A Beehive of Activity — Howard L. Cohen

Praesepe is one of the brightest, easiest to find open star clusters and can be conveniently used to judge the limiting visual magnitude of your telescope

Observers at our last, very successful star party on Saturday, 2006 May 20 treated themselves to many wonderful celestial sights including Jupiter with its red spot and the *egress* of Europa's shadow. In addition, Saturn cast a beautiful shadow on its ring system with the Cassini division clearly defined. Nevertheless, we spent most of the evening searching and finding multitudes of deep sky objects in the night sky. Among these was the well-known Praesepe Star Cluster, only 1-1/4 degrees above brilliant Saturn. This star cluster, known to many as the "Beehive," is best seen at low powers since it subtends a large angle of about three lunar diameters or ninety-five arc minutes. (One *arc minute* is 1/60th of a degree.) Indeed, using a low power, wide angle eyepiece, my telescope gloriously showed both Praesepe and Saturn in the same field of view on the night of our May star party!

Praesepe (Latin for "manger" and pronounced prēsē'pē or pray-SEE-pee) is an example of an *open star cluster*, a loose arrangement of dozens to hundreds or more stars. They are common in spiral and irregular galaxies where star formation is active. Thousands have been observed and cataloged in our own *Milky Way Galaxy* but these must represent only a fraction of their total number. Open star clusters are important objects in the study of stellar evolution since cluster members are typically similar in age making possible evolutionary comparisons.

The estimated distance to this cluster is a mere 580 light years, which actually makes it one of the closest star clusters to us. Therefore, the Beehive is comparatively easy to see with the naked eye under dark skies because of its large apparent size and brightness. (The cluster's combined apparent visual brightness is about magnitude +3.7.) Located in the constellation of *Cancer*, this wonderful group of stars has been known since ancient times and is one of the first objects observed by Galileo with his newly made telescope. Ancient Greeks judged weather by the visibility of this faint patch of light since its naked eye visibility is sensitive to atmospheric moisture. If not seen on dark, moonless nights, storms might be brewing!

Praesepe is one of few clusters visible to the naked eye but using binoculars or a small telescope will reveal dozens of its dazzling beauties. (See Fig. 1.) Within a volume of about 16 light years, astronomers estimate a total stellar population in the hundreds. Included is a vast stellar "zoo" such as *41 Epsilon Cancri* (its brightest member and a hot "metal line star" with a *spectroscopic binary* companion). Here too, are many other multiple stars including *TX Cancri* (a *W Ursae Majoris* star, a type of eclipsing binary with a period less than a day with two close, highly distorted

Figure 1. M44 (NGC 2632) in *Cancer*, also known as Praesepe or the Beehive Star Cluster. (Cred. *TheSky6,* Software Bisque.)

stars). Praesepe also contains several *Delta Scuti* stars (short period, low amplitude pulsating stars) of magnitudes seven to eight in "proto-giant" states, older red giants, very old white dwarfs and a peculiar blue star.

Although astronomers estimate the cluster's age at approximately 730 million years, Praesepe is a moderately young object in our universe (cf. the Sun's age of about 4.6 billion years). However, this is remarkably old for an open star cluster (cf. the Pleiades star cluster's age of about 100 million years). Since open star clusters are only loosely gravitationally bound, encounters with other clusters or galactic material easily disrupt them after only several hundred million years. Curiously, the Praesepe Cluster has a similar age, stellar content and motion on the sky as the Hyades Star Cluster, the nearest open cluster to us. This may suggest a common origin for both. It is also interesting that many Praesepe stars appear to rotate (spin) about 30 percent faster than their Hyades counterparts.

Charles Messier (pronounced Mess-ee-ay), the famous French comet hunter of the 18th-19 centuries, listed the Praesepe Cluster in his famous catalog of nebulous objects as number 44 (designated "Messier 44" or "M44"). The inclusion of this cluster in his catalog is a debated, historical oddity since the purpose of Messier's catalog was to identify "nebulous objects" that he might mistake for comets. Of course, Messier did list other, definitely noncomet-like objects such as M42 (Orion Nebula), M43 (part of the Orion Nebula) and the Pleiades Star Cluster (M45) but did omit the double cluster, h & Chi Persei. Although M44 (also known as NGC 2632) looks like a hazy, oval patch to the unaided eye, even small telescopes reveal its spectacular stellar nature. Some have hypothesized that Messier wanted to bring his initial count to an even 45 so included other nonnebulous objects. (He ultimately listed 103 entries in his published catalog of 1781 with modern lists now including 110 objects.)

I am particularly fond of this cluster because of a research project on the Praesepe done in the early 1960s. This research involved a search for eclipsing binaries using photographic photometric techniques. I used an instrument, called a "Cuffy iris photometer," to send a measuring light beam through each star image on a photographic plate. I then regulated this light by an iris for comparison to a reference light beam in order to measure the photographic brightness or magnitudes of each star. Finally, with the help of my wife, Marian, we laboriously produced magnitude calibration charts from these data.

Since the Beehive cluster is one of the brighter, larger, easier to find open star clusters, and begs low magnification, put it on your short list of celestial wonders. *Cancer* is visible through much of the year, especially during winter and spring evenings. Praesepe is easy to find since it is conveniently in the middle of *Cancer* (within an irregular box formed by *Gamma, Delta*, *Theta* and *Nu Cancri*).
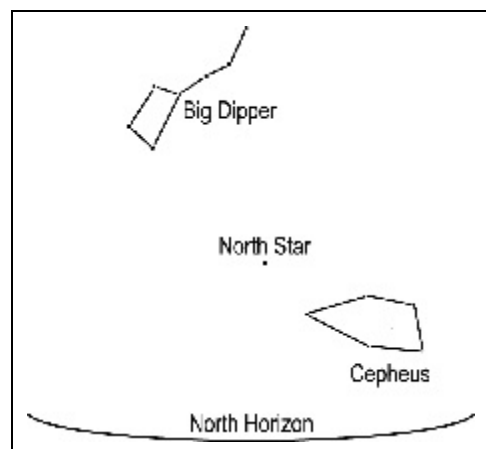
Figure 2. Cepheus appears to some as a house with a peaked roof. This resembles the outline of bright stars in the central region of the Praesepe Star Cluster. (See Fig. 3.)
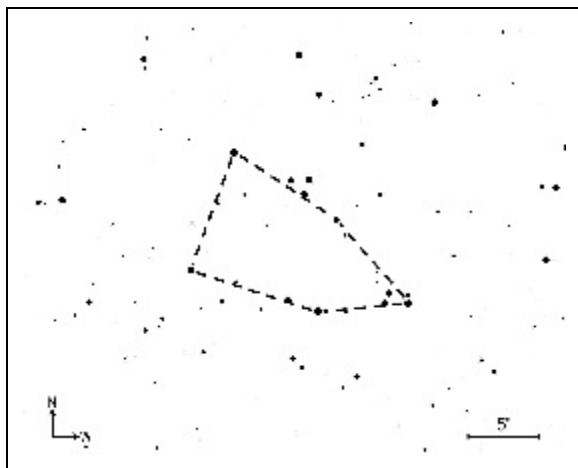
Figure 3. The inner region of the open star cluster, Praesepe, mimics the shape of the constellation of Cepheus. (See Fig. 2).

I have always found this cluster to have a unique appearance—some of the central cluster stars make an asterism reminiscent of the north circumpolar constellation of *Cepheus*, "The King" (see Fig. 2 and 3), a shape akin to a simple house with a peaked roof. Others may find this asterism similar to other constellations. For example, look at a star chart of *Auriga*, "The Charioteer." Can you see the resemblance? In fact, can you see the "three kids" of *Auriga* (*Epsilon*, *Zeta* and *Eta*) mimicked by some stars in Praesepe?

From a practical point of view for star gazers with telescopes, the Praesepe Star Cluster, like many others, makes a useful object to judge the "naked eye visibility" of your scope. Many factors affect limiting visual magnitude including both instrumental, sky and personal effects. Examples include telescope aperture and design, optical quality and cleanliness, magnification, clouds, haze, humidity (which affect transparency), *seeing* (blurring due to air turbulence), lunar phase and position, twilight, *air glow* and *zodiacal light*, artificial light pollution including nearby and distant lights, and the object's *zenith distance* (angular distance from overhead), and *azimuth* around the horizon! Personal qualities include your experience, age, dark adaption, health, tobacco, alcohol, drugs, etc.

Although many "formulas" exist for calculating limiting magnitudes, each method is approximate because accounting for all variables is difficult. (The *aperture* or diameter of the telescope's objective lens or mirror is the single, most important factor.) Table 1 gives a very rough guide to limiting visual magnitudes with various aperture telescopes under clear, dark skies (assumed naked eye limit about +5.7 magnitude) with high elevation stars (small *zenith distance*) and moderately high magnification. Increasing magnification from low to moderate powers will help but observing an object at low elevations can cost you a magnitude or more.

Table 1. Rough Guide to Telescope Limiting Visual Magnitude

Telescope Aperture	Limiting Magnitude	Telescope Aperture	Limiting Magnitude	Telescope Aperture	Limiting Magnitude
3-in (75 mm)	+10.9 mag	**6-in** (150 mm)	+12.4 mag	**12-in** (300 mm)	+13.9 mag
4-in (100 mm)	+11.5 mag	**8-in** (200 mm)	+13.0 mag	**14-in** (350 mm)	+14.2 mag
5-in (125 mm)	+12.0 mag	**10-in** (250 mm)	+13.5 mag	**16-in** (400 mm)	+14.5 mag

Check these magnitude limits out by observing objects as the Praesepe Cluster. Charts 1 and 2 (included as full page inserts for easy use with your telescope) give star charts for the Praesepe Cluster *without* and *with* magnitudes, respectively, for many stars in the Praesepe region. (Not all stars may be cluster members but that is not a factor here.)

Charts 3 and 4 give similar charts but with east and west reversed for telescopes that produce mirror images. (If your telescope inverts, hold the charts upside down.)

These star charts omit each magnitude's decimal point so the decimal points are not confused with stars. (Examples: magnitude +9.3 is displayed as 93; magnitude +11.4 is given as 114.) Note that observing the faintest stars visible in your telescope is prudent **before** one looks at the charts giving magnitudes! (Charts and magnitudes produced from data in *SkyMapPro*, Ver. 10 by C.A. Marriott.)

You may not want to use the Praesepe Star Cluster to predict weather, but while you are gazing at the stunning light of stars that have traveled many light years to reach Earth, you can use the appeal of this cluster to discover how faint you are seeing with your telescope. ¤

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