

The Fall Sky

by Dr. Whitney Shane, MIRA's Charles Hitchcock Adams Fellow

Fixed Stars

Of the few galactic clusters that are recognizable with the unaided eye, the Pleiades is certainly the most evident. You will find it easily in the eastern sky, if you are willing to stay up a little late. It is exceptional mainly for the fact that it is so very close to the Sun, only about 130 parsecs away. The only closer ones are the Hyades, which is less striking because of the absence of bright stars, and the very sparse and difficult Coma cluster.

The Pleiades is a cluster of average age, as galactic clusters go, about 100 million years. This is estimated by examining the Hertzsprung-Russell diagram, where we plot the brightness of each star against its temperature (or spectral type). As the stars age, they exhaust their hydrogen and become larger and cooler. This happens first for the brightest stars. By comparing the diagram for the Pleiades with the corresponding diagrams for the youngest clusters, we can see at which brightness the stars have begun to cool. From stellar evolution calculations, we can then determine the age at which this would happen.

A simple, but not very accurate, way to do this would be to calculate the rate at which hydrogen must be burned in order to maintain the luminosity of the star and then calculate the age at which most of the hydrogen would be used up.

Although we see only seven stars with the unaided eye, the Pleiades is a relatively rich cluster, with about 100 known members; but as is the case with almost all open clusters, the mass is not sufficient to hold it together against its own internal motions and the tidal forces of the Galaxy.

Thus, after another 1000 million years or so, the Pleiades will no longer be seen as a star cluster, but it can then still be identified as a moving group, indicating that the stars have a common origin. There are now many such moving groups known, each of which must have been, at one time, a star cluster.

Before the stars were formed, the Pleiades, like every other beginning star cluster, must have been a large cloud of dust and gas. Much of the material goes into the

formation of the stars, but some always remains. This is then often expelled from the cluster by the radiation pressure of the stars. In the case of the Pleiades, however, there is still enough that it can easily be observed as reflection nebulae around the brightest stars. This seems to suggest that very massive stars, which would have been bright enough to drive out the gas, never formed in the Pleiades. Such stars, if they had ever existed, would by now have completed their evolution and exist only as faint white dwarfs, which it would be very hard to identify, even at this modest distance.



The Pleiades (M45) photographed by Chuck Vaughn.

The hottest (and brightest) stars in the Pleiades have surface temperatures of 14000 K or less. This is not enough to ionize the surrounding gas, so we see only the scattered light from the dust. Since dust scatters blue light more effectively than red, we see these reflection nebulae as somewhat more blue than the stars themselves. If the hottest stars were 25000 K or hotter, as is the case in some very young star clusters such as the Rosette Nebula, the gas would be ionized and the nebulosity would appear red because of the red emission line of hydrogen. Such star clusters, however, are rare because the bright stars have very

short lives and they tend to expel the dust through the radiation pressure. This apparently did not happen to the Pleiades.

Planets

Although Mercury is at eastern elongation in early November, it is too far south for observation from the northern hemisphere. A better observing opportunity will be in early December, when it will rise well before the Sun.

Venus is also quite far south for northern observers, but it remains very well observable during the whole quarter. It will be brightest in early December.

Mars executes retrograde motion during almost the whole quarter and is in opposition on November 7, when it will be very well placed for observation from the northern hemisphere. Confusing internet messages to the contrary notwithstanding, there is nothing very special about this opposition. By the end of December, Mars will have moved into the evening sky. If you happen to be in northeast Siberia on December 12, you can enjoy seeing Mars being occulted by the Moon.

Jupiter, which is in conjunction with the Sun in late October, will reappear in the morning twilight in November and become better observable as the year draws to a close.

Saturn, moving very slowly, remains in Cancer during the whole quarter and is stationary on November 22. It begins as a morning object in October, but by the end of the year it is visible for almost the whole night.

Uranus and Neptune are now past opposition. We observed both from the Oliver Observing Station on the night of 13 August.

Meteor Showers

The fall quarter is rich in meteor showers, some of which are quite interesting and a few of which can be observed without much interference from the Moon.

The quarter opens with the Draconids, a stream which is highly variable, sometimes reaching storm intensity. The parent comet, 21P/Giacobini-Zinner, is now close to perihelion, so this might be a promising year for a storm, although theoretical predictions do not indicate this. The predicted peak falls after sunrise on October 8, so, with the Moon near first quarter, the best observing opportunity would be in the early morning hours.

The Orionids reach their peak on October 21, which is so close to full moon that observing is not likely to be

rewarding.

The Taurids, which are divided into two closely related streams, peak in early November and are observable over a period of two weeks. They are thought to produce more than their share of fireballs. The Moon is favorable for observations this year.

Two of the quarter's most promising showers, the Leonids, peaking on November 17, and the Geminids on December 14, are both within a day of full moon, so that neither one will be usefully observable this year.

Finally, the Ursids, a rather poor shower with mainly faint meteors but occasional outbursts, will peak on December 22. The Moon is near last quarter, so evening observations are indicated.

Comets

There are no bright comets to be expected in the fall quarter. In fact, the brightest may be Comet 9P/Tempel 1, which was the target of the Deep Impact experiment in July. The results of this experiment as obtained at MIRA are described elsewhere in this *Newsletter*. The comet survived the experiment, but it is now fading and visible only with difficulty, low in the southwestern evening sky.

Two other periodic comets are currently visible, 161P/2004 V2 Hartley-IRAS very low in the evening sky and 21P/Giacobini-Zinner in the morning sky. Both are well past perihelion and fading rapidly.

A newly discovered comet, C2005 P3 Swan, is already past perihelion and fading rapidly, but being far north it is observable all night, best in the morning hours. It is expected to be magnitude 13 and fading in October.

Comet C2005 E2 McNaught is still approaching perihelion and should reach tenth magnitude early next year. Although still very far south, it is observable in the evening sky. It will gradually move north as the quarter progresses.

Eclipses

The eclipses return on October 3 when there will be an annular solar eclipse. The eclipse will begin just off the coast of Spain at sunrise and move southeasterly across northeastern Africa, ending in the Indian Ocean at sunset.

A partial lunar eclipse will take place on the early morning of October 17. The whole eclipse will be visible from our area, although it will end only shortly before moonset.