Nightfall Guide

Free online catalogues and resources



Cosmic

Stargazing Tonight?

Is it clear	up	ther	e?
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Oy, walked out the door,

looked up.

Stars !

No clouds !²

Let's g - o - o - o o !³

FAQs

- How long will it stay that way?
- Should I go shirtsleeves for the night or bundle up a bit?
- The stars looked a little wobbly, so will I see pinponts or slobs?
- What is that satellite passing over?
- *How do I find the satellites above me on my Android phone?* (If that fizzles, *try this one*. Jump through all the hoops, then go outside and

point the thing at the first moving dot.

- *That airliner, too*; I wonder who could be on it and where they're going? (Slide the screen over till it's above your locale.)
- When will *The Moon rise or set*? (also check *IceInSpace*)

OK, the scope is set up and cooling down. Is the observing table stocked and ready? Observing table is all arranged like I want it?

Now, while we let our eyes dark adapt ...

How far away are the objects I see? *How old are they? Is it the same everywhere as it looks from here*?

Online Catalogs to Help You Find Things

ASSA Top 100 Observing List

Alvin Huey's Downloadable Observing Guides

Alvin Huey's *Printed Observing Guides* (spiral or coil bound) Alvin Huey, *Herschel* 400 *Observing Guide I* (downloadable PDF) Alvin Huey, *Herschel* 400 *Observing Guide II* (downloadable PDF) Alvin Huey, *Herschel* 300 *Observing Guide III* (downloadable PDF)

Sharpless emission nebulae & SNRs

Stewart Sharpless, <u>A Catalogue of H II Regions</u>, 1959.
Life & Work of Stuart Sharpless
Sharpless Catalogue by Reiner Vogel, fully illustrated with positions & observing notes.
Dean Salman's Best of the Sharpless Catalogues.

Young Stellar Objects (YSOs) and Herbig-Haro Objects

Rainer Vogel, Hubble's Variable Nebula and NGHC 1999 Orion.

Wolf-Rayet expansion shells

Reiner Vogel, *Wolf-Rayet Shells* with analyses by *Lionel Mulato*. Agnès Acker, *Nebulueses autour d-etoiles Wolf-Rayet*, l'Astronomie 2015.

Dark Nebulae & Barnard Objects

Edward Emerson Barnard, *A Photographic Atlas of Selected Regions of the Milky Way*, Carnegie institution of Washington, 1927 (lists citations only, see *A-J* 41, *I-24* 1919 and *Mikkel Steine's messier45.com* for versions with images and text).

Galactic Cirrus & Integrated Flux Nebulae

Steve Mandel, *Unexplored Nebulae Project* Lynds *Catalogue of Dark Nebulae*, Astrophysical Journal Supplement, vol. 7, p.1, 1962. Beverly Lynds' list of 1802 dark nebula N of –33° compiled from the National Geographic-Palomar Sky Atlas (POSS).

Catalogs of Catalogues

SEDS *List of Common Deep Sky Catalogs* (many links) *Deep Sky Catalogues,* last edited Sept 2015 by SkyNomad Danilo Pivato, *List of Astronomical Catalogues - Nomenclature, Acronyms & Abbreviations* (last update Apr 2016)

NASA Collection of Weird HI Galaxies. Too good to pass by.



Gamma-ray burst GRB 130427A. In April 2013 a blast of light from a dying star in a distant galaxy became one of the brightest ever seen. Source: <u>NASA</u>.

Amateur radio astronomy

What, actually, are we talking about here? Beginner's Introduction to Radio Astronomy Society for Amateur Radio Astronomy Amateur Radio Astronomy Projets Galaxy Zoo Forum: Build a Radio Telescope Starter Kit for Amateur Radio Astronomy Mike Brown's Build a Radio Telescope At Home

How to Build a Radio Telescope

An affordable everyday radio telescope

Is It Possible to Build a DIY Radio Telescope?

For the well-heeled: Commercial vendor: SPIDER 300A - Advanced radio telescope

AARL (USA) National Association for Amateur Radio (mainly HAM enthusiasts, but contains radio astronomy guides, too.)



The Three Hills Observatory

equipment consists of a Ku band (approx 12GHz) analogue satellite TV setup with an offset fed 750x850mm elliptical dish. The dish is Alt Az mounted on a photographic tripod. Note the counterbalance weight added to balance the dish. The receiver is an inexpensive "satellite finder" meter. (The satellite receiver is just used to supply 18v power to the LNB and satellite finder.) The meter has an audible output with the sounder voltage varying with the signal shown on the meter. This signal was disconnected from the sounder and fed to a digital multimeter which has a serial PC interface to log the signal.

FIRST LIGHT 20th December

2007: The setup proved easily capable of detecting the different levels of radio flux from the frozen ground at approximately 273 deg K and the cold sky at the zenith (~5 deg K ?). A person standing in the beam 2m away from the dish also produced a good signal (this signal was less than the ground signal as the dish was not fully illuminated) The satellite finder bandwidth is very wide (over 1GHz) which means that any Ku band transmissions in the beam will be picked up. Geostationary satellites are easily avoided by aiming the dish at a vacant part of the sky. Moving sources (eg other satellites, planes) pose a problem however as do trees, rooftops, overhead wires etc which all produce a thermal signal.

Source Catalogues for the Open Clusters we like most

About 2100 galactic open clusters are known. Most of them have been observed in at least one of the five commonly used photometric systems. The number of stars per cluster ranges from several thousands for the most prominent clusters down to as few as a dozen stars for the poorest clusters.

Wiki has a nice list in the "Best & Brightest" style. It's a crossover list, some GCs are included. Each cluster number has a link to a more detailed Wiki page about the cluster. A good example is *Hodge 301* in the LMC. It is part of the same massive *Tarantula Nebula* star-forming complex but is offset several arc minutes from the super-massive R136 cluster at the heart of the Tarantula.

The Open Clusters and Galactic Structure

catalog was compiled and then systematised data from numerous other

catalogues, particularly the "Big Four": proper motion, radial velocity, distance, and age.



Low-resolution chart of some Milky Way giant molecular clouds; all are potential star-formation sites. Many more smaller ones are known to exist. Bruno Alessi, *Open Clusters and Galactic Structure.* (Also 1, 2). Alessi succinctly states the case for observing open cluster in the lead-off paragraphs of the website above: "The open cluster system is of great value for the study of The Galaxy dynamics, because they span a relatively wide range of ages, that can be determined with more precision than any other spiral arm tracer. They are the key objects to understand the motion of spiral arms and moving groups of stars, to derive the rotation curve and distinguish between star formation processes."

Jack Bennett (1960s), Bennett Catalogue.

Although christened John Caister Bennett, he was known to all as Jack. His modest list of 85 cometary imposters was born in the spirit of Charles Messier. He pounced on an amazing array of objects given that his primary telescope was a 5-inch refractor at 21x mounted on an undriven alt-azimuth mount. With this he discovered the first

supernova since the telescope was invented. He was the veritable model of the meticulous log-keeper. He reported having spent 815 hours fighting off dew, mozzies, and bats, all for the sake of fuzzy bits

Nightfall's List of Catalogs & Resources

in an eyepiece. As eccentricities go, Jack Bennett was well ahead of everyone else. So is astronomy, come to think of it.

Berkeley Open Cluster Catalogue, compiled by Gosta Lyngå 1979, 90 open clusters numbered between 1 and 104, original source: Alter, G.; Ruprecht, J.; Vanýsek, V. *Catalogue of star clusters and associations*, Prague, Pub. House of the Czechoslovak Academy of Sciences, 1958. **Sydney van den Bergh 2006**, *Diameters of Open Star Clusters*, A-J v131, No.3.

Abbe Nicholas Louis de la Caille (1750s) was the first observer to systematically catalog the entire southern sky. A remarkable achievement in itself, which morphs into an astonishment when we consider his optical aid, a tube about 25 cm long with an objective lens 13 mm in diameter and magnification of 25x. That is only about 4 times the light-gathering power of the naked eye. ASSA's own Auke Slotegraaf laboriously put together a small sampler list available free *here* and in spreadsheet form *here*.

Caldwell Catalog, 109 mostly Northern objects compiled by Patrick Moore as an additional challenge list to the Messier Objects.

Per Collinder 1931, *Catalogue of Open Galactic Clusters*, 471 clusters listed by 16 classification parameters, with second non-tabular observational and original sources. Source plates were Franklin-Adams (1953).

Anton Czernik 1966, *New Catalog of Clusters*. The source paper is an *Acta Astronomica* paper from Czechoslovakia available only in PDF.



Collinder 261 (Harvard 6) Musca is the Southern Hemisphere skies' oldest open cluster, at log 9.95 or 8.9 billion years. It has managed to survive so long because, like the Sun, it lies near the Milky Way's co-rotation radius, where stars circling the Milky Way core travel at nearly the same velocity as the spiral arm density wave travels in the same direction. The result is a net forward velocity shear of nearly zero. Collinder 261 also enjoys a

position of considerable distance from the centreline of the Galactic disc, at Galactic latitude of –5.528° or 1,800 light years removed from the nonstop torque and shear of daily life in the middle of our Galaxy.

Czernik's paper gives some source information, but beyond his mention of them as being "faint" he does not mention why the catalog was prepared. SIMBAD lists the 45 Czernik clusters on an *HTML linked fully researchabe database here*.

James Dunlop 1826. Downloadable PDF of the cluster numbers and the Dunlop story *here*. There's a fine article about the Dunlop clusters by James Cozens, *James Dunlop's Historical Catalog of Nebulae and Clusters*. This is a long article about the errors and inadequacies of James Dunlop's 1826 catalog. It also reproduces the original catalog.



Star forming region in the Small Magellanic Cloud in infrared light from the Herschel Space Observatory and the Spitzer Space Telescope. The image was coloured to show different dust temperatures. The coldest objects appear in red, corresponding to infrared light at 250 microns, or millionths of a meter. Herschel's Photodetector Array Camera and Spectrometer fill out the green mid-temperature bands at 100 and 160 microns. Warm regions in blue are from the Spitzer telescope's 24- and 70-micron data. *Source*: NASA.



Hogg 15 lies on the near side side of the Coal Sack dark nebula at 2262 parsec (7375 lyr). At 5.88 million years of age Hogg 15 has expelled its natal gas and is about to undergo its first core-contraction cycle. It will slowly dissolve into the spiral medium in 15 to 20 million years. Since many of the object positions were erroneous or the objects averted imagination, the Dunlop Catalog s better seen as a reference tool than a list to chase after.

Harvard Catalogue, WEBDA lists 6 out of the 21 Harvard open clusters compiled in 1930 by Harlow Shapely. Half of the clusters are not listed in any other prior catalog. Harvard clusters are generally faint and sparse. Harvard 3 has absconded somewhere. If you find it, let us know. For southern observers, Harvard 6 in Musca (also Collinder 261) is the

oldest open cluster (8.89 Gyr) in the Southern Hemisphere. It can be seen in dark skies using a pair of binoculars, but requires 8 inches aperture and very dark skies for its brightest stars at M_v 14.8.

Haffner clusters are much studied because they are mostly over 1 billion years old and in advanced states of dissolution into the Galactic medium. Rather little is known about their catalog compiler Hubert Haffner. His original paper containing the classifications is in the German-language *Zeitschr. Astrophys.*, 43, 89-94 (1957), "Neue galaktische Sternhaufen in der sudlichen Milchstrasse". If you are rather more keen on just having a squizz (look) at them, *WEBDA* lists the positions and data for 23, all of which are faint and rather high in the Galactic plane due to disc heating processes that tend to ease old star clusters ever outward into the disc from the centreline where most clusters are born. If you want to know more you can search for individual Haffners by typing the cluster name into the search box on SIMBAD.

Hogg star clusters were catalogued by Helen Sawyer Hogg during her research into the variable stars in the Large Magellanic Clouds. It was this research that led her to discover the period-luminosity relationship of variables whose light curves ascended rather sharply but descended more slowly. The progenitor of λ Cephei prompted these stars to be named Cepheid Variables. Hogg's discovery was one of astronomy's most important. It enabled astronomers to more precisely estimate the distances of stars. *WEBDA* lists all 23 of them.

Jim Kaler, *Open Clusters Visible to the Naked Eye* (includes three globulars).

Kharchenko et al 2013, *Global Survey of Star Clusters in the Milky Way*, the most complete source of astrophysical data thus far and a substantial improvement over previous catalogs based on Hipparchos & Tycho data. Not for the faint-hearted. Lists 3784 objects surveyed, 3006 confirmed. Individual star data from 2MASS, PPMXL, USNO-B1.0, & ICRS, to M_v 20.0, Padova stellar models w/*J H K* isochrone fits. Also lists 142 GCs, 19 moving groups, 21 associations, 221 cluster

Nightfall's List of Catalogs & Resources



King 26 in DSS image on WEBDA website.

remnants. Most proper motions in mas/yr.

King *WEBDA* lists all 26 of them. King 17, 18, 20, 23, 26 were recently studied for the first time by *A.L. Tadross.*

Loden WEBDA lists 54 of the over 2300 clusters identified with the Loden name. (Many of these WEBDA don't connect to supporting data; it's

push the little mouse button and hope for the best. And once you do get to a Loden, they are ferociously hard to identify on the basis of photo image — and not a great deal easier at the eyepiece. Loden clusters are for that rare soul, the passionate cluster collector with the patience of a saint, endurance of a tardigrave, and eyes of an owl.

Melotte *Catalogue of Star Clusters shown on Franklin-Adams Chart Plates* contains both open clusters and globular clusters. The English amateur astronomer John Franklin-Adams (1843–1912) created an early photographic atlas of the sky, based on plates taken at Johannesburg, South Africa, and in England, published 1913–1914 by P. J. Melotte. 206 charts 15° square each with stars to M_v 17, covering the entire sky.

J. Ruprecht (1963), *Classification of Open Star Clusters* (to M_v 20.3 based on the POSS blue plates; images S of –12° were taken with the 10″ f/12 Metcalf refractor. Czech astronomer Jaroslav Ruprecht published a definitive list of OB associations compiled from several observatories, all classified following the Trumpler system; 852 true open clusters with 116 not definitively bound systems.

Stock (clusters <u>1 & 2</u>, <u>1956</u>), (<u>3 to 23</u>, <u>1959</u>), (<u>24</u>, <u>1970</u>). In the early 1960s the German astronomer Jürgen Stock was asked by the university of Chicago to test sites in Chile for for astronomical telescope suitability. Stock already had published two lists of 23 sparse star clusters he had identified in papers on photographic photometry of open clusters and stars in the North Polar Sequence. His three-years of searching eventuated in today's array of the world's largest astronomical instruments being constructed in Chile. He also discovered *three minor planets now named after him*, (4388) Jurgenstock = 1964 VE = 1982 UA = 1999 LG.

Clyde Tombaugh (1938 and 1942) of Pluto fame discovered 5 loose aggregations that were eventually shown to be bound clusters while he was using the photographic plates from the 13" Lawrence Lowell astrograph. The modern observer/writer Max Radloff wrote a report on the Tombaugh clusters in the now-defunct Deep Sky Magazine in Dec. 1990/91. There is also a *Google Group* for the Tombaugh objects.

Trümpler Born in Switzerland, Robert Trümpler emigrated to the United States in 1915. Trümpler used telescopes at the Allegheny (Pennsylvania) and Lick observatories (California) to discover that the brightness of distant open clusters was lower than expected. He suspected this dimming was caused by interstellar dust, even the reality and chemistry of cosmic dust was not commonly understood. His 1930 analysis of 334 open star clusters included 37 that were not previously listed at that time. These 37 bear the Trümpler name. Trümpler's system of classifying star clusters is still used today. For Southern observers, Trumpler 14 in the Carina Nebula is one of the most dazzling in the sky. Appearing very compact, it contains over 2,000 stars weighing about 4,300 M . Its brightest star HD 93129AB (the AB means it is a spectroscopic binary) is the most luminous star known in the Milky Way, radiating a fearsome 1.3 million times the luminosity of the Sun from a surface temperature of 53,000 K.

vdB–Ha (S. van den Bergh – G.L. Hagen), Uniform survey of clusters in the Southern Milky Way, 1975. (*See image of VdB-176 Norma at right*.)

Globular Cluster Catalogs

Alvin Huey free downloadable PDF *Globular Clusters*. The original 13 *Palomar globular clusters* were first identified on Palomar Observatory Sky Survey (POSS) plates by George Abell in the 1950s. They got their Palomar name (and soon nicknamed Pal globulars) by Helen Sawyer Hogg. The final two, Pal 14 and Pal 15, were added later.



One of the more challenging van den Bergh-Hagen) clusters is VdB-Ha 176 (in SIMBAD <u>ESO 224-8</u>) an open cluster in Norma. Highly reddened, its

large population of $>M_V$ 14 stars led to its being classified as a globular for a time. Stellar dispersion studies showed it to be an ancient open cluster in a state of slow diffusion into the Galactic medium. Nightfall writer Dana De Zoysa has published detailed articles about this cluster *here* and *here*.

Planetary Nebula Catalogs

The Planetary Nebulae from Jim Kaler's *Stars*. Reiner Vogel, *Large Planetaries Observing Guide*. Reiner Vogel, *Proto PN Observing Guide*. Reiner Vogel, *Abell Planetaries Observing Guide*. George Abell, description of 86 objects in ApJ 04-1966, *Properties of Some Old Planetary Nebulae*. See also Globular Clusters and Planetary Nebulae Discovered on the National Geographic Society-Palomar Observatory Sky Survey (POSS). George Abell, Publ.Astro.Soc.Pacific 08-1955, *GCs & PNs discovered on*

POSS plates.

Dwarf Galaxy Catalogs

Alvin Huey free downloadable PDF *The Local Group*. Sydney van den Bergh, *Luminosity classifications of dwarf galaxies*.

Hickson Galaxy Groups

Paul Hickson, ApJ 04-1982, *Systematic properties of compact groups of galaxies*.

Paul Hickson, A&A 00-1997, *Compact Groups of Galaxies*. Paul Hickson's *webpage*.

Reiner Vogel, *Hickson Catalog of Compact Groups of Galaxies*. Gottlieb & Shields, *32 Interesting Hickson Groups*.

Abell Galaxy Clusters

Alvin Huey, *Abell Galaxy Clusters* (free downloadable PDF).



The ghostly sphere of Abell 39 in Hercules (PN A66 39) is thought to be one of the most perfect planetary nebulae in the sky. It's even boundary testifies to the very low, homogenous underdense interstellar medium in its 2.5 light year radius. The nebula's Galactic coordinates tell us why: at 047.0517 +42.4827, it is very high above the Galactic plane, at 6.8 ly away, will up into the thin medium of the Galactic halo. Halo stars are very old, in keeping with Abell 39's estimated mass of about the same as the Sun when it finally shed the last of its atmosphere into this shell. The white dwarf core star visible in the centre is M_v 15.6. The shell's integrated magnitude is 13.7. At only 2 arcmins dia, good luck spotting it.

From our mates at IceInSpace in Oz:

John Bambury has created his BAM600, a variation on the Herschel 400 compiled especially for southernskies observers.

Stephen Saber has a *list of 110 doubles* accessible with a 6-inch.

Glen Cozens has a 150 Dunlops list.

Paul Mayo has a 100 Brightest Galaxies for Southern Observers list.

Ian Cooper has a wonderful *hirez SMC chart* detailed enough to list even the SMC's hardly-ever-observed GC & YMCs cluster L1 & L2 below 47 Tuc and L113 in the middle of the SMC's quadrant of SE Nowhere. **Excel spreadsheet of 235 SMC objects.**

Patrick Cavanaugh has a magnificent set of *14 LMC and SMC hirez photo charts* with object IDs, plus another zip file of observing notes.

The Council of Giants

Tracking down the galaxies in the image on the right can be the hobbyist astronomer's first foray into visualising galaxies visible in a 6 or 8 inch telescope as part of a much larger structure than our familiar Local Group (LG) of the Milky Way / M31 Andromeda / M33 Triangulum neighbourhood. The LG is in fact a small part of the next larger cosmic structure, the Local Sheet. The Canadian Astronomer Marshall McCall colourfully rebadged the Local Sheet as the "Council of Giants" after the -2way small seedlings grow up in a circle around a giant redwood or sequoia tree. When the grand old giant dies, the small ones then grow to giants themselves, hence the "Council" name. In 2014 McCall published an analysis of how the Council itself is but a small part of a much larger structure called the Local Volume. Many such 100 megaparsec-scale structures in turn are but strands on a thread that merges into a common stream flowing toward the Virgo Supercluster. The universe is a gigantic web of such filaments, sheets, and walls, separated from each other by enormous voids which are nearly empty of matter. None of these assemblies is static: they are like huge rivers, constantly changing their courses, merging new tributaries, spreading into wide aprons. The physical laws governing large scale structure are very different from motions inside our own galaxy. More here: 1, 2, 3, 4, 5, 6.



A bit more technical . . .

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Stars

Jim Kaler, *The Natures of the Stars* The *Morgan-Keeler Catalog of 1943*

Spectroscopy

Visual starlight tells us what an object looks like. The object's spectrum tells us what it is—and much, much more. We can deduce what the object has been and will become, and what will be the object's effects on its surroundings.

Spectroscopy is no piece of cake; it's the most demanding of the nonmathematical aspects of astronomy. You can stick your toe in the water with **Richard Walker & Marc Trypsteen**'s *Twin Book Project*, *Astronomical Spectroscopy*. It's a beginner's guide for advanced amateurs with a yen for physics.

Astronomical Spectroscopy (a website of links to numerous other resources)

The Spectra of Stars on the Hertzspring-Russell Diagram



The distant galaxy cluster MACS J0717 as seen in diffuse blue of light emitted by gas at millions of degrees (Chandra X-ray Observatory). The diffuse pink colour is from gas excited by shock waves and turbulence (Jansky Very Large Array in New Mexico USA). Source: NASA, ESA, CXC, NRAO/AUI/NSF, STScI.

Jim Kaler, *Spectra*. The splash screen shows a box with 30 rectangles, each with a property about spectra inside. Click on any box and the page opens to a long list of all 30 topics, with the topic you clicked on art the top of the page.

There is a broad overview of the subject from *Cloudy Nights*, one of the online astro-forums for amateur astronomers.

- *Richard Walker* has produced two superb technical guides: *Spectroscopy for Amateur Astronomers* (equipment and methods of spectroscopy)
- *Spectral Atlas for Amateur Astronomers* an illustrated guide to what spectrograms reveal about stars and other objects.

You can resolve individual lines on the NIST *Atomic Spectra Database Lines Form*.

The Hertzsprung-Russell Diagram and its many derivatives

Jim Kaler's *The Hertzsprung-Russell (HR) Diagram* opens to a box of 56 rectangles, each of which references a particular topic. Click on any one topic and a main page opens up which discusses all 56 options, showing the specific option you clicked at the top of the screen. (*Image at right copied from Kaler source file.*)



14

Remember iron filings in those boring Matric classes??



Magnetic field of our Milky Way galaxy as seen by the Planck satellite, compiled from the first all-sky observations of polarised light emitted by interstellar dust. Darker regions correspond to stronger polarised emission, and the striations indicate the direction of the magnetic field projected on the plane of the sky. the magnetic field lines being predominantly parallel to the plane of the Milky Way. *Source: NASA*.