUBLE STARs

Mesartim (γ). *m*4.5/4.6, Sep=7.5", [1h55m, +19°25'].
ε Arietis. *m*4.6/4.9, Sep=1.5", [3h01m, +21°26'].
λ Arietis. *m*4.8/6.7, Sep=37", [1h59m, +23°43'].
1 Arietis. *m*5.9/7.0, Sep=2.9", [1h52m, +22°24'].
14 Arietis. *m*5.0/8.0, Sep=107", [2h11m, +26°04'].
33 Arietis. *m*5.3/9.6, Sep=29", [2h42m, +27°10'].

AURIGA

[Aur • *Aurigae* • 5N, 5E]

DEEP SKY OBJECTs

M36 Cluster. *m*6.0, 12', 60*, [5h38m, +34°09'].
M37 Cluster. *m*5.6, 24', 150*, [5h54m, +32°33'].
M38 Cluster. *m*6.4, 21', 100*, [5h30m, +35°51'].
NGC 1664 Cluster. *m*7.6, 18', 40*, [4h53m, +43°43'].
NGC 1778 Cluster. *m*7.7, 7', 25*, [5h10m, +37°03'].
NGC 1857 Cluster. *m*7, 6', 40*, [5h22m, +39°22'].
NGC 1893 Cluster. *m*7.5, 10', 60*, [5h24m, +33°25'].
Known as the *Letter Y Cluster*.
NGC 1907 Cluster. *m*8.2, 7', 30*, [5h30m, +35°20'].
NGC 1931 Nebula/Cluster. *m*10, 5', 24*, [5h33m, +34°15'].
Miniature *"Orion Nebula"* with corresponding *"Trapezium."*
NGC 2281 Cluster. *m*5.4, 15', 30*, [6h50m, +41°02'].
IC 405 *Flaming Star Nebula* (B). *m*10.0, 30x19', [5h18m, +34°18'].
Simeis 147 Supernova Remnant. *Photographic object*, 3.3x3.3°, [5h42m, +28°01']. About 40,000 years old.

DOUBLE STARs

θ Aurigae. *m*2.6/7.2, Sep=3.5", [6h01m, +37°13'].
ψ5 Aurigae. *m*5.2/8.6, Sep=30.1", [6h49m, +43°33'].
4 Aurigae. *m*5.0/8.0, Sep=4.6", [5h01m, +37°56'].
14 Aurigae. *m*5/7.3, Sep=14.1", [5h17m, +32°43'].
41 Aurigae. *m*6.2/6.9, Sep=7.6", [6h14m, +48°42'].

RED STARs

S Aurigae. *m*8.2–14.0, Period=590 days, [5h29m, +34°10'].
UU Aurigae. *m*5.3–6.5, Period=235 days/Irregular, [6h38m, +38°26'].

BOOTES

[Boo • *Bootis* • NCP, 17N, 14N, 17E 14E]

DEEP SKY OBJECTs

NGC 5248 Galaxy (S). *m*10.2, 4x2', [13h39m, +8°45'].
NGC 5466 Globular Cluster. *m*9.1, 34', [14h07m, +28°25'].
NGC 5557 Galaxy (E). *m*11.1, 2x1', [14h19m, +36°23'].
NGC 5669 Galaxy (S). *m*11.3, 3x2', [14h34m, +9°47'].
NGC 5676 Galaxy (S). *m*11.2, 4x2', [14h34m, +49°21'].

DOUBLE STARs

Alkalurops (μ). *m*4.3.7.1/, Sep=107", [15h25m, +37°17'].
Izar (ε). *m*3.3/4.7, Sep=2.6", [14h46m, +26°58'].
δ Bootis. *m*3.6/7.9, Sep=1.7", [15h17m, +33°13'].
ζ Bootis. *m*3.4/3.8, Sep=0.5", [14h42m, +13°37'].
ι Bootis. *m*4.8/7.4, Sep=38.7", [14h17m, +51°15'].
κ Bootis. *m*4.5/6.6, Sep=13.5", [14h14m, +51°40'].
ξ Bootis. *m*4.8/7.0, Sep=6.3", [14h53m, +19°00'].
π Bootis. *m*4.9/5.8, Sep=5.5", [14h42m, +16°19'].
39 Bootis. *m*5.7/6.1, Sep=2.9", [14h51m, +48°37'].
44 Bootis. *m*4.8/5.7, Sep=1.8", [15h05m, +47°33'].
HR 5385. *m*5.0/6.8, Sep=6.2", [14h25m, +8°20'].

CAELUM

[Cae • *Caeli* • 5E, 5S]

DEEP SKY OBJECT

NGC 1679 Galaxy (S). *m*11.5, 3x2', [4h51m, –31°55'].

DOUBLE STAR

γ Caeli. *m*4.6/8.1, Sep=3.2", [5h05m, –35°27'].

CAMELOPARDALIS

[Cam • *Camelopardalis* • NCP, 8N, 5N, 2N]

DEEP SKY OBJECTs

Kemble's Casade. Twenty *m*8 stars in a 2.5° line.
Middle is *m*5 star at: [4h00m, +63°09'].
NGC 1501 Planetary Nebula. *m*11.5, 52", [4h09m, +60°59'].
NGC 1502 Cluster. *m*5.7, 7', 45*, [4h10m, +62°23'].
NGC 2146 Galaxy (S). *m*10.6, 5x3', [6h23m, +78°21'].
NGC 2336 Galaxy (S). *m*10.4, 5x3', [7h31m, +80°08'].
NGC 2403 Galaxy (S). *m*8.5, 16x8', [7h39m, +65°33'].
NGC 2655 Galaxy (S). *m*10.1, 5x4', [8h59m, +78°08'].

CAM

Greek Alphabet

α alpha
β beta
γ gamma
δ delta
ε epsilon
ζ zeta
η eta
θ theta
ι iota
κ kappa
λ lambda
μ mu
ν nu
ξ xi
ο omicron
π pi
ρ rho
σ sigma
τ tau
υ upsilon
φ phi
χ chi
ψ psi
ω omega

Objects *by* Constellation

IC 342 Galaxy (S). *m*9.7, 20x19', [3h49m, +68°10'].
St 23 Cluster. *m*7.5+, 17', 25*, [3h18m, +60°12'].

DOUBLE STARs

β Camelopardalis. *m*4.1/7.4, Sep=83", [5h06m, +60°29'].
1 Camelopardalis. *m*5.8/6.8, Sep=11", [4h34m, +53°58'].
HR 1686. *m*5.0/9.2, Sep=26", [5h27m, +79°15'].
HR 4893. *m*5.3/5.9, Sep=22", [12h50m, +83°17'].

CANCER

[Cnc • *Cancri* • 8N, 8E, A-5]

DEEP SKY OBJECTs

M44 *Praesepe* or *Beehive* (Cluster). *m*3.1, 1.6°, 50*, [8h42m, +19°35']. *Praesepe* means "manger" or "hive."
M67 *King Cobra* (Cluster). *m*6.9, 30', 200*, [8h53m, +11°42'].
NGC 2513 Galaxy (E). *m*11.6, 3x2', [8h04m, +9°21'].
NGC 2624 Galaxy (S). *m*14.7, 46x28", [8h40m, +19°38']. **A-5**
NGC 2625 Galaxy (S). *m*15.3, 31x26", [8h40m, +19°38']. **A-5**
NGC 2637 Galaxy (S). *m*15.7, 31x26", [8h43m, +19°36']. **A-5**
NGC 2647 Galaxy (E). *m*15.1, 43x34", [8h44m, +19°34']. **A-5**
NGC 2775 Galaxy (S). *m*10.1, 5x4', [9h12m, +6°56'].

DOUBLE STARs

ζ Cancri. *m*5.3/6.0, Sep=5.9", [8h14m, +17°34'].
Triple. The brighter is also a double just 1" apart.
ι Cancri. *m*4.1/6.0, Sep=31", [8h48m, +28°40'].
The Spring Albireo.
σ4 Cancri (**66 Cancri**). *m*5.9/8.1, Sep=4.5", [9h03m, +32°09'].
φ2 Cancri. *m*6.2/6.2, Sep=5.2", [8h28m, +26°51'].
57 Cancri. *m*5.4/5.7, Sep=1.5", [8h56m, +30°29'].

CANES VENATICI

[CVn • *Canum Venaticorum* • NCP, 14N, 11N, 14E, 11E]

DEEP SKY OBJECTs

M3 Globular Cluster. *m*6.2, 16', [13h43m, +28°15'].
M51 *Whirlpool Galaxy* (S). *m*8.1, 11x8', [13h31m, +47°04'].
M63 *Sunflower Galaxy* (S). *m*8.6, 12x8', [13h17m, +41°54'].
M94 *Croc's Eye Galaxy* (S). *m*8.1, 11x9', [12h52m, +40°59'].
M106 Galaxy (S). *m*8.3, 18x8', [12h20m, +47°10'].
NGC 4111 Galaxy (S). *m*10.7, 2x1', [12h08m, +42°56'].
NGC 4138 Galaxy (S). *m*11.4, 3x2', [12h11m, +43°33'].
NGC 4143 Galaxy (S). *m*11.5, 3x2', [12h11m, +42°24'].
NGC 4145 Galaxy (S). *m*11.3, 5x2', [12h11m, +39°49'].
NGC 4151 Galaxy (S). *m*10.8, 6x4', [12h12m, +39°16'].
NGC 4214 Galaxy (I). *m*9.8, 8x6', [12h17m, +36°11'].
NGC 4217 Galaxy (S). *m*11.2, 6x2', [12h17m, +46°57'].
NGC 4220 Galaxy (S). *m*11.3, 3x1', [12h17m, +47°45'].
NGC 4242 Galaxy (S). *m*10.8, 5x4', [12h19m, +45°29'].
NGC 4244 Galaxy (S). *m*10.4, 16x3', [12h19m, +37°40'].
NGC 4346 Galaxy (S). *m*11.5, 3x1', [12h25m, +46°51'].
NGC 4395 Galaxy (S). *m*10.4, 4x2', [12h27m, +33°25'].
NGC 4449 Galaxy (I). *m*9.6, 6x5', [12h29m, +43°57'].
NGC 4460 Galaxy (S). *m*11.5, 4x1', [12h30m, +44°44'].
NGC 4490 Galaxy (S). *m*9.8, 6x3', [12h32m, +41°30'].
NGC 4618 Galaxy (S). *m*10.8, 4x3', [12h43m, +41°01'].
NGC 4631 Galaxy (S). *m*9.2, 14x3', [12h43m, +32°24'].
NGC 4656 Galaxy (S). *m*10.5, 7x1', [12h45m, +32°02'].
NGC 4800 Galaxy (S). *m*11.5, 2x1', [12h56m, +46°24'].
NGC 5005 Galaxy (S). *m*9.8, 5x3', [13h12m, +36°56'].
NGC 5033 Galaxy (S). *m*10.2, 11x6', [13h15m, +36°27'].
NGC 5350 Galaxy (S). *m*11.5, 3x2', [13h54m, +40°14'].
NGC 5353 Galaxy (S). *m*11.0, 3x2', [13h55m, +40°10'].
NGC 5354 Galaxy (S). *m*11.4, 3x1', [13h55m, +40°11'].
NGC 5371 Galaxy (S). *m*10.6, 4x3', [13h57m, +40°20'].
NGC 5377 Galaxy (S). *m*11.3, 4x2', [13h57m, +47°07'].
NGC 5383 Galaxy (S). *m*11.5, 3x2', [13h58m, +41°43'].
NGC 5395 Galaxy (S). *m*11.5, 3x2', [14h00m, +37°18'].

DOUBLE STARs

Cor Caroli (**α**). *m*2.9/5.5, Sep=19.3". [12h57m, +38°11'].
25 Canum Venaticorum. *m*4.8/6.8, Sep=1.8". [13h39m, +36°10'].

RED STAR

Y Canum Venaticorum. *m*4.8–6.5, Period=158 days, [12h46m, +45°18'].

CANIS MAJOR

[CMa • *Canis Majoris* • 8E, 5E, 8S, 5S]

DEEP SKY OBJECTs

Canis Major Dwarf Galaxy (I). *m*—, 12x12°, [Centered at 7h13m, –27°40']. Discovered in 2003, it is, to date, the closest galaxy to our *Milky Way Galaxy* at 25,000 light years. Not plotted.
M41 *Little Beehive* (Cluster). *m*4.5, 38', 80*, [6h47m, –20°47'].
NGC 2204 Cluster. *m*8.6, 13', 80*, [6h17m, –18°40'].
NGC 2207 Galaxy (S). *m*10.8, 4x3', [6h17m, –21°23'].
NGC 2217 Galaxy (S). *m*10.2, 5x4', [6h23m, –27°15'].
NGC 2243 Cluster. *m*9.4, 5', 25*, [6h31m, –31°18'].
NGC 2280 Galaxy (S). *m*10.5, 6x3', [6h46m, –27°40'].
NGC 2325 Galaxy (E). *m*11.2, 4x2', [7h04m, –28°44'].
NGC 2345 Cluster. *m*7.7, 12', 70*, [7h09m, –13°13'].
NGC 2354 Cluster. *m*6.5, 19', 100*, [7h15m, –25°44'].
NGC 2359 *Thor's Helmet* (Em Nebula). *m*—, 7x6', [7h20m, –13°15'].
NGC 2360 Cluster. *m*7.2, 12', 80*, [7h19m, –15°41'].
NGC 2362 Cluster. *m*4.1, 7', 60*, [7h20m, –25°00']. Nice!
NGC 2367 Cluster. *m*7.9, 3.5', 30*, [7h21m, –21°55'].
NGC 2374 Cluster. *m*8, 19', 25*, [7h25m, –13°18'].
NGC 2380 Galaxy (S). *m*11.5, 2x2', [7h25m, –27°35'].
NGC 2383 Cluster. *m*8.4, 6', 40*, [7h26m, –20°59'].
IC 2165 Planetary Nebula. *m*10.6, 9", [6h23m, –13°00'].
Cr 121 Cluster. *m*2.6, 50', 20*, [6h57m, –24°45'].
Centered around o1 Canis Majoris.
Cr 140 Cluster. *m*3.5, 1°, 30*, [7h25m, –31°54'].

DOUBLE STARs

Adhara (**ε**). *m*1.5/7.5, Sep=7.0", [7h00m, –29°00'].
Sirius (**α**). *m*–1.4/8.5, [6h46m, –16°44']. Separation is 10.4" in 2015 and grows to a maximum of 11.3" by 2023. Minimum separation will be 2.5" in 2043. Period is 50.1 years. *Extreme* challenge because of the brightness of Sirius and a contrast difference of 9000 between the two stars.
μ Canis Majoris. *m*5.3/7.1, Sep=3.2", [6h57m, –14°05'].
ν1 Canis Majoris. *m*5.8/7.4, Sep=17.5", [6h37m, –18°41'].
145 G Canis Majoris. *m*5.0/5.8, Sep=26.8", [7h18m, –23°22'].
The Winter Albireo—beautiful! The "145" designation was assigned by Benjamin Apthorp Gould when he charted the skies of the southern hemisphere—the "G" is often omitted.
FN Canis Majoris. *m*5.4/9.0, Sep=17.5", [7h08m, –11°20'].
HR 2834. *m*5.4/7.6, Sep=98.5" or 1.6', [7h26m, –31°51'].
The *m*5.4 star also has a *m*9.7 companion 2.1" away.

Objects *by* Number

The objects in this section are listed by catalogue designation in alphabetical and numerical order to serve as a cross references when the constellation is unknown. The type of object and 3-letter abbreviation of the constellation is given for each object. For more information about an object, see the corresponding entry under Objects *by* Constellation starting on page 40. At the beginning of each list, the name of the cataloguer, catalogue or origin is provided.

EDWARD BARNARD

B 33 Dark Nebula. **Ori**
B 72 Dark Nebula. **Oph**

VICTOR BLANCO

Blanco 1 Cluster. **Scl**

STEFAN CEDERBLAD

Ced 122 Nebula. **Cen**

PER COLLINDER

Cr 21 Cluster. **Tri**
Cr 69 Cluster. **Ori**
Cr 121 Cluster. **CMa**
Cr 135 Cluster. **Pup**
Cr 140 Cluster. **CMa**
Cr 228 Cluster. **Car**
Cr 232 Cluster. **Car**
Cr 350 Cluster. **Oph**
Cr 338 Cluster. **Sco**
Cr 394 Cluster. **Sgr**
Cr 399 Cluster. **Vul**
Cr 401 Cluster. **Aql**

S. G. DJORGOVSKI

Djorg 1 Globular. **Sco**
Djorg 2 Globular. **Sgr**

EUROPEAN SOUTHERN OBSERVATORY

ESO 121-6 Galaxy. **Pic**
ESO 358-63 Galaxy. **For**

COLIN GUM

Gum 15 Nebula. **Vel**
Gum 17 Nebula. **Vel**
Gum 39 Nebula. **Cen**
Gum 41 Nebula. **Cen**

HAUTE-PROVENCE

HP 1 Globular. **Oph**

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IC 239 Galaxy. **And**
IC 342 Galaxy. **Cam**
IC 348 Nebula/Cluster. **Per**
IC 405 Nebula. **Aur**
IC 434 Nebula. **Ori**
IC 694 Galaxy. **UMa**
IC 1276 Globular. **Ser**
IC 1287 Nebula. **Sct**
IC 1297 Planetary. **CrA**
IC 1318 Nebula. **Cyg**
IC 1396 Nebula. **Cep**
IC 1459 Galaxy. **Gru**
IC 1613 Galaxy. **Cet**
IC 1805 Nebula/Cluster. **Cas**
IC 1848 Nebula. **Cas**
IC 1871 Nebula. **Cas**
IC 1954 Galaxy. **Hor**
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IC 2177 Nebula. **Mon**
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IC 2488 Cluster. **Vel**
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IC 2553 Planetary. **Car**
IC 2581 Cluster. **Car**
IC 2602 Cluster. **Car**
IC 2621 Planetary. **Car**
IC 2714 Cluster. **Car**
IC 2872 Nebula. **Cen**
IC 2944 Cluster. **Cen**
IC 2948 Nebula. **Cen**
IC 3370 Galaxy. **Cen**
IC 3896 Galaxy. **Cen**
IC 4191 Planetary. **Mus**
IC 4296 Galaxy. **Cen**
IC 4329 Galaxy. **Cen**
IC 4406 Planetary. **Lup**
IC 4444 Galaxy. **Lup**
IC 4499 Globular. **Aps**
IC 4592 Nebula. **Sco**
IC 4593 Planetary. **Her**
IC 4601 Nebula. **Sco**
IC 4634 Planetary. **Oph**
IC 4651 Cluster. **Ara**
IC 4662 Galaxy. **Pav**
IC 4663 Planetary. **Sco**
IC 4665 Cluster. **Oph**
IC 4756 Cluster. **Ser**
IC 4776 Planetary. **Sgr**
IC 4797 Galaxy. **Tel**
IC 4889 Galaxy. **Tel**
IC 4997 Planetary. **Sge**
IC 5052 Galaxy. **Pav**
IC 5067 Nebula. **Cyg**
IC 5105 Galaxy. **Mic**
IC 5117 Planetary. **Cyg**
IC 5146 Nebula/Cluster. **Cyg**
IC 5148 Planetary. **Gru**
IC 5181 Galaxy. **Gru**
IC 5201 Galaxy. **Gru**
IC 5217 Planetary. **Lac**
IC 5240 Galaxy. **Gru**
IC 5267 Galaxy. **Gru**
IC 5273 Galaxy. **Gru**
IC 5325 Galaxy. **Phe**
IC 5328 Galaxy. **Phe**
IC 5332 Galaxy. **Scl**

Leo I (1) Galaxy. **Leo**

CHARLES MESSIER

M1 Supernova. **Tau**
M2 Globular. **Aqr**
M3 Globular. **CVn**
M4 Globular. **Sco**
M5 Globular. **Ser**
M6 Cluster. **Sco**
M7 Cluster. **Sco**
M8 Nebula. **Sgr**
M9 Globular. **Oph**
M10 Globular. **Oph**
M11 Cluster. **Sct**
M12 Globular. **Oph**
M13 Globular. **Her**
M14 Globular. **Oph**
M15 Globular. **Peg**
M16 Nebula/Cluster. **Ser**
M17 Nebula/Cluster. **Sgr**
M18 Cluster. **Sgr**
M19 Globular. **Oph**
M20 Nebula/Cluster. **Sgr**
M21 Cluster. **Sgr**
M22 Globular. **Sgr**
M23 Cluster. **Sgr**
M24 Milky Way Patch. **Sgr**
M25 Cluster. **Sgr**
M26 Cluster. **Sct**
M27 Planetary. **Vul**
M28 Globular. **Sgr**
M29 Cluster. **Cyg**
M30 Globular. **Cap**
M31 Galaxy. **And**
M32 Galaxy. **And**
M33 Galaxy. **Tri**
M34 Cluster. **Per**
M35 Cluster. **Gem**
M36 Cluster. **Aur**
M37 Cluster. **Aur**
M38 Cluster. **Aur**
M39 Cluster. **Cyg**
M40 Asterism. **UMa**
M41 Cluster. **CMa**
M42 Nebula. **Ori**
M43 Nebula. **Ori**
M44 Cluster. **Cnc**
M45 Cluster. **Tau**
M46 Cluster. **Pup**
M47 Cluster. **Pup**
M48 Cluster. **Hya**
M49 Galaxy. **Vir**
M50 Cluster. **Mon**
M51 Galaxy. **CVn**
M52 Cluster. **Cas**
M53 Globular. **Com**
M54 Globular. **Sgr**
M55 Globular. **Sgr**
M56 Globular. **Lyr**
M57 Planetary. **Lyr**
M58 Galaxy. **Vir**
M59 Galaxy. **Vir**
M60 Galaxy. **Vir**
M61 Galaxy. **Vir**
M62 Globular. **Oph**
M63 Galaxy. **CVn**
M64 Galaxy. **Com**
M65 Galaxy. **Leo**
M66 Galaxy. **Leo**
M67 Cluster. **Cnc**
M68 Globular. **Hya**
M69 Globular. **Sgr**
M70 Globular. **Sgr**
M71 Globular. **Sge**
M72 Globular. **Aqr**
M73 Asterism. **Aqr**
M74 Galaxy. **Psc**
M75 Globular. **Sgr**
M76 Planetary. **Per**
M77 Galaxy. **Cet**
M78 Nebula. **Ori**
M79 Globular. **Lep**
M80 Globular. **Sco**
M81 Galaxy. **UMa**
M82 Galaxy. **UMa**
M83 Galaxy. **Hya**
M84 Galaxy. **Vir**
M85 Galaxy. **Com**
M86 Galaxy. **Vir**
M87 Galaxy. **Vir**

Objects *by* Type

The objects listed in this section are by type. The 3-letter abbreviation of the constellation is given for each object. For more information about an object, see the corresponding entry under "Objects *by* Constellation" starting on page 40. This listing provides for cross-referencing and to give observers a convenient check-off list for observing objects of a single type—an endeavor many amateurs pursue. Note: Clusters and nebulae are often intertwined objects because clusters are born from nebulae. For this reason, those clusters associated with a nebula are listed under both Clusters and Nebulae.

Asterisms

Big Dipper. UMa
Circlet. Psc
Coathanger. Vul
False Cross. Car/Vel
Great Square. Peg
Kemble's Cascade. Cam
Keystone. Her
Little Dipper. UMi
M40. UMa
M73. Aqr
Northern Cross. Cyg
Sickle. Leo
Summer Triangle. Aql/Cyg/Lyr
Winter Triangle. CMa/CMi/Ori

Clusters

• Associated with nebulosity

Blanco 1. Scl
Cr 21. Tri
Cr 69. Ori
Cr 121. CMa
Cr 135. Pup
Cr 140. CMa
Cr 228. Car
Cr 232. Car
Cr 338. Sco
Cr 350. Oph
Cr 394. Sgr
Cr 399. Vul
Cr 401. Aql
Delta Lyrae Cluster. Lyr
Gamma Velorum Cluster. Vel
• **IC 348**. Per
• **IC 1805**. Cas
IC 2391. Vel
IC 2395. Vel
IC 2488. Vel
IC 2581. Car
IC 2602. Car
IC 2714. Car
IC 2944. Cen
IC 4651. Ara
IC 4665. Oph
IC 4756. Ser
• **IC 5146**. Cyg
M6. Sco
M7. Sco
• **M8**. Sgr
M11. Sct
• **M16**. Ser
• **M17**. Sgr
M18. Sgr
• **M20**. Sgr
M21. Sgr
M23. Sgr
M25. Sgr
M26. Sct
M29. Cyg
M34. Per
M35. Gem
M36. Aur
M37. Aur
M38. Aur
M39. Cyg
M41. CMa
• **M42**. Ori
M44. Cnc
M45. Tau
M46. Pup
M47. Pup
M48. Hya
M50. Mon
M52. Cas
M67. Cnc
M93. Pup
M103. Cas
Mel 20. Per
Mel 101. Car
Mel 111. Com
Mel 227. Oct
NGC 152. Tuc
NGC 188. Cep
NGC 225. Cas
NGC 290. Tuc
NGC 330. Tuc
NGC 339. Tuc
• **NGC 346.** Tuc
NGC 361. Tuc
• **NGC 371.** Tuc
NGC 381. Cas
NGC 436. Cas
• **NGC 456**. Tuc
NGC 457. Cas
NGC 458. Tuc
• **NGC 460.** Tuc
NGC 465. Tuc
• **NGC 602**. Hyi
NGC 637. Cas
NGC 654. Cas
NGC 559. Cas
NGC 659. Cas
NGC 663. Cas
NGC 743. Cas
NGC 752. And
NGC 869/884. Per
NGC 884/869. Per
NGC 1027. Cas
NGC 1342. Per
NGC 1502. Cam
NGC 1513. Per
NGC 1528. Per
NGC 1545. Per
• **NGC 1624**. Per
NGC 1647. Tau
NGC 1662. Ori
NGC 1664. Aur
NGC 1711. Men
• **NGC 1727**. Dor
NGC 1746. Tau
NGC 1751. Men
• **NGC 1770**. Dor
NGC 1778. Aur
NGC 1783. Dor
NGC 1786. Dor
NGC 1817. Tau
NGC 1818. Dor
NGC 1845. Men
NGC 1846. Dor
• **NGC 1848**. Men
NGC 1857. Aur
• **NGC 1858**. Dor
NGC 1866. Dor
NGC 1869. Dor
NGC 1871. Dor
NGC 1873. Dor
NGC 1893. Aur
NGC 1907. Aur
• **NGC 1929**. Dor
• **NGC 1931**. Aur
• **NGC 1934**. Dor
• **NGC 1935**. Dor
• **NGC 1936**. Dor
• **NGC 1937**. Dor
• **NGC 1955**. Dor
• **NGC 1966**. Dor
NGC 1978. Dor
NGC 1981. Ori
• **NGC 2014**. Dor
• **NGC 2018**. Men
NGC 2021. Men
• **NGC 2048**. Dor
• **NGC 2070**. Dor
NGC 2112. Ori
• **NGC 2122**. Men
NGC 2129. Gem
NGC 2158. Gem
NGC 2169. Ori
• **NGC 2175**. Ori
NGC 2186. Ori
NGC 2194. Ori
NGC 2204. CMa
NGC 2215. Mon
NGC 2232. Mon
NGC 2236. Mon
NGC 2243. CMa
NGC 2244. Mon
NGC 2251. Mon
• **NGC 2264**. Mon
NGC 2266. Gem
NGC 2281. Aur
NGC 2286. Mon
NGC 2301. Mon
NGC 2324. Mon
NGC 2331. Gem
NGC 2335. Mon
NGC 2343. Mon
NGC 2345. CMa
NGC 2353. Mon
NGC 2354. CMa
NGC 2360. CMa
NGC 2362. CMa
NGC 2367. CMa
NGC 2374. CMa
NGC 2383. CMa
NGC 2395. Gem
NGC 2420. Gem
NGC 2421. Pup
NGC 2423. Pup
NGC 2439. Pup
NGC 2451. Pup
NGC 2453. Pup
NGC 2467. Pup
NGC 2477. Pup
NGC 2479. Pup
NGC 2482. Pup
NGC 2483. Pup
NGC 2489. Pup
NGC 2506. Mon
NGC 2509. Pup
NGC 2516. Car
NGC 2527. Pup
NGC 2533. Pup
NGC 2539. Pup
NGC 2546. Pup
NGC 2547. Vel
NGC 2567. Pup
NGC 2571. Pup
NGC 2580. Pup
NGC 2587. Pup
NGC 2627. Pyx
NGC 2669. Vel
NGC 2670. Vel
NGC 2818. Pyx
NGC 2910. Vel
NGC 2925. Vel
NGC 3114. Car
NGC 3228. Vel
• **NGC 3247**. Car
• **NGC 3293**. Car
• **NGC 3324**. Car
NGC 3330. Vel
NGC 3532. Car
NGC 3572. Car
NGC 3590. Car
NGC 3680. Cen
NGC 3766. Cen
NGC 3960. Cen
NGC 4052. Cru
NGC 4103. Cru
NGC 4230. Cen
NGC 4349. Cru
NGC 4439. Cru
NGC 4609. Cru
NGC 4755. Cru
NGC 5138. Cen
NGC 5281. Cen
NGC 5316. Cen
• **NGC 5367**. Cen
NGC 5460. Cen
NGC 5606. Cen
NGC 5617. Cen
NGC 5662. Cen
NGC 5822. Lup
NGC 5823. Cir
NGC 5925. Nor
NGC 6025. TrA
NGC 6031. Nor
NGC 6067. Nor
NGC 6087. Nor
NGC 6124. Sco
NGC 6134. Nor
NGC 6152. Nor
NGC 6167. Nor
NGC 6169. Nor
NGC 6178. Sco
NGC 6192. Sco
NGC 6193. Ara
NGC 6200. Ara
NGC 6204. Ara
NGC 6208. Ara
NGC 6231. Sco
NGC 6242. Sco
NGC 6249. Sco
NGC 6250. Ara
NGC 6259. Sco
NGC 6268. Sco
NGC 6281. Sco
NGC 6322. Sco
NGC 6383. Sco
NGC 6396. Sco
NGC 6400. Sco
NGC 6416. Sco
NGC 6425. Sco
NGC 6451. Sco
NGC 6469. Sgr
NGC 6520. Sgr
NGC 6546. Sgr
NGC 6568. Sgr
NGC 6583. Sgr
NGC 6603. Sgr
NGC 6604. Ser
NGC 6633. Oph
NGC 6645. Sgr
NGC 6664. Sct
NGC 6709. Aql
NGC 6716. Sgr
NGC 6738. Aql

Objects *by* Name

8-Burst Nebula. *See* **Southern Ring Nebula**.
30 Doradus. *See* **Tarantula Nebula**.

37 Cluster. NGC 2169. Ori/**5E**
47 Tucanae. Globular Cluster. NGC 104. Tuc/**SCP**, **A-8**

α (Alpha) Persei Cluster. *See* **Alpha Persei Cluster**.
η (Eta) Carinae Nebula. *See* **Eta Carinae Nebula**.
ο (Omicron) Velorum Cluster. *See* **Omicron Velorum Cluster**.
ρ (Rho) Ophiuchi Nebula. *See* **Rho Ophiuchi Nebula**.
ω (Omega) Centauri. *See* **Omega Centauri**.

Alpha (α) Persei Cluster. Cluster next to *Mirphak*. Per/**2N**
Andromeda Galaxy. M31. And/**2N**
Antennae Galaxies. Galaxy pair. NGC 4038/4039. Crv/**11E**

Barnard's Galaxy. Irregular Galaxy. NGC 6822. Sgr/**20S**
Barnard's Loop. Nebula. Sh2-276. Ori/**5E**
Barnard's Star. Fast moving star. Oph/**17E**
Beehive. *See* **Praesepe**.
Big Dipper. An Asterism of Ursa Major but most of us think of the Big Dipper *as* Ursa Major. UMa/**NCP**, **11N**
Black Eye Galaxy. M64. Com/**14E**
Black Swan. Cluster. M18. Sgr/**17E**, **A-12**
Blinking Planetary. Planetary Nebula. NGC 6826. Cyg/**20N**
Blue Planetary. Planetary Nebula. NGC 3918. Cen/**11S**, **A-9**
Blue Snowball. Planetary Nebula. NGC 7662. And/**23N**
Bode's Nebulae. Galaxy pair. M81/M82. UMa/**11N**
Bow Tie Nebula. Planetary Nebula. NGC 40. Cep/**23N**
Box. 4 faint Galaxies: NGC's 4169, 4173, 4174, 4175. Spans 4', *m*12.2–14.3, centered at [12h13m, +29°02']. In Coma Berenices. Not plotted.
Box Nebula. Planetary Nebula. NGC 6309. Oph/**17E**
Brocchi's Cluster. Asterism. Cr 399. Better known as the Coathanger because it is shaped like one. Vul/**20N**.
Bubble Nebula. Stellar-wind Nebula. NGC 7635. Cas/**23N**
Bug Nebula. Planetary Nebula. NGC 6302. Sco/**17S**, **A-12**
Butterfly Cluster. M6. Sco/**17S**, **A-12**

California Nebula. Star-forming Nebula. NGC 1499. Per/**5N**
Carinae Nebula. *See* Eta Carinae Nebula.
Cat's Eye. Globular Cluster. M4 Sco/**17S**
Cat's Eye Nebula. Planetary Nebula. NGC 6543. Dra/**17N**
Cave Nebula. Star-forming Nebula. Sh2-155. Cep/**23N**
Centaurus A. Galaxy & Radio Source. NGC 5128. Cen/**14S**
Christmas Tree Cluster. Cluster. NGC 2264. Mon/**8E**
Cigar Galaxy. Irregular Galaxy. M82. UMa/**11N**
Circlet. An Asterism of Pisces. Six stars that form a ring below the Great Square of Pegasus. Psc/**23E**.
Coalsack. Dark Nebula. Cru/**14S**, **A-9**
Coathanger. *See* **Brocchi's Cluster**
Cocoon Galaxy. Spiral Galaxy. NGC 4490. CVn/**14N**
Cocoon Nebula. Star-forming Nebula. IC 5146. Cyg/**23N**, **20N**
Cone Nebula. Diffused & Dark Neb. NGC 2264. Mon/**8E**
Copeland's Septet. 7 faint Galaxies: NGC's 3745, 3746, 3748, 3750, 3751, 3753, 3754. Spans 5', *m*13.6–15.2, centered at [11h39m, +21°56']. In Leo. Not plotted.
Crab Nebula. Supernova Remnant. M1. Tau/**5N**
Crescent Nebula. Emission Nebula. NGC 6888. Cyg/**20N**
Croc's Eye. Sprial Galaxy. M94. CVn/**14N**
Cross. *See* **Northern Cross** and/or **Southern Cross**.

Dark Doodad. Dark Nebula. Mus/**14S**
Demon Star. The Variable Star, *Algol*. Per/**2N**
Diamond Cluster. Cluster. NGC 2516. Car/**8S**
Double-Double. Double Star, *ε Lyrae*. Lyr/**20N**
Double Cluster. Side-by-Side pair. NGC 869/884. Per/**2N**
Dumbbell Nebula. Planetary Nebula. M27. Vul/**20N**

Eagle Nebula. Nebula/Cluster. M16. Ser/**17E**, **A-12**
Eight-burst Nebula. *See* **Southern Ring Nebula**.
Engagement Ring. Asterism. Nine stars that roughly form a circle with *Polaris*. UMi/**A-1**.
Eskimo Nebula. Planetary Nebula. NGC 2392. Gem/**8N**
Eta (η) Carinae Nebula. Star-forming Nebula. NGC 3372. Car/**11S**, **A-9**, **A-11**
Eyes. Two Galaxies. NGC 4435 & 4438 in Markarian's Chain. Vir/**A-14**

False Cross. 2 stars in Carina & 2 stars in Vela that are confused with the true Southern Cross. Indicated on charts **11S** and **8S**.
Firecracker Galaxy. Spiral Galaxy. NGC 6946. Cyg/**20N**
Flame Nebula. Emission Nebula. NGC 2024. Ori/**5E**
Flaming Star Nebula. Star-forming Nebula. IC 405. Aur/**5N**
Flickering Globular. Globular Cluster. M62. Oph/**17S**

Garnet Star. *See* **Herschel's Garnet Star**.
Gem Cluster. Cluster. NGC 3293. Car/**11S**, **A-9**
Ghost of Jupiter. Planetary Nebula. NGC 3242. Hya/**11E**
Great Hercules Cluster. Globular Cluster. M13. Her/**17N**
Great Orion Nebula. *See* **Orion Nebula**.
Great Pegasus Cluster. Globular Cluster. M15. Peg/**23E**
Great Rift. A dark dust lane in the Milky Way Band that stretches from Cygnus to Sagittarius. **20N**, **20E**, **17E**
Great Sagittarius Cluster. Globular Cluster. M22. Sgr/**20S**, **A-12**
Great Square. An Asterism of Pegasus. Four bright stars in Pegasus that form a giant "square." Peg/**23N**.
Grus' Quartet. 4 Galaxies: NGC's 7752, 7582, 7590, 7599. Gru/**23S**

Heart Cluster. Cluster. NGC 2547. Vel/**8S**
Heart Nebula. Emission Nebula. IC 1805. Cas/**2N**
Helix Galaxy. Polar-ring Galaxy. NGC 2685. UMa/**8N**
Helix Nebula. Planetary Nebula. NGC 7293. Aqr/**23E**
Hercules Cluster. *See* **Great Hercules Cluster**.
Herschel's Garnet Star. Red Star, *μ Cephei*. Cep/**23N**
Hind's Variable Nebula. Nebula. NGC 1555. Tau/**5N**
Horsehead Nebula. Dark Nebula. Overlaps IC 434. Ori/**5E**
Hourglass Nebula. Brightest part of the Lagoon Nebula, M8. Sgr/**17E**, **A-12**
Hubble's Variable Nebula. Nebula. NGC 2261. Mon/**8E**
Hyades. Largest Cluster. Also an Asterism. Tau/**5N**

Intergalactic Wanderer. Globular Cluster. NGC 2419. Lyn/**8N**
Iris Nebula. Star-forming Nebula. NGC 7023. Cep/**20N**

Jewel Box. Cluster. NGC 4755. Cru/**14S**, **A-9**. There is a northern counterpart called the Northern Jewel Box.

Kemble's Cascade. Twenty *m*8 stars in a 2.5° line. Cam/**5N**
Kepler's Star. Supernova Remnant, 1604 AD. Oph/**17S**, **A-12**
Keystone. Asterism. Four stars that form the shape of the top center stone used in forming an arch, like that of a doorway. Her/**17N**.
King Cobra. Cluster. M67. Cnc/**8N**

Messier Objects

The Messier Object catalogue represents the cream-of-the-crop deep sky objects that can be seen from the mid-latitudes of the northern hemisphere. It was compiled at the end of the 1700s by Charles Messier from Paris, France, using telescopes around 3 to 4-inches in diameter. This catalogue is historically significant because it is the very first catalogue ever compiled of deep sky objects. And, since it lists the biggest and brightest objects in the sky, it has become a logical "next step" for amateurs wanting to go beyond observing the Moon and planets.

An interesting point about this catalogue is that it has at least one example of every type of deep sky object that exists, so it represents a good sample of the objects that can be found in the heavens.

There is a quirk of nature that allows viewing all of the Messier objects in one night. This can be accomplished around New Moon during March. This event has become known as a Messier Marathon and many astronomy clubs sponsor "parties" to accomplish this dusk to dawn task.

Charles Messier was born in Badonviller, France in 1730. His father held a mayoral-type position in the town but passed away when Messier was 11. Hyacinthe, Charles's brother, trained Charles as an administer's assistant and eventually found Charles a job in Paris as an assistant to an astronomer.

Charles Messier was the leading observational astronomer in the 1700s and compiled the first catalogue of deep sky objects.

Messier did exceedingly well at his job, advanced, and became, during his time, the leading observational astronomer in the world. He eventually acquired his boss's position as Astronomer of the Navy. During his career, he wrote numerous articles that spanned the field of astronomy and were published in the leading scientific journals. One of his most notable life-long achievements was discovering about 20 comets, which established his credibility and lead to his induction into almost every European science academy.

Messier never would have believed that his namesake would be defined by his little catalogue—he would have thought it would have been his comet discoveries. He catalogued deep sky objects because he realized that such a catalogue was missing in the field of astronomy (astronomy and most sciences were just starting to get organized during this time in history). To start the catalogue, he used a few short lists of deep sky objects compiled by other astronomers and quickly added objects he found exploring the night sky. Three editions of his catalogue were published, each growing in size, with the last published in 1781, listing 103 objects. He stopped adding objects because in 1785, William Herschel, inspired by Messier's catalogue, published a catalogue listing about 1,000 objects using an 18.7-inch diameter telescope. Messier knew he could not compete!

Although Messier's last catalogue listed just 103 objects, seven additional objects have been added—objects that he described in other publications but never listed in his catalogue. In the table below, the Double Cluster (in Perseus) has been added as objects 111 and 112 because these are Messier-type objects that Messier knew existed but for some reason missed including them—his only glaring "error."

Messier passed away in 1731 at his residence in the Cluny Hotel (near the Sorbonne), now known as the National Museum of the Middle Ages. His observatory was atop the front tower but no trace remains.

The Messier Catalogue

#	Cons.	Charts	NGC#	RA 2025.0	Dec	Object	Mag.	Arc Size	Name
M1	Tau	**5N**, **5E**	1952	5h 36m	+22° 02'	Supernova Remnant	8	6x4'	Crab Nebula
M2	Aqr	**23E**, **20E**	7089	21h 35m	−0° 43'	Globular Cluster	6.5	13'	
M3	CVn	**14N**, **14E**	5272	13h 43m	+28° 15'	Globular Cluster	6.2	16'	
M4	Sco	**17E**, **17S**	6121	16h 25m	−26° 35'	Globular Cluster	5.9	26'	Cat's Eye
M5	Ser	**14E**, **17E**	5904	15h 20m	+1° 59'	Globular Cluster	5.7	17'	
M6	Sco	**17E**, **17S**[1]	6405	17h 42m	−32° 16'	Cluster	4.2	15'	Butterfly Cluster
M7	Sco	**17E**, **17S**[1]	6475	17h 56m	−34° 47'	Cluster	3.3	80'	Ptolemy's Cluster
M8	Sgr	**17E**, **17S**[1]	6523	18h 05m	−24° 23'	Nebula	6	1.5x0.7°	Lagoon Nebula
M9	Oph	**17E**, **17S**[1]	6333	17h 21m	−18° 33'	Globular Cluster	7.7	9'	
M10	Oph	**17E**	6254	16h 58m	−4° 08'	Globular Cluster	6.6	15'	
M11	Sct	**20E**, **20S**	6705	18h 52m	−6° 14'	Cluster	5.8	14'	Wild Duck Cluster
M12	Oph	**17E**	6218	16h 49m	−2° 00'	Globular Cluster	6.7	15'	
M13	Her	**17N**, **17E**	6205	16h 43m	+36° 25'	Globular Cluster	5.8	17'	Great Hercules Cluster
M14	Oph	**17E**	6402	17h 39m	−3° 16'	Globular Cluster	7.6	12'	
M15	Peg	**23E**, **20E**	7078	21h 31m	+12° 17'	Globular Cluster	6.2	12'	Great Pegasus Cluster
M16[2]	Ser	**17E**, **17S**[1]	6611	18h 20m	−13° 46'	Nebula/Cluster	6	35x28'	Eagle Nebula
M17	Sgr	**17E**, **17S**[1]	6618	18h 22m	−16° 10'	Nebula/Cluster	6.5	46x37'	Omega Nebula, Swan Nebula
M18	Sgr	**17E**, **17S**[1]	6613	18h 21m	−17° 05'	Cluster	6.9	9'	Black Swan
M19	Oph	**17E**, **17S**[1]	6273	17h 04m	−26° 18'	Globular Cluster	6.8	14'	
M20	Sgr	**17E**, **17S**[1]	6514	18h 04m	−23° 02'	Nebula/Cluster	8	28x28'	Trifid Nebula

[1]See close-up chart A-12, too.

[2]Contains the *Pillars of Creation* (pictured on the back cover).

Caldwell Objects

The Calwell objects are a more recent listing of deep sky objects picked by the British amateur astronomer Sir Patrick Alfred Caldwell-Moore (1923–2012) from existing catalogues. Although Moore is mostly unknown to Americans, he was a well-known British celebrity having the longest run British TV show on astronomy, *The Sky at Night*, and has written more than 70 books on astronomy.

In 1995, the popular US astronomy magazine, *Sky and Telescope*, published Moore's list of 109 deep sky objects that he selected as a supplement to Messier's objects, but encompassing the entire celestial sphere. His catalogue contains objects mostly from the NGC and IC catalogues by Dreyer. He uniquely ordered his objects by declination from north to south.

The Caldwell objects are not specifically noted in this celestial atlas using Moore's designations because the list is not historically significant. However, all of the Caldwell objects can be found in this celestial atlas using their traditional catalogue designations, which are included in the table below. The Caldwell catalogue is provided because of an interest by amateurs to find objects on lists.

The Caldwell Catalogue

#	Cons.	Charts	NGC#	RA 2025.0	Dec	Object	Mag.	Arc Size	Name
C1	Cep	**NCP**	188	0h 50m	+85° 23'	Cluster	8.1	17'	
C2	Cep	**23N**	40	0h 14m	+72° 40'	Planetary Nebula	10.7	36"	Bow Tie Nebula
C3	Dra	**NCP**, **11N**	4236	12h 18m	+69° 19'	Spiral Galaxy	9.6	22x6'	
C4	Cep	**20N**	7023	21h 02m	+68° 16'	Nebula	6.8	18x18'	Iris Nebula
C5	Cam	**2N**	IC 342	3h 49m	+68° 11'	Spiral Galaxy	9.7	20x19'	
C6	Dra	**NCP**, **17N**	6543	17h 59m	+66° 38'	Planetary Nebula	8.1	20"	Cat's Eye Nebula
C7	Cam	**8N**	2403	7h 39m	+65° 33'	Spiral Galaxy	8.5	16x8'	
C8	Cas	**2N**	559	1h 31m	+63° 26'	Cluster	9.5	5'	
C9	Cep	**23N**	Sh2-155	22h 58m	+62° 45'	Nebula	7.7	50x10'	Cave Nebula
C10	Cas	**2N**	663	1h 48m	+61° 22'	Cluster	7.1	16'	
C11	Cas	**23N**	7635	23h 22m	+61° 20'	Nebula	11.0	15x8'	Bubble Nebula
C12	Cyg	**20N**	6946	20h 35m	+60° 14'	Spiral Galaxy	9.1	12x11'	
C13	Cas	**2N**	457	1h 21m	+58° 25'	Cluster	6.4	13'	Owl Cluster
C14	Per	**2N**	869/884	2h 22m	+57° 14'	Two Clusters	4 & 4	30' & 30'	Double Cluster
C15	Cyg	**20N**	6826	19h 45m	+50° 35'	Planetary Nebula	8.9	25"	Blinking Planetary
C16	Lac	**23N**	7243	22h 16m	+50° 00'	Cluster	6.4	29'	
C17	Cas	**2N**	147	0h 35m	+48° 39'	Elliptical Galaxy	9.6	9x5'	
C18	Cas	**2N**	185	0h 40m	+48° 29'	Elliptical Galaxy	9.2	9x7'	
C19	Cyg	**23N**, **20N**	IC 5146	21h 54m	+47° 23'	Nebula/Cluster	7.2	12x12'	Cocoon Nebula
C20	Cyg	**20N**	7000	21h 00m	+44° 26'	Nebula	6	2x1.7°	North America Nebula
C21	CVn	**14N**	4449	12h 29m	+43° 57'	Irregular Galaxy	9.6	6x5'	
C22	And	**23N**	7662	23h 27m	+42° 40'	Planetary Nebula	8.3	17"	Blue Snowball
C23	And	**2N**	891	2h 24m	+42° 28'	Spiral Galaxy	9.9	13x3'	
C24	Per	**5N**, **2N**	1275	3h 21m	+41° 36'	Seyfert Galaxy	11.8	2x1'	
C25	Lyn	**8N**	2419	7h 40m	+38° 50'	Globular Cluster	9.1	6'	Intergalactic Wanderer
C26	CVn	**14N**	4244	12h 19m	+37° 40'	Spiral Galaxy	10.4	16x3'	
C27	Cyg	**20N**	6888	20h 13m	+38° 29'	Nebula	7.4	20x10'	Crescent Nebula
C28	And	**2N**	752	1h 59m	+37° 54'	Cluster	5.7	50'	
C29	CVn	**14N**	5005	13h 12m	+36° 56'	Spiral Galaxy	9.8	5x3'	
C30	Peg	**23N**	7331	22h 38m	+34° 33'	Spiral Galaxy	9.5	10x4'	
C31	Aur	**5N**	IC 405	5h 18m	+34° 18'	Nebula	10.0	30x19'	Flaming Star Nebula
C32	CVn	**14N**	4631	12h 43m	+32° 24'	Spiral Galaxy	9.2	14x3'	
C33	Cyg	**20N**	6992/5	20h 57m	+31° 49'	Supernova Remnant	8	60x8'	East Veil Nebula
C34	Cyg	**20N**	6960	20h 47m	+30° 48'	Supernova Remnant	8	70x6'	West Veil Nebula
C35	Com	**14N**	4889	13h 01m	+27° 51'	Elliptical Galaxy	11.5	3x2'	
C36	Com	**14N**	4559	12h 37m	+27° 49'	Spiral Galaxy	9.8	11x5'	

Stars *by* Name

Name (Desig.)	Mag.[1]	Const.	Dist.	Chart
Acamar (θ)	3.2	Eridanus	161 ly	**2S**
Achernar (α)	0.5	Eridanus	139 ly	**2S**
Acrux (α)	0.8	Crux	320 ly	**14S**
Acubens (α)	4.3	Cancer	174 ly	**8N**
Adhafera (ζ)	3.4	Leo	274 ly	**11E**
Adhara (ε)	1.5	Canis Major	430 ly	**8S**
Albali (ε)	3.8	Aquarius	208 ly	**20E**
Albireo (β)	3.2	Cygnus	430 ly	**20N**
Alchiba (α)	4.0	Corvus	48 ly	**11S**
Alcor (80)	3.99	Ursa Major	83 ly	**14N**
Alcyone (η)	2.86	Taurus/Pleiades	444 ly	**A-3**
Aldebaran (α)	0.9v	Taurus	65 ly	**5E**
Alderamin (α)	2.5	Cepheus	49 ly	**23N**
Alfirk (β)	3.2	Cepheus	690 ly	**23N**
Algedi (α[1])	4.3	Capricorn	690 ly	**20S**
(α[2])	3.6	Capricorn	109 ly	**20S**
Algenib (γ)	2.8	Pegasus	390 ly	**23E**
Algieba (γ)	2.0	Leo	130 ly	**11E**
Algol (β)	2.1v	Perseus	93 ly	**2N**
Algorab (δ)	3.1	Corvus	87 ly	**11S**
Alhena (γ)	1.9	Gemini	109 ly	**8E**
Alioth (ε)	1.8	Ursa Major	83 ly	**11N**
Alkaid (η)	1.9	Ursa Major	104 ly	**14N**
Alkalurops (μ)	4.5	Bootes	121 ly	**14N**
Alkes (α)	4.1	Crater	174 ly	**11E**
Almaak (γ)	2.3	Andromeda	350 ly	**2N**
Alnair (α)	1.7	Grus	101 ly	**23S**
Alnasl (γ)	3.0	Sagittarius	97 ly	**17S**
Alnath (β)	1.7	Taurus	131 ly	**5E**
Alnilam (ε)	1.7	Orion	1,300 ly	**5E**
Alnitak (ζ)	1.7	Orion	1,260 ly	**5E**
Alphard (α)	2.0	Hydra	177 ly	**11S**
Alphekka (α)	2.2	Corona Borealis	75 ly	**17N**
Alpheratz (α)	2.1	Andromeda	97 ly	**23N**
Alrakis (μ)	5.7	Draco	88 ly	**17N**
Alrescha (α)	4.5	Pisces	139 ly	**2E**
Alshain (β)	3.9	Aquila	45 ly	**20E**
Alsuhail/Regor (λ)	1.8	Vela	1,100 ly	**8S**
Altair (α)	0.8	Aquila	17 ly	**20E**
Altais (δ)	3.1	Draco	97 ly	**17N**
Alterf (λ)	4.3	Leo	336 ly	**11E**
Aludra (η)	2.4	Canis Major	2,000 ly	**8S**
Alula Australis (ξ)	3.8	Ursa Major	29 ly	**11N**
Alula Borealis (ν)	3.5	Ursa Major	399 ly	**11N**
Alya (θ)	4.0	Serpens	132 ly	**20E**
Ancha (θ)	4.2	Aquarius	187 ly	**23E**
Ankaa (α)	2.4	Phoenix	85 ly	**2S**
Antares (α)	1.1	Scorpius	550 ly	**17S**
Arcturus (α)	−0.04v	Bootes	37 ly	**14E**
Arkab (β)	4.0	Sagittarius	378 ly	**20S**
Arneb (α)	2.6	Lepus	2,200 ly	**5E**

Name (Desig.)	Mag.[1]	Const.	Dist.	Chart
Ascella (ζ)	2.6	Sagittarius	88 ly	**20S**
Asellus Australis (δ)	3.9	Cancer	136 ly	**8E**
Asellus Borealis (γ)	4.7	Cancer	158 ly	**8E**
Aspidiske (ι)	2.2	Carina	690 ly	**11S**
Asterope (21)	5.76	Taurus/Pleiades	444 ly	**A-3**
Atik (ζ)	2.8	Perseus	750 ly	**5N**
Atlas (27)	3.6	Taurus/Pleiades	444 ly	**A-3**
Atria (α)	1.9	Triangulum Australe	391 ly	**17S**
Avior (ε)	1.9	Carina	610 ly	**8S**
Azha (η)	4.1	Eridanus	121 ly	**2E**
Baten Kaitos (ζ)	3.9	Cetus	260 ly	**2E**
Becrux/Mimosa (β)	1.3	Crux	280 ly	**11S**
Beid (ο[1])	4.0	Eridanus	125 ly	**5E**
Bellatrix (γ)	1.6	Orion	250 ly	**5E**
Betelgeuse (α)	0.6v	Orion	643 ly	**5E**
Biham (θ)	3.5	Pegasus	97 ly	**23E**
Canopus (α)	−0.7	Carina	310 ly	**8S**
Capella (α)	0.1	Auriga	43 ly	**5N**
Caph (β)	2.3	Cassiopeia	55 ly	**2N**
Castor (α)	1.6	Gemini	51 ly	**8E**
Cebalrai (β)	2.8	Ophiuchus	82 ly	**17E**
Celaeno (16)	5.44	Taurus/Pleiades	444 ly	**A-3**
Chara (β)	4.3	Canes Venatici	28 ly	**14N**
Chertan (θ)	3.4	Leo	165 ly	**11E**
Cor Caroli (α)	2.9	Canes Venatici	110 ly	**14N**
Cursa (β)	2.8	Eridanus	89 ly	**5E**
Dabih (β)	3.1	Capricornus	328 ly	**20E**
Deneb (α)	1.3	Cygnus	2,600 ly	**20N**
Deneb Algedi (δ)	2.9	Capricornus	39 ly	**20E**
Deneb Kaitos (β)	2.0	Cetus	96 ly	**2E**
Denebola (β)	2.1	Leo	36 ly	**11E**
Dubhe (α)	1.8	Ursa Major	123 ly	**11N**
Edasich (ι)	3.3	Draco	101 ly	**17N**
Electra (17)	3.70	Taurus/Pleiades	444 ly	**A-3**
Enif (ε)	2.4	Pegasus	690 ly	**23E**
Errai (γ)	3.2	Cepheus	45 ly	**23N**
Etamin (γ)	2.2	Draco	154 ly	**17N**
Fomalhaut (α)	1.2	Piscis Austrinus	25 ly	**23S**
Furud (ζ)	3.0	Canis Major	362 ly	**8E**
Gacrux (γ)	1.7	Crux	89 ly	**11S**
Giausar (λ)	4.1	Draco	334 ly	**11N**
Gienah (γ)	2.6	Corvus	154 ly	**11E**
Gomeisa (β)	2.9	Canis Minor	162 ly	**8E**
Graffias (β)	2.6	Scorpius	400 ly	**17S**
Grumium (ξ)	3.8	Draco	113 ly	**17N**
Hadar (β)	0.6	Centaurus	350 ly	**14S**
Hamal (α)	2.0	Aries	66 ly	**2N**
Homam (ζ)	3.4	Pegasus	204 ly	**23E**
Izar (ε)	2.7	Bootes	203 ly	**14N**
Kaus Australis (ε)	1.8	Sagittarius	143 ly	**17S**
Kaus Borealis (λ)	2.8	Sagittarius	78 ly	**17S**

See Notes at the bottom of page 86 about spellings.

[1]The small "v" next to magnitudes indicates that the star varies a little in brightness.

Greek Mythology

Today, we have a scientific understanding of the world but ancient civilizations did not have this luxury, so they made up stories to explain natural wonders like the shape of mountains and everyday events like the wind, thunder, lightning and movement of the Sun and Moon. Often these stories involved mighty characters or gods who wielded the power to move heaven and Earth. Over time, these stories became traditions, beliefs and their religions. This occurred with every civilization at every "corner" of the world.

The "stories" that influenced our western culture the most came from the Greeks and were adopted by the Romans.

The Greek stories are plentiful and rich in content but they differ from the stories that we tell and write today. Our modern-day stories unfold in a way that is familiar because they reflect our experiences, perceptions and values. And, so did the Greek's but they saw life differently! To them, life was capricious and heavily laced with non-sequitur twists and turns. As such, their mythological stories often take us on a wild roller-coaster ride that jumps rails.

The mythological stories vary and overlap. Presented below are some of the more popular versions as they relate to the heavens.

North Circumpolar Constellations

Ursa Major and **Ursa Minor**, respectively the "Big Bear" and "Little Bear," are better known as the Big and Little Dippers. In Greek mythology they represent a mother, Callisto and her son, Arcas sent to the sky by Jupiter. Jupiter came upon the beautiful Callisto, daughter of King Lycaon of Arcadia, when he was on Earth, inspecting carnage caused by Phaethon, son of Helios, who had arrogantly tried to ride the Sun Chariot across the sky. Jupiter took favor upon Callisto, and against her will, fathered her a son, Arcas. Jupiter's wife, Juno discovered her husband's escapade and turned Callisto into an ugly bear. Later, when Arcas had grown up and was hunting, he encountered a bear running towards him. Not knowing that it was his mother, he aimed an arrow to kill but Jupiter took sympathy and intervened, turning Arcas into a bear and hurling both into the sky as restitution for all the agony he caused.

Cepheus and **Cassiopeia** were the king and queen of Ethiopia and parents of a daughter, **Andromeda**. The gods became angry at Cassiopeia because of her boastings that she and her daughter were more beautiful than the Nereids mermaids, whose protector was Neptune. To appease the gods for Cassiopeia's disrespect, Cepheus had to sacrifice his daughter to the Sea Monster, **Cetus**. About this same time, **Perseus**, the son of Jupiter, had cut off Medusa's head for a wedding gift, and was heading back with it from this journey. He saw Andromeda chained to a sea cliff, and instantly fell in love.

Noticing her parents watching in agony, Perseus agreed to rescue her for marriage and then chopped Cetus' head off with the sickle he had used on Medusa. At his wedding, a prior suitor showed up which prompted the royal parents to renege on their promise to Perseus.

A fight ensued, and Perseus was almost overpowered but was saved by using Medusa's head, for all who looked upon her face turned to stone. Afterwards, the royal couple was banished to the heavens by Neptune for their misdeeds.

Draco, the Dragon, was one of the many monsters fighting along with the great Titans against the Olympians, commanded by Jupiter. Near the climax of the battle, the dragon opposed the goddess of Wisdom, Minerva, who in turned flung it to the heavens where it froze twisted, after landing so close to the frigid North Celestial Pole.

Camelopardalis, the Giraffe, **Lacerta**, the Lizard, and the **Lynx** are faint constellations that were added in the 1600's.

Spring Constellations

Originally, **Leo**, the Lion, extended eastward to **Cancer** and westward to **Coma Berenices**. Its whiskers were the Beehive (M44) and its tail ended up in the faint cluster of stars at the top of Coma Berenices (Mel 111). *Regulus*, the brightest star in Leo, has been identified with the birth of Christ. Its name implies King, Mighty, Great, Center or Hero, depending on the culture.

There is no classical mythology for **Leo Minor**, because this constellation was created in the 1600s. **Cancer**, the Crab, was sent to prevent **Hercules** from killing the **Hydra**. However, Hercules trampled the Crab and succeeded in killing the Hydra anyway. The Hydra had nine heads and if one was chopped off, two grew back in its place. Hercules had to burn each stub to prevent the heads from growing back. **Corvus** was a bird placed in the heavens on Hydra's back by Apollo for being slow in bringing him water and lying about his tardiness. **Crater** represents the container of water that is always out of reach of Corvus.

Canes Venatici are the Hunting Dogs of **Bootes**, the Bear Driver, who is sometimes seen as a Herdsman or Ploughman. One story has it that Ceres, the goddess of Agriculture, asked Jupiter to place Bootes amongst the stars in gratitude for his invention, the plough. Another story is that Bootes was a grape grower taught to make wine by Bacchus, the god of Wine. Upon making the first batch, he celebrated with his friends who got so drunk, they fell asleep. The next morning, his friends killed him because they thought he was trying to poison them. His hunting dogs were so shaken by his death that they died with him.

An interesting story about **Virgo**, the Maiden, is that she was Proserpina, the daughter of Ceres. Pluto, the god of the Underworld, noticed her beauty one day when she was playing in her mother's fields. He swiftly abducted her to the Underworld. Ceres was enraged at his action and decided to abandon all the crops. Jupiter intervened when he noticed the Earth becoming barren, so he struck a compromise. Pluto would have Proserpina for half a year and Ceres for the other half. When Virgo is in the night sky, crops grow, but when she has sunk below the horizon to the Underworld, the growing season ends.

Centaurs were offspring of the gods, half-man and half-horse creatures that walked on four legs. Some say that **Centaurus** represents Chiron, the wisest and gentlest of his kind, whom Jupiter placed in the heavens to reward him for educating Hercules, Jason, Achilles and others. **Lupus**, the Wolf, was a generic wild animal to the Greeks but was also seen as the centaurs' offering to the gods or a wine skin for libation (having nothing to do with animals). Take your pick!

Summer Constellations

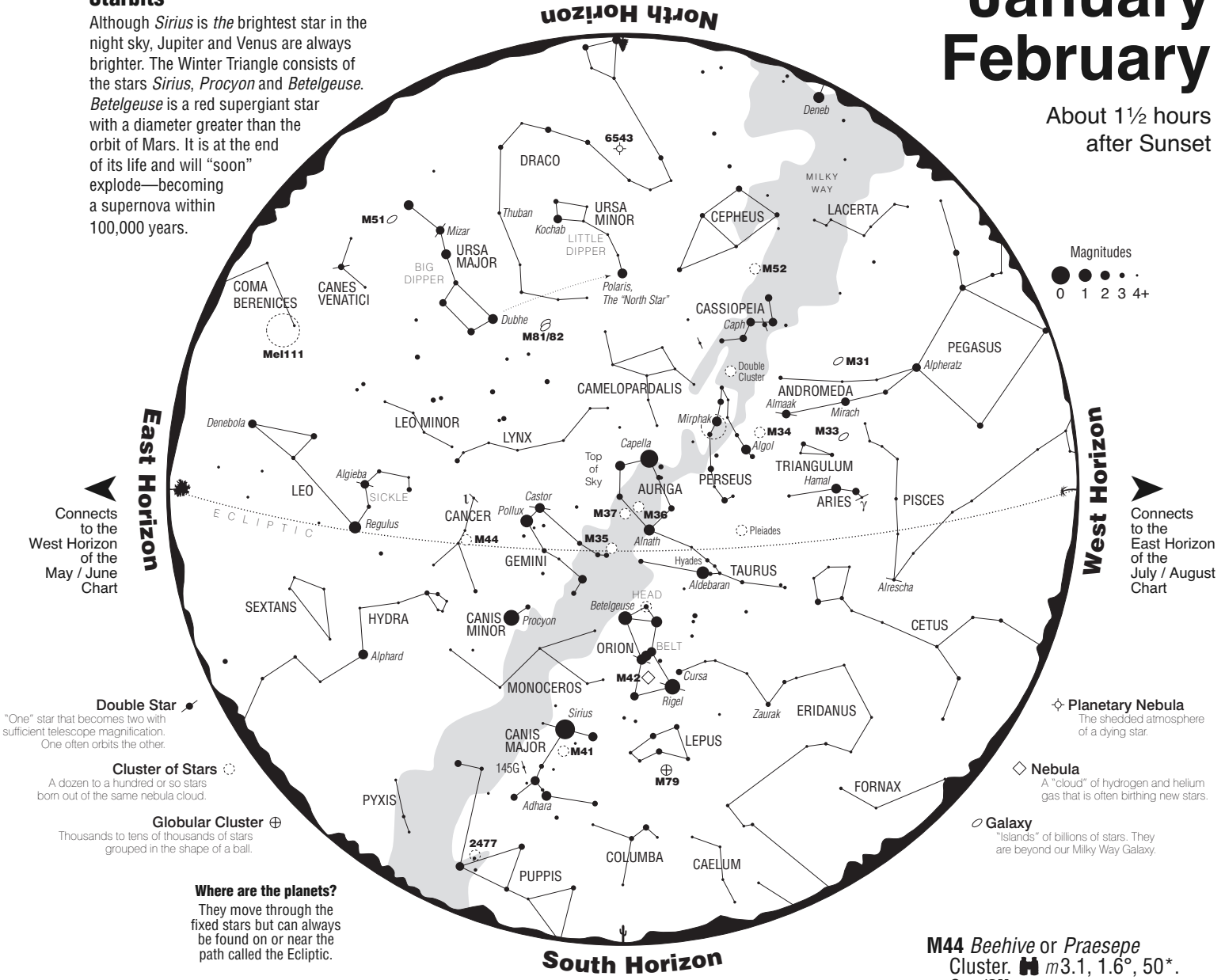
There is probably more lore about **Hercules**, the Strongman, than any other mythological figure. It is ironic however, that his stars are not as prominent as his stature. Hercules should have the stars of Orion. Hercules' mother was Alcmene and his father Jupiter, but, Alcmene was married to the Thebesian military leader, Amphytrion. Once, when he was off to battle, Jupiter came to Alcmene in the form of her husband, feigning a short leave. Hercules, like many offspring of Jupiter, had to endure the wrath of Jupiter's wife Juno for most of his life. One day, Hercules met two women, Pleasure and Virtue, who foretold that he could have either of their lives, but that the life of Virtue which Hercules picked would be difficult yet have a glorious end. This leads to the famous twelve labors of Hercules which were tasks directed by King Eurystheus. The labors often involved fighting ferocious beasts with themes loosely based on the twelve zodiacal constellations. Hercules was placed into the heavens by Jupiter after his wife Deianeira gave him a caustic poison because she wrongly believed that he was interested in another woman.

January
February

About 1½ hours after Sunset

Starbits

Although *Sirius* is *the* brightest star in the night sky, Jupiter and Venus are always brighter. The Winter Triangle consists of the stars *Sirius*, *Procyon* and *Betelgeuse*. *Betelgeuse* is a red supergiant star with a diameter greater than the orbit of Mars. It is at the end of its life and will "soon" explode—becoming a supernova within 100,000 years.



Double Star
"One" star that becomes two with sufficient telescope magnification. One often orbits the other.

Cluster of Stars
A dozen to a hundred or so stars born out of the same nebula cloud.

Globular Cluster ⊕
Thousands to tens of thousands of stars grouped in the shape of a ball.

Planetary Nebula
The shedded atmosphere of a dying star.

Nebula ◇
A "cloud" of hydrogen and helium gas that is often birthing new stars.

Galaxy
"Islands" of billions of stars. They are beyond our Milky Way Galaxy.

Where are the planets?
They move through the fixed stars but can always be found on or near the path called the Ecliptic.

The late winter sky is dominated in the south by Orion. Its three Belt stars, hovering halfway up the southern horizon, are easy to spot, sandwiched between red *Betelgeuse* and *Rigel*. Below the Belt, nestled in the Sword, is the Great Orion Nebula, the "greatest" nebulae in the northern hemisphere. It is lit by four young stars called the Trapezium, because of their shape. If you extend the Belt south, it points to *Sirius*, the brightest star in the entire celestial sphere—a beacon of the winter night. The winter sky has a plenitude of clusters including the Pleiades, Hyades and Double Cluster, treats for the naked eye, binoculars or small telescope.

SELECTED OBJECTs

Alpha Persei Cluster. 🔭 *m*1.8–7, 3°, 100*. Per/**2N**
Around the star Mirphak.
D=600 ly, S=31 ly

Double Cluster. *m*4 each, 30' each, 200*/115*. Per/**2N**
D=7,200 ly, S=63 ly

Head of Orion Cluster. 🔭
Group of 15 stars. Ori/**5E**
D=1,600 ly, S=28 ly

Hyades Cluster. Eyes / 🔭
*m*0.5, 5.5°, 100*. Tau/**5N**
D=153 ly, S=15 ly

Pleiades Cluster. 🔭
*m*1.2, 1.8°, 100*. Tau/**5N**
D=395 ly, S=13 ly

NGC 2477 Cluster.
*m*5.8, 26', 160*. Pup/**8S**
D=3,600 ly, S=27 ly

M31 *Andromeda Galaxy*. 🔭
*m*3.5, 3x1°. And/**2N**
D=2,400,000 ly, S=120,000 ly

M34 Cluster.
*m*5.2, 35', 60*. Per/**2N**
D=1,400 ly, S=14 ly

M35 Cluster.
*m*5.1, 28', 200*. Gem/**5N**
D=2,800 ly, S=23 ly

M36 Cluster.
*m*6.0, 12', 60*. Aur/**5N**
D=3,700 ly, S=13 ly

M37 Cluster.
*m*5.6, 24', 150*. Aur/**5N**
D=4,200 ly, S=29 ly

M41 *Little Beehive* Cluster.
*m*4.5, 38', 80*. CMa/**8S**
D=2,200 ly, S=24 ly

M42 *Orion Nebula*.
*m*4.0, 1.1x1°. Ori/**5E/A-4**
D=1,500 ly, S=66 ly

M44 *Beehive* or *Praesepe* Cluster. 🔭 *m*3.1, 1.6°, 50*. Can/**8N** D=580 ly, S=16 ly

M52 Cluster.
*m*6.9, 13', 100*. Cas/**23N**
D=3,300 ly, S=11 ly

M79 Globular Cluster.
*m*7.7, 9'. Lep/**5E**
D=41,000 ly, S=107 ly

DOUBLE STARs

145G Canis Majoris. Blue & Gold. *m*5.0/5.8, Sep=26.8". CMa/**8S** D=6,300 ly

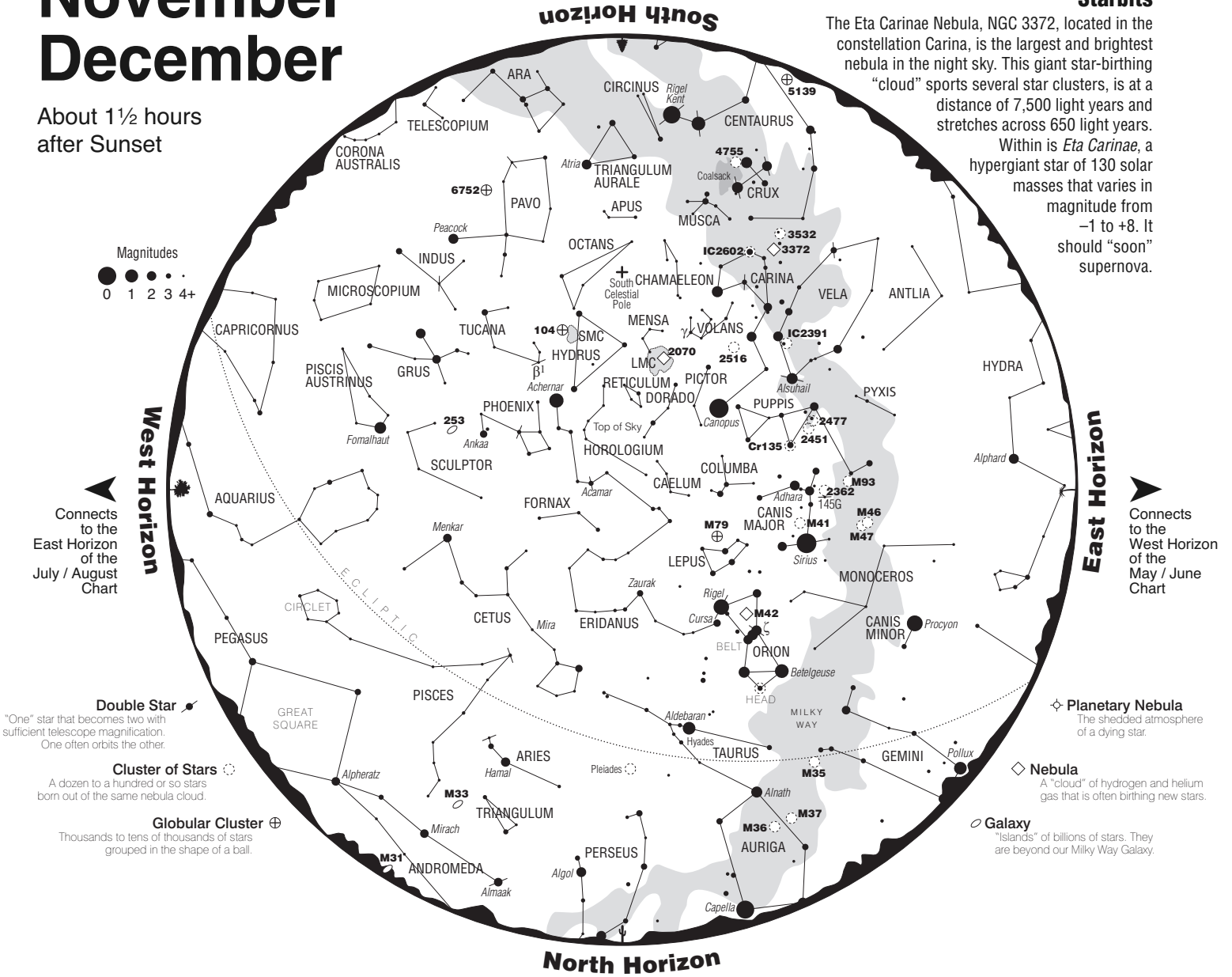
ι Cancri. Blue & Gold. *m*4.1/6.0, Sep=31". Can/**8N** D=298 ly

Castor (α). Favorite! *m*1.9/3.0, Sep=4.6". Gem/**8N** D=52 ly

Trapezium (θ¹). Four stars. In the M42 *Orion Nebula*. See close-up chart **A-4**.

November
December

About 1½ hours after Sunset



Connects to the East Horizon of the July / August Chart

Connects to the West Horizon of the May / June Chart

Double Star "One" star that becomes two with sufficient telescope magnification. One often orbits the other.

Cluster of Stars A dozen to a hundred or so stars born out of the same nebula cloud.

Globular Cluster Thousands to tens of thousands of stars grouped in the shape of a ball.

Planetary Nebula The shedded atmosphere of a dying star.

Nebula A "cloud" of hydrogen and helium gas that is often birthing new stars.

Galaxy "Islands" of billions of stars. They are beyond our Milky Way Galaxy.

Starbits

The Eta Carinae Nebula, NGC 3372, located in the constellation Carina, is the largest and brightest nebula in the night sky. This giant star-birthing "cloud" sports several star clusters, is at a distance of 7,500 light years and stretches across 650 light years. Within is *Eta Carinae*, a hypergiant star of 130 solar masses that varies in magnitude from –1 to +8. It should "soon" supernova.

The Large and Small Magellanic Clouds may appear as detached patches of the Milky Way Band but they are galaxies, albeit small, just like our Milky Way Galaxy. And, these two are satellites or "moons," gravitationally bound to us. Near to the northwest horizon are the Andromeda (M31) and Pinwheel (M33) Galaxies. The Andromeda Galaxy, visible to the naked eyes, the Magellanic Clouds, and the Pinwheel Galaxy, are four of about 50 Local Group galaxies that are gravitationally bound to one other. Unfortunately, the orbits of the 50 are not as orderly as we might like because in about four billion years, our galaxy will collide with the Andromeda Galaxy.

SELECTED OBJECTs

CR 135 Cluster. ⬤ *m*2.1, 50', 15*. Very loose & sparse. Pup/**8S** D=840 ly, S=12 ly

M41 *Little Beehive* Cluster. *m*4.5, 38', 80*. CMa/**8S** D=2,200 ly, S=24 ly

M42 *Orion Nebula*. *m*4.0, 1.1x1°. Ori/**5E/A-4** D=1,500 ly, S=66 ly

M46 Cluster. *m*6.1, 27', 100*. Pup/**8S** D=5,400 ly, S=42 ly

M47 Cluster. *m*4.4, 30', 30*. Pup/**8S** D=1,600 ly, S=14 ly

M78 Nebula. *m*8, 8x6'. Ori/**5E** D=1,600 ly, S=4 ly

M79 Globular Cluster. *m*7.7, 9'. Lep/**5E** D=41,000 ly, S=107 ly

M93 Cluster. *m*6, 22', 80*. Pup/**8S** D=3,600 ly, S=23 ly

NGC 104 *47 Tucanae* Globular Cluster. *m*4.0, 43'. Tuc/**23S** D=16,700 ly, S=209 ly

NGC 2070 *Tarantula Nebula*. Inside the LMC. Nebula and cluster. *m*5.0, 40x25'. Contains a 5' super cluster with thousands of stars. Dor/**5S** D=157,000 ly, S=1,800 ly

NGC 2362 Cluster. *m*4.1, 7', 60*. CMa/**8E** D=4,800 ly, S=10 ly

NGC 2451 Cluster. *m*2.8, 44', 40*. Pup/**8S** This is actually two clusters in the same line of sight!

NGC 2477 Cluster. *m*5.8, 26', 160*. Pup/**8S** D=3,600 ly, S=27 ly

DOUBLE STARs

145G Canis Majoris. Blue & Gold. *m*5.0/5.8, Sep=26.8". CMa/**8S** D=6,300 ly

Acamar (θ). *m*3.2/4.3, Sep=8.3". Eri/**5S** D=161 ly

Alsuhail (γ). Four stars spanning 1.5'. *m*1.8/4.3/7.4/9.2. Vel/**8S** D=336 ly

Rigel (β). *m*0.3/10.4, Sep=9.5". Ori/**5E** D=860 ly

Trapezium (θ¹). Four stars. In the M42 *Orion Nebula*. See close-up chart **A-4**.

ζ Orionis. *m*1.7/3.9, Sep=2.3". Ori/**5E** D=387 ly

β¹ Tucanae. *m*4.3/4.5, Sep=27". Tuc/**23S** D=140 ly

γ Volantis. *m*4.0/5.5, Sep=14.4". Vol/**8S** D=142 ly

Moon, Mercury *and* Venus

Major features of the Moon

The most notable features on the Moon are its brighter cratered highlands called terrae and smoother darker plains known as maria. These and other features are described below.

Terminator. The border or "line" separating the lighted side from the dark side. The terminator is absent during Full Moon. Craters, and other surface detail, appear their sharpest/best near the terminator.

Craters. Large and small bowl-like depressions on the Moon. Most of the craters on the Moon were formed from meteoroid or cometary impacts that ended about 3 billion years ago.

Terrae & Maria. Terms coined by Galileo meaning "highlands" and "seas." The lighter-colored terrae have the highest concentration of craters and are older than the maria. The darker maria are smoother areas of the Moon and represent 31% of its surface on the near side. They are the result of impacts from very large asteroids or comets creating fractures to the once molten interior, releasing dark, iron-rich, basalt lava, which flowed upward and outward to create the great plains. They average 500 to 600 feet thick. There are very few maria on the far side of the Moon.

Rilles & Faults. Rilles are long valley-type depressions in the maria, up to hundreds of miles in length that can be linear, curved or sinuous. Many rilles can be seen in telescopes. Faults, like the Straight Wall (see photo on page 107), can also be seen in the maria.

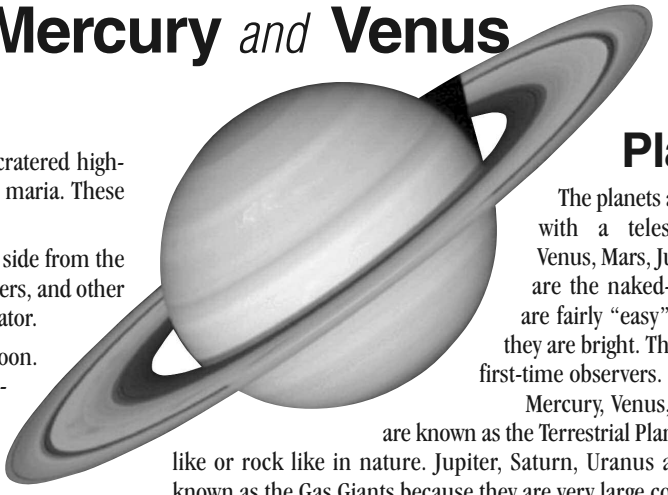
Rays. Bright streaks that radiate from some craters. They represent lighter, reflective material, ejected during the formation of craters and are most pronounced around Full Moon. The crater Tycho has the longest rays, spanning one-quarter of the globe. It is estimated that rayed craters are less than one billion years old because the rays of older craters have been eroded by micrometeorites (as described in Regolith, below). You can see the rays around the craters Copernicus and Kepler (craters numbered 69 and 68, respectively) on page 108.

Regolith. A fine grained "soil" that covers the surface of the Moon. Created from the bombardment of the surface by micrometeorites, the regolith varies in depth from 3 to 15 feet in the maria, and to 50 feet or more in the highlands. The micrometeorites that bombard Earth burn up in the atmosphere.

Apollo Lunar Landings

Mission	Date	Three Astronauts *Circled the Moon in Command Module
Apollo 11	July 20, 1969	Armstrong, Aldrin, Collins*
Apollo 12	Nov 19, 1969	Conrad, Bean, Gordon*
Apollo 14	Feb 5, 1971	Shepard, Nitchell, Roosa*
Apollo 15	July 30, 1971	Scott, Irwin, Worden*
Apollo 16	April 21, 1972	Young, Duke, Mattingly*
Apollo 17	Dec 11, 1972	Cernan, Schmitt, Evans*

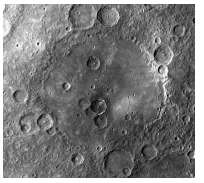
Selena, goddess of the Moon



Planets

The planets are best observed with a telescope. Mercury, Venus, Mars, Jupiter and Saturn are the naked-eye planets and are fairly "easy" to spot because they are bright. They are delights to first-time observers.

Mercury, Venus, Earth and Mars are known as the Terrestrial Planets, being Earth-like or rock like in nature. Jupiter, Saturn, Uranus and Neptune are known as the Gas Giants because they are very large compared to Earth and have atmospheres that extend downward for thousands of miles, thickening to a liquid and then a solid.



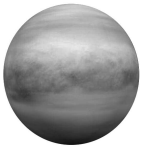
Mercury

Riddled with craters, Mercury looks like the Moon, but it is elusive to see because it orbits close to the Sun, "peeking out," just a few times a year. So, just to see Mercury in the sky is a treat, all by itself.

Observing Mercury. Mercury is visible only for a short time, up to an hour, at dusk or dawn, near the horizon of a Sun that has just set or is about to rise. Unfortunately, this places Mercury very low and in the most turbulent part of the sky, sometimes making it disappointing to view through a telescope because it might look like a bubbling blob.

The window of opportunity to see Mercury is about a week's time, two or three times a year, when it is farthest from the Sun, at what is called its greatest eastern or western elongation, and will appear at half phase. Consult an astronomy internet site for dates. An obstructed horizon, with houses, trees or low-lying clouds can easily foil your attempt to locate this planet because the most it will be above the horizon is about one pencil's length at an arm's distance. For evening dates, start searching about 30 minutes after sunset. You will have about one-half hour to see Mercury. For morning dates, start searching about one hour prior to sunrise. In either case, Mercury will appear as bright as magnitude –2 in a lightened sky above and near the sunrise/sunset point, so it may be the only "star" visible in the twilight, making it easy to identify. At times, it will be plainly visible to the naked eye, but more often, it may blend in with the lightened sky and you may need binoculars to help locate it because it can be easily missed unless you are looking *directly* at it. Oh, Mercury does not have any moons.

Enhanced image to show clouds



Venus

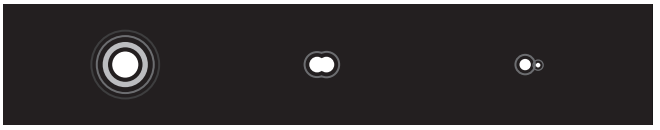
Often referred to as the morning or evening star, it can linger for months as a shining beacon above the eastern or western horizon. At its brightest, and without competition from the Moon, it will cast shadows.

Observing Considerations

spoiler to observing "closer" double stars is poor seeing caused by a turbulent atmosphere. During these times, stars appear as big scintillating blurs that makes stars close to one another impossible to separate. This effect usually exists with stars close to the horizon, even on nights of good seeing.

Generally, when observing double stars, start with lower magnifications and work your way up to higher magnifications. After some experience, you will know the magnification required to split or separate double stars with specific arc angle separations.

The separation distance of many double stars varies over time because the stars are in binary systems, where one star revolves around the other (or they revolve about each other). So, some of the separation values listed in this atlas will change over time.



Examples of Airy disks and their associated rings that can be seen around stars at higher magnifications with good, well-alligned optics and good seeing conditions. *Left:* The Airy disk and rings around a bright star. *Center:* The appearance of a very close double star with less than an arc second of separation. It cannot be split into two separate stars but is observed as the merger of two Airy disks. *Right:* The Airy disks around a resolved or "split" double star with a fainter component.

To observe very close doubles, around 1 arc second of separation, it will take a night of good seeing and 200x magnification or more to discern the two stars.

And, when you observe stars at these higher magnifications, they will appear as little disks—these are called "Airy disks" and are a result of the wave nature of light. The small disks *do not* represent the actual diameters of the stars. Additionally, there are a few rings of light around any Airy disk. Both the Airy disk and associated rings are more noticable with brighter stars. For very close doubles, those around one-half to one arc second separation, the best "separation" that you will get are two merged Airy disks or "one" that appears elongated.

The Deep Sky Objects (DSOs)

For the following objects, the darker a moonless night sky, the better. You can forget about observing these objects within any major city, but you might fair better on their outskirts. If you live in the heart of a city, you will have to travel to a darker site to enjoy viewing these objects. At a dark location, almost every object plotted in this atlas can be seen in a smaller, 6-inch diameter telescope.

Binocular Note in Regards to DSOs

Some deep sky objects are large and might not be recognized if viewed in a telescope. For example, the Pleiades, because of its size, is best viewed in its entirety through binoculars. The cluster, IC 4665, in Ophiuchus, was an overlooked Messier and NGC object because you need lower magnifications to recognize it in its entirety. And, some objects, like the M33 galaxy, are often easier to see in binoculars because of their large size and low surface brightness.

Observing Clusters of Stars

The best example of a cluster is the Pleiades, which is visible to the naked eyes. But, there are many more smaller and fainter clusters that can be seen only with telescopes. Start with magnifications around 50x. At first, it might be somewhat challenging to positively identify clusters, but after observing several, you will catch on. A good starting point is to find and observe the smaller and brighter Messier clusters like M6, M7, M11, M25, M34, M35, M36, M37, M38, M41, M46, M47, M48 and M67. This will give you a foundation for finding others that are smaller and fainter. Some clusters stand out and are distinct from the surrounding stars while others blend in more and are thus harder to identify. Clusters composed of fainter stars that cannot be resolved by smaller telescopes will appear as faint hazy patches and may only be glimpsed using averted vision, while a larger diameter telescope could show them plainly.

Observing Globular Clusters

In smaller telescopes, globular clusters often look like unremarkable faint cotton balls that brighten towards their centers. Some of the bigger and brighter ones like M3, M13 and M22 will, however, show a sprinkle of faint but distinct stars. Globular clusters look absolutely spectacular in very large telescopes (around 12 inches in diameter and up) because these telescopes can resolve many of the fainter stars that make up these clusters, so you can literally see hundreds of stars in the shape of a ball. Start with magnifications around 50x.

Observing Planetary Nebulae

The Messier list of planetary nebulae consists of M27, M57, M76 and M97. M57, the Ring Nebula, is much smaller than most people think and requires 100x or higher in order to recognize it the first time. Overall, the Messier planetary nebulae are not representative of the NGC planetary nebulae because they are large and fairly bright. Many of the NGC planetary nebulae are stellar-like, that is, they look like stars at lower magnifications and will only assume a small disk-type appearance with sufficient magnification, around 100x to 250x. These objects were originally dubbed "planetary" because of their roundish shape—resembling the disks of the planets.

Observing Nebulae

Although there are some bright nebulae, like M17, M18, M42 and NGC 3372, in general, nebulae are difficult to observe because they are faint and gossamer. Needless to say, dark skies are necessary to see these objects. Averted vision can help to catch a glimpse of those that are faint. Another technique for those that are fainter (and, this applies to galaxies, too) is to either let the nebulae drift through the eyepiece field-of-view (turn off any tracking motors) or move/slew the telescope back and forth slowly. The movement of faint objects sometimes registers with the eye, especially in the area of peripheral vision.

Observing Galaxies

There are many more galaxies than all other DSOs combined. Observing them is a similar experience to observing nebulae. Therefore, they are very affected by light pollution. Although some galaxies brighten toward their cores or centers, none are as bright or detailed as the brightest nebulae. Since galaxies are outside our galaxy, no individual stars can be seen or resolved except for a rare supernova. For the most part, galaxies appear grayish, gossamer, plain and often, just faint smudges. Spiral galaxies that are "face on" are very faint, like M33 and M101, while those that are "edge on" are much brighter because all their light is concentrated along a band, like M82. Some arms of spiral galaxies can be glimpsed, like with M51. Overall, elliptical galaxies are fainter than spiral galaxies and will be more challenging to see. Although the Andromeda Galaxy (M31), is extremely large and "bright" (you can see it with the naked eyes), you will not be able to see any detail like in photos. Review the observing technique described about nebulae in the above paragraph to help see faint galaxies.

▮ See PICTURES of Deep Sky Objects on pages 116, 119 and the back cover ▮

Glossary

Many stars near the end of their lives expand to a hundred or thousand times their original diameter before they finally "die" to become a white dwarf, neutron star or black hole. Near the end of our Sun's life, it will puff up to become a red giant star having a diameter about 250 times its present diameter—perhaps expanding beyond Earth's orbit. Supergiant stars are stars that started with masses from 8 to 12 times that of the Sun and expand, at the end of their lives, anywhere from 30 to 500 and on to 1,000 times the diameter of our Sun. The very largest stars are called hypergiants with initial masses ranging from 100 to 265 times that of our Sun, having expanded diameters reaching 1,000 times or more of our Sun and with luminosities upwards of two million times that of our Sun.

The distance to stars is measured using the unit of length called a light year (ly). One light year is the distance that light can travel in one year's time which is nearly 6 trillion miles or 9.5 trillion kilometers. The stars that we see in the sky range anywhere from 4 ly to 3,000 ly away. All the stars in the sky are in our Milky Way Galaxy.

Star Cluster. A general term that refers to an open cluster, galactic cluster or globular cluster. *See* Cluster.

Star of Bethlehem. *See* Conjunction.

Summer Solstice. The 90° point on the ecliptic (chart 5E & in Taurus). When the Sun is at this position, about June 21, it is the start of Summer in the northern hemisphere.

Summer Triangle. The three bright stars, *Altair* in Aquila, *Deneb* in Cygnus and *Vega* in Lyra.

Sun. The name commonly given to the star that Earth orbits. The ancient Roman and Greek names are respectively, Sol and Helios. So, the Sun is the closest star to Earth—sometimes asked as a "trick" question.

Supergiant Stars. *See* Star.

Supernova (plural: Supernovae)**.** An explosion of a massive star, at the end of its life, of such intensity that the light emitted outshines all the stars in its galaxy. A supernova can remain brilliant for several weeks. They occur infrequently in our galaxy, so amateur and professional astronomers observe them more often in other galaxies. The last supernova visible in our galaxy was seen in the year 1604. A supernova explosion leaves a nebula remnant. Well-known examples are the Crab Nebula (M1) in Taurus and the larger Veil Nebula (NGC 6960/6992) in Cygnus.

Telrad. A popular "finder" that is attached to a telescope and aids pointing a telescope to an object or spot in the night sky. The Telrad is a reflex-sight finder that projects a red bullseye onto the night sky. This reticle pattern is reproduced on the side of the main charts. The bullseye reticle does not actually get projected onto the sky but is reflected back to the eye from an angled piece of glass. Like all reflex-sight finders, the Telrad provides no magnification. To use it, you place your eye (head) a few inches to a foot behind the back while looking at the sky through the slanted glass (see picture). The red bullseye appears superimposed on the night sky allowing you to easily point the telescope to any spot. The brightness of the red bullseye can be changed. This type of finder is much easier to use than traditional finders which are small, low-powered telescopes that have narrow/confining fields-of-view. *See* Finder.

Telrad Reflex Finder

Telescope. An optical instrument that magnifies distant objects. The telescope was invented in 1608 and by the end of 1609, Galileo had improved it by increasing its magnification from 3x to about 30x.

There are two basic types of telescopes, the original refractor invented from using eyeglass lenses and the reflector, a telescope that uses a concave mirror to focus light, first built by Newton in 1668 and called the Newtonian reflector in his honor. There are also hybrid telescopes, a combination of a refractor and reflector, called catadioptrics, and the most common design is called the Schmidt-Cassegrain Telescope or SCT, which was first made popular by Celestron telescopes in the early 1970s.

A Newtonian reflector telescope of 6 to 8 inches in diameter is a very adequate telescope for exploring the night sky. This type of telescope is the least expensive per aperture inch, that is, it is the best deal for the money (great for those on a budget or just getting started). They usually have simple, manual, altazimuth mounts, and in this form, are often called Dobsonians, after John Dobson who popularized larger, low-cost Newtonian telescopes on simple altazimuth mounts. Today, Newtonians used by amateurs can have diameters more than 36 inches and these large telescopes are best for observing the fainter deep sky objects.

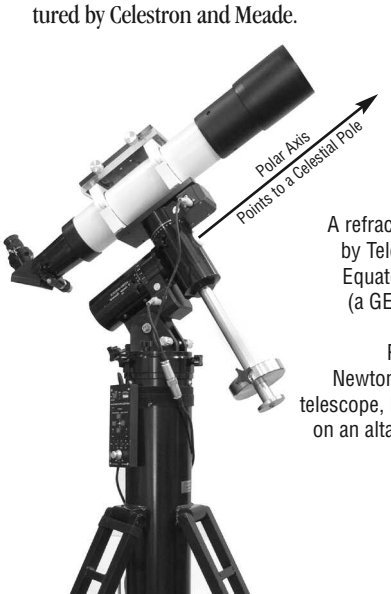
Refractor telescopes typically have diameters that range in size from 2 to 6 inches but the most popular sizes are from 3 to 4 inches. The highest quality refractors, known as "apochromatics," are, by far, the most expensive telescopes per optical inch but they also have the highest image quality of any telescope.

The Schmidt-Cassegrain Telescope or SCT generally provides the most "bang" for the buck because it usually includes a computer-motorized mount that will automatically "GO TO" and follow any object chosen from a hand controller. The most popular size is 8 inches in diameter. Anything larger in diameter starts to get heavy fast.

Magnification should not be a consideration when buying a telescope. The highest useful magnification for any telescope, independent of it size, is about 350x because this represents the resolution limit created by the turbulence in the atmosphere. Theoretically, a 12-inch diameter telescope can see twice as much detail as a 6-inch but our turbulent atmosphere places the limit on seeing detail. The greatest resolution (or smallest detail) that a "normal" Earth-based telescope can resolve is about 0.5 arc seconds (½ an arc second), which is the theoretical limit of an 8-inch diameter telescope.

What is the advantage of larger diameter telescopes if an 8-inch provides the maximum resolution? It is light-gathering capability—the ability to see fainter objects. For example, a 12-inch diameter telescope has 4 times the surface area of a 6-inch diameter telescope, so fainter objects will visually be brighter in a 12-inch diameter telescope than in a 6-inch. In this case, the 12-inch will allow seeing objects to about 1.5 magnitudes fainter than the 6-inch (1.5 magnitudes is more significant than you might think).

A GOTO or GO TO telescope actually refers to the mount, but some GO TO mounts have integrated telescopes, like with many SCTs manufactured by Celestron and Meade.



LEFT
A refractor telescope by Tele Vue on an Equatorial mount (a GEM mount).

RIGHT
Newtonian reflector telescope, Dobsonian style, on an altazimuth mount.

Chart Reference

Constellation	Chart	Page
ANDROMEDA	2N	15
ANTLIA	11S	28
APUS	14S	27
AQUARIUS	23E	16
AQUILA	20E	17
ARA	17S	26
ARIES	2N	15
AURIGA	5N	14
BOOTES	14N	11
CAELUM	5S	30
CAMELOPARDALIS	5N	14
CANCER	8N	13
CANES VENATICI	14N	11
CANIS MAJOR	8E	21
CANIS MINOR	8E	21
CAPRICORNUS	20E	17
CARINA	11S	28
CASSIOPEIA	2N	15
CENTAURUS	14S	27
CEPHEUS	23N	8
CETUS	2E	23
CHAMAELEON	SCP	32
CIRCINUS	14S	27
COLUMBA	5S	30
COMA BERENICES	14N	11
CORONA AUSTRALIS	20S	25
CORONA BOREALIS	17N	10
CORVUS	11E	20
CRATER	11E	20
CRUX	14S	27
CYGNUS	20N	9
DELPHINUS	20N	9

Constellation	Chart	Page
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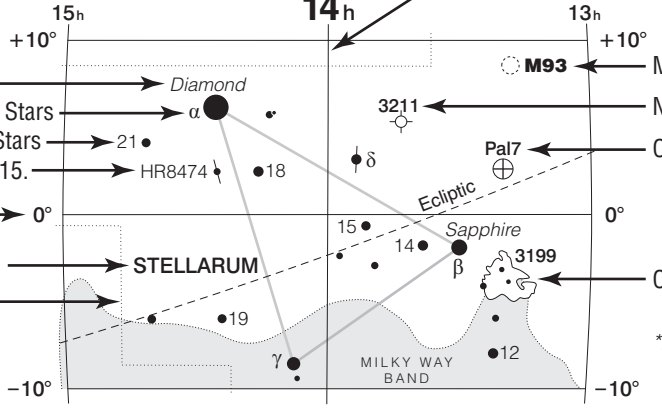
DRACO	NCP	7
EQUULEUS	20E	17
ERIDANUS	5S/2S	30–31
FORNAX	2S	31
GEMINI	8E	21
GRUS	23S	24
HERCULES	17N	10
HOROLOGIUM	5S	30
HYDRA	14E/11E/8E	19–21
HYDRUS	2S	31
INDUS	20S	25
LACERTA	23N	8
LEO	11E	12
LEO MINOR	11N	12
LEPUS	5E	22
LIBRA	14S	27
LUPUS	14S	27
LYNX	8N	13
LYRA	20N	9
MENSA	5S	30
MICROSCOPIUM	20S	25
MONOCEROS	8E	21
MUSCA	11S	28
NORMA	17S	26
OCTANS	SCP	32
OPHIUCHUS	17E	18
ORION	5E	22

Constellation	Chart	Page
PAVO	20S	25
PEGASUS	23N	8
PERSEUS	2N	15
PHOENIX	2S	31
PICTOR	5S	30
PISCES	23E/2E	16/23
PISCIS AUSTRINUS	23S	24
PUPPIS	8S	29
PYXIS	8S	29
RETICULUM	5S	30
SAGITTA	20N	9
SAGITTARIUS	20S/17S	25–26
SCORPIUS	17S	26
SCULPTOR	23S	24
SCUTUM	20E	17
SERPENS	17E	18
SEXTANS	11E	20
TAURUS	5E	22
TELESCOPIUM	20S	25
TRIANGULUM	2N	15
TRIANGULUM AUSTRALE	17S	26
TUCANA	23S	24
URSA MAJOR	11N	12
URSA MINOR	NCP	7
VELA	11S/8S	28–29
VIRGO	14E	19
VOLANS	8S	29
VULPECULA	20N	9

Right Ascension Lines
ANALOGOUS TO LONGITUDE BUT USES 24 HOURS FOR DIVISIONS

Stars & Constellations

Star Names are *Italicized*
Greek Letter (Bayer) Designation for Stars
Flamsteed Number Designation for Stars
Other Star Designations. See page 115.
Declination Lines SIMILAR TO LATITUDE
Constellation Names in UPPERCASE
Constellation Boundary



DSOs*

M93 — Messier DSO Designation
3211 — NGC DSO Designation (2 to 4 digits)
Pal7 — Other DSO Catalogue Designation

ALL DSOs ARE DESCRIBED IN "Objects *by* Constellation"

Outline of Nebula with NGC Designation

**DSOs are "Deep Sky Objects," that is, Clusters of Stars, Nebulae & Galaxies.*

Greek Alphabet

α	alpha	ε	epsilon	ι	iota	ν	nu	ρ	rho	φ	phi
β	beta	ζ	zeta	κ	kappa	ξ	xi	σ	sigma	χ	chi
γ	gamma	η	eta	λ	lambda	ο	omicron	τ	tau	ψ	psi
δ	delta	θ	theta	μ	mu	π	pi	υ	upsilon	ω	omega