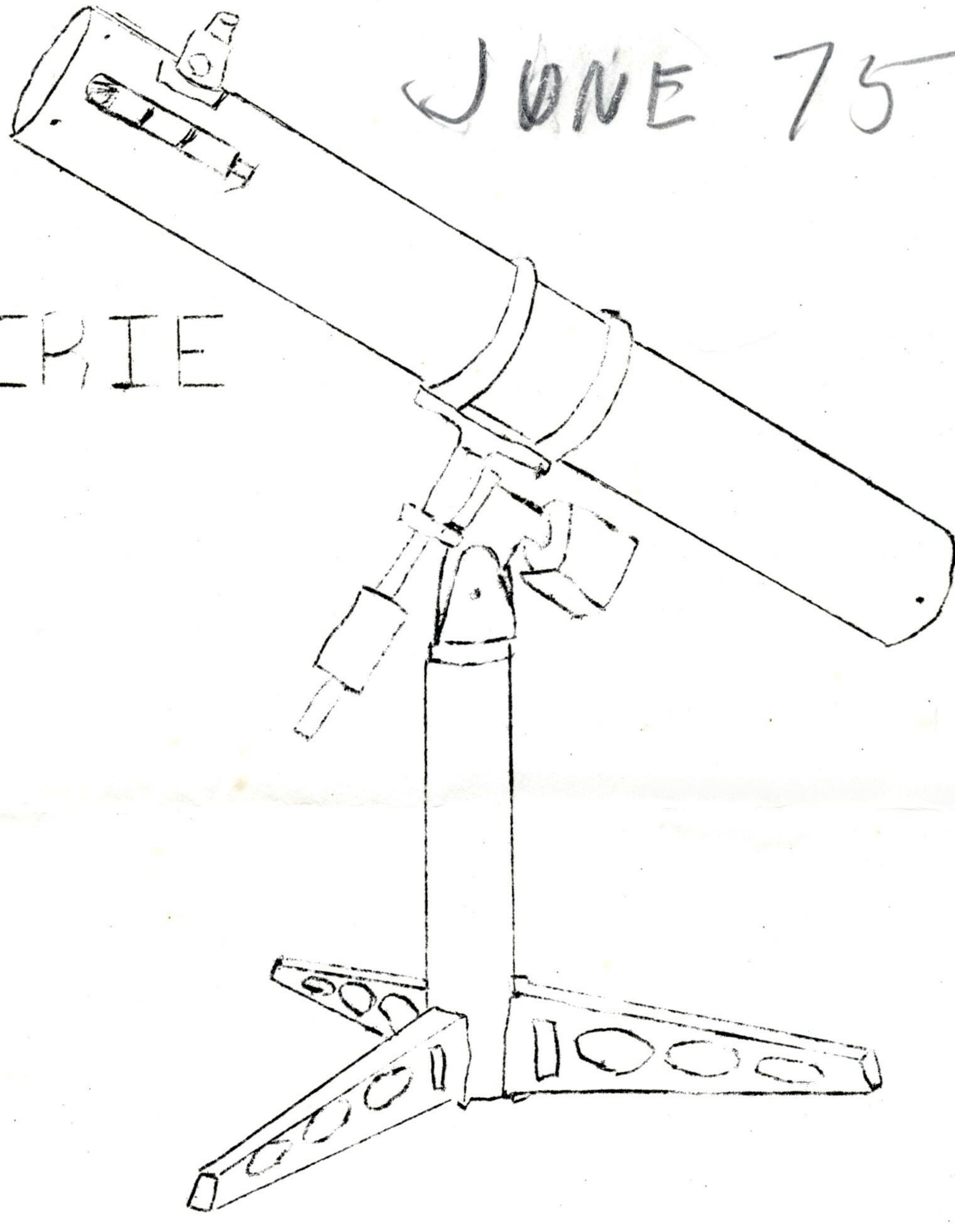
THE PRAIRIE ASTRONOMER

JUNE 75



OUR MEETING THIS MONTH WILL BE AT 7:30 PM ON TUESDAY, JUNE 24, 1975 IN THE OLIN HALL OF SCIENCE ON THE NEBRASKA WESLEYAN CAMPUS. BE SURE NOT TO MISS THIS MEETING AS THE ELECTIONS FOR NATIONAL LEAGUE OFFICERS WILL BE HELD, AND YOUR VOTE IS IMPORTANT-THIS WILL BE CONFIRMED BY SOMETHING THAT WILL BE MENTIONED AT THE MEETING.

+++++GATEWAY SHOW+++++

OUR MONTHLY SKY SHOW AT GATEWAY FOR THIS MONTH WILL BE ON THE 17TH OF JULY -THURSDAY- WITH THE NEXT NIGHT-FRI.-AS A CLOUD OUT DATE. HOPE TO SEE YOU THERE.

THE BASIC STRUCTURE OF OUR GALAXY

On April 4th, I managed to get out to Behlen Observatory to view some of the wonders of the April sky including several galaxies. In particular, I came to get a good look through the 30-inch reflector at M-51, the whirlpool galaxy in Canes Venatici. Through the big scope, the object showed clear spiral structure in a way that I have never seen it before. The clumpings and knots in the arms were clearly visible as they spiraled outward from the small circular nucleus, with the arms immersed in a milky sort of haze. About that time, I remembered some interesting characteristics of our own galaxy that were presented to me a few days earlier in my Astronomy 203 class. I will present them here in a bare bones and, I hope, a non technical form, so as to give you a better idea of just what sort of a star system we live in.

To begin with, I think I should mention some early ideas of our local "Universe." In the 1700's, Hershel and Kant looked at and counted the stars in the sky and came to the conclusion that our sum was right smack-dab in the middle of an elliptical disk of stars! Well, it seems to me that a similar line of self centered reasoning about 200 years earlier made by some short sighted men was proved very much wrong, and eventually this newer theory was also proved wrong. So much for theory. R. J. Trumpler started work on the problem of our galaxy and eventually discovered that interstellar space is not a perfect vacuum, as Kant and Hershel assumed, but filled with dust and gas. Using telescopes and correcting for interstellar absorption, astronomers found us at the edge of an enormous stellar system, with the density of stars increasing rapidly as we approach the galactic center. As for size, this presented a problem. Just how big is this thing and how far are we from the center? To answer this, astronomers had to use two powerful mathematical laws. One is the Doppler effect formula. A spectral line or wavelength emitted by an atom is shifted in wavelength when the object containing the atom is moving toward or away from the observer. The expression is:

$$\frac{\Delta\lambda}{\lambda} = \frac{v}{c}$$

where $\frac{\Delta\lambda}{\lambda}$ is the shift in wavelength divided by the initial rest wavelength, v is the velocity of the object, and c is the velocity of light. Using this relation, we can study the velocity of stars or our sun to find how fast our sun is traveling about the galactic center. Using this, we find, after studying the shift in wavelengths of nearby galaxies, that we are moving at 250 kilometers per second around the galactic center. If we study stars that are fairly close, say 300 light years or less, we find that the stars that are farther away from the galactic center than we are move slower than we do and those closer to the center move faster, somewhat like the way the planets move about the sun. This means that the stars in this section of the galaxy obey another basic mathematical relationship known as Kepler's Harmonic Law. This relationship states that the period of revolution of a body (and thus its velocity) squared is proportional to the cube of its mean distance to the center, so we now have the means to determine the distance we are from the center of the galaxy. This distance turns out to be about 10,000 parsecs or 32,600 light years (1 parsec = 3.26 light years). The actual radius of our galaxy is about 15,000 parsecs, so we are about 2/3 of the way out from the center. There are also certain stars called Cepheids which can be used as distance markers to determine the thickness of our galaxy. Our sun is slightly above the galactic plane so a correction had to be made, but it now appears that the galaxy is between 500 and 1000 parsecs thick at the sun's distance. Using both optical observations and radio astronomy, we have determined that our galaxy has an elliptical bulge at the center that is about 2000 parsecs thick. Near the center of this bulge is a small area of possibly explosive activity marked by a point known as the nucleus. Its size has been determined by the use of infrared light and it seem that this object is incredibly small. It is only 5 light years across! We know this size is quite probable through the observations of other galaxies. I myself have seen the almost star-like nucleus of the great Andromeda Spiral, M-31, through the 30 inch and I can say quite plainly that the darn thing is terribly small.

Let's now look at the overall structure of our galaxy. Observing the spiral arms optically is very difficult due to intervening matter, so we turn once again to radio astronomy for an answer. It seems that neutral hydrogen marks the position of the major spiral arms and this hydrogen emits a radio wave of a wavelength of 21 centimeters Using radio telescopes and noting any Doppler shift in wavelength, due to motion, we can map out the basic spiral arms. The more the 21 centimeter line is shifted, the faster the gas is moving, and this velocity is related to the distance the gas is from the center. Once we know that, we can plot the position of the gas relative to the sun and galactic center. Sure enough, the spiral structure shows up, although it isn't the most regular structure in the universe. It appears that our galaxy has two major spiral arms that are fairly tightly wound and we are in the Carina-Cygnus arm, an area of very luminous young stars. Here, however, we run into an interesting paradox. As I said earlier, the stars that are about the same distance from the galactic center as our sun is, move according to Kepler's laws, i.e. those farther out move slower that those closer in. But if we look somewhat closer to the galactic center, we find that the inner portions of our galaxy rotate as a unit like a giant pinwheel with the objects on the outside moving faster that those on the inside. As a matter of fact, the changeover point between rigid body rotation and Keplerian rotation is slightly inside the orbit of the sun about the galactic center. There doesn't appear to be any reason why this should occur and I think that poor Kepler is probably rolling in his grave over this!

As for a theory tying all this together, we have only one major one. The spiral arms are probably caused by what are termed Density Waves. The arms are where young, hot stars are being formed out of hydrogen gas. Since hot O, B, and A type stars are the most luminous, they make the arms stand out somewhat, and since they also have relatively short lifetimes compared to our sun, they will probalby die out before they drift far from the arms. Since new stars are being created all the time in the arms, the spiral structure will be perpetuated by the wave of new stars and by the rigid-body rotataion of the galaxy neared the center. Thus by coordinating optical and radio observations, we can obtain a fairly good picture of what our galaxy looks like. If time permits me to do so, I will attempt a drawing of our galaxy to be presented at a future date. If anyone has any ques questions, ask me at the meeting, and I will attempt to fill in any gaps with more specific information.