



# WASP

## Warren Astronomical Society Paper

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May, 1990

### POLAR ALIGNMENT By Steve Franks

Among the many remarkable achievements of Joseph Fraunhofer, the one he is seldom remembered for is the invention of the German Equatorial Mount. I couldn't say for sure that he was indeed the first to devise such a method for supporting a telescope, but he did deliver to the Dorpat Observatory in Estonia one of the greatest telescopes in history. In 1817, it was not only the largest refractor in the world, 9.6 inches, but it was the first professional instrument to be equipped with an equatorial mount complete with a mechanical clockdrive!

As most of you are aware, the theory of such a mounting is to allow the telescope to sweep the sky and accurately follow a star by simply moving about its polar axis. A simple altazimuth mount must move in two motions simultaneously, horizontally and vertically, to accomplish the same effect. It's a tribute to the patience of great astronomers like Cassini, Huygens, Rosse, and the two Herschels, who worked such unwieldy or mammoth instruments without benefit of equatorial mounts. The German Equatorial mounting affords further refinements like clockdrives, which compensate for the earth's rotation and setting circles to direct the telescope to precise locations of countless astronomical objects.

But how many of us can accurately align our instruments to make use of the advantages this mount offers? Some amateurs who own instruments for many years still are sometimes not able to get accurate alignments suitable for anything but casual short term viewing. Many beginners are just too puzzled to even try beyond pointing the mount northward.

A good case in point is a fellow amateur who, after boasting many times about how Jupiter could stay in the eyepiece for more than an hour at a time, turned out to have no more methodology than simply putting Polaris square on the crosswires. This was all he knew. Needless to say, Jupiter could not stay imprisoned in his eyepiece for very long because Polaris is in fact some 47.6 minutes away from true celestial north. How many of us have apologized for our alignments with the quip, "I just did a quick alignment, I'm not doing anything

*.... Turn to page 3*

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# The WASP

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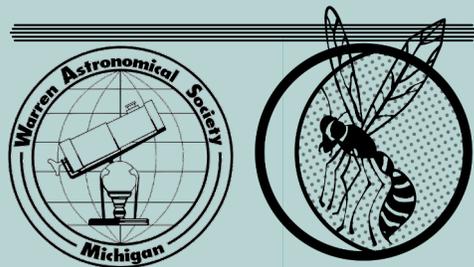
**Warren Astronomical Society**  
**P.O. Box 474**  
**East Detroit, MI 48021**

Send membership applications  
to and dues to:

Jeff Bondono  
51054 Kingwood  
Utica MI 48087

## 1990 Officers:

President:	Marty Kunz	477-0546
1st V.P.:	Ken Kelly	839-7250
2nd V.P.:	Robert Halsall	781-6784
Secretary:	Elizabeth Stabler	641-7023
Treasurer:	Jeff Bondono	731-4706
Librarian:	Tom MacLaney	541-8198



The Warren Astronomical Society, Inc., is a local, non-profit organization of amateur astronomers. The Society holds meetings on the first and third Thursdays of each month, starting at 7:30 PM.

### General Meeting on 1st Thursday:

Cranbrook Institute of Science  
500 Lone Pine Road  
Bloomfield Hills, MI

### Business meeting on 3rd Thursday:

Macomb Community College  
South Campus, Building B, Room 216  
14500 Twelve Mile Road  
Warren, MI

Membership in the Society is open to all. Annual Dues are:

Student:	\$10	College:	\$15
Senior Citizen:	\$15	Family:	\$25
Individual:	\$20		

Along the many benefits of membership are:

### Discount magazine subscriptions:

Sky and Telescope:	\$16.00 (12 monthly issues)
Astronomy:	\$14.00 (12 monthly issues)
DeepSky:	\$ 8.00 (4 Quarterly issues)
Telescope Making:	\$ 8.00 (4 Quarterly issues)
Odyssey:	\$12.50 (12 monthly issues)

Free copy of each WASP newsletter.

Free use of Stargate Observatory.

Special interest subgroups.

Call list - don't miss unexpected events.

Free membership in Astronomical league.

Free Reflector (Astronomical League Newsletter)

Free use of W.A.S. Library.

## Warren Astronomical Society Paper.

The Wasp is the official publication of the Society. Each new issue of the WASP is made available at the Macomb meeting on the third Thursday. Non-members will be charged \$1 for each new issue. Back-issues, when available, are free. Requests by other clubs to receive the WASP and other correspondence should be addressed to the editor. Articles for inclusion in the WASP are strongly encouraged and should be submitted to an editor on or before the first Thursday of each month.

Editor: Jeff Bondono 731-4706  
51054 Kingwood  
Utica MI 48087

Tom MacLaney  
Mike O'Dowd  
Ken Kelly

**Stargate Observatory** is owned and operated by the Society in conjunction with Rotary International. Located on the grounds of Camp Rotary on 29 Mile Road, 1.8 miles east of Romeo Plank Road, Stargate features a 12.5 inch F17 club-built Cassegrainian telescope under a steel dome. The observatory is open to all club members in accordance to the 'Stargate Observatory Rules.' Those wishing to use the observatory must call the Observatory Chairman by 7:00 PM on the evening of the session. The Observatory Chairman is:

Robert Halsall 781-6784

The Society maintains a library of astronomy-related books and periodicals at the Macomb County Community College meeting room. See the librarian for library rules or to checkout a book.

**Lectures** are given at Stargate Observatory each weekend. The lecture will be either Friday or Saturday evening, depending on the weather and the lecturer's personal schedule. Lecturers should check with the ranger at Camp Rotary early in the week to determine whether scouts will be at the camp, and to inform the ranger of the day and time of the lecture. If you cannot lecture on your scheduled weekend, please make arrangements to switch weekends with another lecturer, or call the chairman as soon as possible.

### Upcoming lecturers are:

Dan Cwierniewicz	4-20/21
Jeff Bondono	4-27/28
Francis Stabler	5-04/05
Riyad Matti	5-11/12
Scott Jorgenson	5-18/19
Frank McCullough	5-25/26

Several **subgroups** exist for those interested in specialized areas.

Those interested should contact the chairperson, listed below:

Solar:	Ed Cressman	645-1837
Lunar/Planetary:	Alan Rothenberg	624-9339
Cosmology:	Mike O'Dowd	268-7125
Deep Sky:	Doug Bock	750-9369

The **Call List** is a list of people who wish to be informed of spectacular and unexpected astronomical events. Anyone who notices such an event calls the next person on the call list, who informs the next person, etc. A call list member can specify that he or she not be called at certain times. Any Society member is welcome to join the call list and can do so by notifying Jeff Bondono, 731-4706.

### Calendar of Events

Thursday, April 19	7:30 WAS Meeting at Macomb Community College.
Saturday, Apr 28	Astronomy Day. Bring your scope for an all-day public education outing at Cranbrook Institute of Science
Thursday, May 3	7:30 WAS Meeting at Cranbrook.
Thursday, May 10	7:00 Cosmology Group Meeting. Contact Mike O'Dowd.
Thursday, May 17	7:30 WAS Meeting at Macomb Community College.
Friday, May 18	Bradford Smith will be speaking about NASA's Voyager Imaging at the GM Tech Center at 13 mile and Van Dyke. Dinner also. \$15. Contact Ken Strom.
Saturday, May 19	Astroganza 1990 at Abrams Planetarium (Michigan State University). Star Bowl, swap meet, astrophoto contest, speaker, much more. Contact Ken Kelly.

### *Alignment, from Page 1*

serious tonight.", when it is really the best we can do. Sure sometimes we are lazy, but the fact is many have been either mystified or frustrated by the various methods found in books. I too have been a victim of well intentioned authors and I always blamed my circles for not being accurate. Certainly my method was correct, after all, I got it out of a book.

To this day I don't understand the method used in Norton's Star Atlas. The 1000+ Atlas not only makes a mistake in a premise, but only works like a charm for a few hours. Polaris is not where it should be in the finder even after some 30 minutes. The old method of the imaginary line extended from Mizar (Ursa Majoris) to Ruchbah (Delta Cassiopeia) doesn't work either. Later books move this imaginary line from Alkaid, the last star of the Dipper's handle, to the first star in the big W, Epsilon Cassiopeia. "Ah, someone has finally taken up the slack caused by precession," I think. But this line isn't right either. Precession has carried Polaris' complementary arc of R.A. well past even them. Using the drift method, aligning to an eastern and southern star, is scientific but so-o-o slow. After an hour or so you just might have it!

Some of us are lucky to have special polar reticles built into our eyepieces or polar telescopes inside our polar shafts. I once read an article in Astronomy Magazine which intended to clarify the use of a polar axis scope. Ha! Einstein couldn't have handled the analog gyrations on the dial! Throwing away my plumb bob and protractor I resolved to find a quick, reliable method.

First we must address the accuracy of the mount. No matter who manufactured your mount, odds are that the optical tube is not parallel with the polar shaft. With the declination shaft exactly horizontal (use a bubble level for this), move the telescope tube up or down and the mounting right or left (in azimuth) until Polaris is centred on the crosswires. Be sure your crosswires are oriented so one wire is vertical. Now swing exactly 12 hours in R.A. until the tube is on the western side of the mount and the declination axis is again horizontal. Look at Polaris and see if it still exactly at the centre. Any deviation right or left of the vertical wire indicates that your tube is not parallel with the polar shaft. Proceed to shim where the tube or cradle rings attach to your mount or cradle plate. By shimming either the forward or rear end of the cradle, remove half of your optical error.

Repeat the procedure until Polaris stays centred on either side of the mount. Please be sure that you have properly aligned your finder to the main tube before doing this or else you will be tilting windmills. If you can accomplish this test by using a crosswire eyepiece in the main instrument, so much the better for accuracy. My own telescope had a 6 minute error and the thickness of a business card solved the problem. Later you can permanently affix brass shimstock which can be had from a machine shop for a buck.

Second, point the telescope south at any old star somewhere near the celestial equator. With the clockdrive off, adjust your telescope until the star sweeps across the centre of the eyepiece field and parallel along the wire. Time the star as it passes through the field. Multiply the minutes and the seconds both by 15 to convert to arc minutes and arc seconds. You now have the actual field of your finder scope. A typical 8x50mm finder is about 4 degrees. Polaris is presently 47.6 arc minutes from the celestial pole. Since the radius of our example finder is 2 degrees from the centre to the edge, Polaris would be just over 3/4 of a degree from the centre of the crosswires. Draw a scale field of view of your finder with Polaris properly measured out on the inside cover of your atlas for reference. Remember its position! The eye can surprise you with its estimate. This and the previous routine will only be performed once and I mention them to help you work out the technical bugs so that we can get to the business at hand, namely, to align the scope to the celestial pole.

With my Atlas 2000.0 opened before me I wanted to find a bright star whose Right Ascension would be close to that of Polaris. It was then that I found out why using Mizar and Alkaid did not work. These stars misplace Polaris from its true orientation in our eyepiece by 1 hour 08 minutes and 44 minutes respectively! That simply will not do. But two stars looked promising because of their brightness or position. These two stars are Kochab (Beta Ursa Minoris) and 5 Ursa Minoris. If we take the R.A. of Polaris and add 12 hours to it, we can extend its line of Right Ascension across the celestial pole to the opposite edge of our star map. Notice that this line passes right between Kochab and 5 Ursa Minoris. The error in Polaris' position using these stars is only 18 minutes 52 seconds and 04 minutes 19 seconds respectively. Bravo!

Now we are ready to quickly and accurately polar align.

First be sure your tripod or pier is absolutely level. Again, with the mount pointing roughly north and the telescope tube on the eastern side of the mount, adjust the declination axis with a bubble level until it is horizontal. Turn the mount right or left {in azimuth} and raise or lower the tube in declination until Polaris comes into the field. With both eyes open (I hope you have a straight thru finder) rotate the finder eyepiece until the crosswire bisects Polaris at its proper distance from centre and points exactly toward Kochab. Use our open and free eye for this. Lock your azimuth and rotate your R.A. circle to read zero or 24 hours. Rotate the scope about the polar axis until the tube is above the mount and the R.A. circle reads 6 or 18 hours. You are now exactly at right angles from your former position. Raise or lower the altitude of the polar axis and swing the tube back and forth in declination until Polaris again comes into view. Bring Polaris back to the wire at its proper distance from centre and see if the

crosswire is still pointing at Kochab. If not, correct it and return to your former position of zero/24 hours on the circle. The orientation of the crosswire should be correct with Polaris bisected at its proper distance. If any adjustment is necessary, it will be miniscule. Correct it and you are finished. If you had a large discrepancy, you will have to sharpen your technique of seeing both stars simultaneously.

Kochab has much going for it in that it is easy to find and can be sighted by your free eye without moving your head from the finder. A feat not easily done with Mizar or Alkaid. Its declination makes it available regardless of where it is in the sky. If the sky is clear enough, use 5 Ursa Minoris instead. This will give you an error of only 4 minutes. An impressive alignment can be had in a procedure that will take only two minutes. Any further improvement can only be had by the s-l-o-w drift method. But I am sure you will find that the further accuracy obtained will not justify the time expended. Only transit work or filar micrometre measures may demand it.

**JOURNAL ROUNDUP**  
By Scott Jorgensen,

**Attention dinosaur fans. Mass extinctions may not be the only result of asteroid and comet impacts, the earth itself may be changed. A great many people believe that the dinosaur's extinction was hastened by a massive impact event. Now Bill Glass from U of D (that's Delaware not Detroit) has advanced the theory that the earth's magnetic field can be reversed by these collisions!**

**It has been know for many years that the earth's magnetic field reverses itself but there has never been a convincing explanation. While some of the proposed examples have been subsequently discredited, there are still several events that occurred just barely before a magnetic reversal. It just may be that our north pole is determined by celestial intervention, but don't tell that to any astrology buffs, it would only encourage them!**

**There has been very good news**

**from the NTT, the new technology telescope.**

**Located in Chile, this is the most advanced telescope anywhere, even the images from it's trial runs have been super sharp. The mirror is "only" 3.5 meters (I'd settle for that at Stargate) but it is extremely light and thin for its size, just 24 inches thick, and it has active optics that nudge the mirror into shape in 75 places.**

**In good seeing it gets 0.3 arcsecond resolution, almost 3 times the resolution of the neighboring 3.6 meter scope on the same site. Bolstered by this success, an array of 8 meter scopes will be built with an even more sophisticated active optics system called adaptive optics.**

**On the inaugural night the NTT resolved 25th magnitude stars, in 10 minutes. It also has photographed the light echo from SN 87A, and provided unprecedented resolution of the Fornax dwarf galaxy 700,000**

light years off. On a bad night they turned the new scope on "easy prey", comet Austin. Despite rough air, the scope imaged a hot spot, sort of a baby jet, though no tail was seen.

At Stanford Univ. Francis Everitt and coworkers are setting out to test Einstein. They are building a 4 million dollar satellite that will test the general theory of relativity. While special relativity has been tested thousands of times, the general theory has yet to undergo definitive testing. It's just not easy to do. The heart of the experiment is a group of virtually perfect gyroscopes. If the theory of relativity is right the gyroscopes will tilt due to the curvature of space time. If they don't, watch out for stunned physicists.

A little further out in orbit, Voyager 1 has taken another photograph, the first one of the whole solar system. After its last planetary visit Voyager 1 was tossed out of the plane of the solar system. Now a few years later it was able to take a mosaic photo of the whole solar system. Actually it did not catch Pluto, but it could have. And where do you have to stand to photograph the solar system? Why, 6 billion miles from earth will do nicely. It is just incredible how much we have learned from those two little satellites.

Science is an odd business, usually the checks done by the experimenter and the review of peers eliminates gross errors. Not so with the observation of the millisecond pulsar in SN 87A (mentioned here a few months back). You may recall that a group of astronomers reported that 87A had the fastest known pulsar, in direct contradiction to the prevailing theory which says that only old pulsars can be fast.

Well the data was messed up with noise from a video camera operating, you guessed it, in the millisecond range. Boy are these guys catching it from the astronomy community. But if they feel foolish, consider the theorists who had announced

explanations of the 'fast pulsar', they really look dumb. In any event most everybody has gone back to the old theory that pulsars are born slow and spin up.

Suppose you had to weigh a galaxy, how would you do it? Galaxies do tend toward big and heavy, besides where could you set the scale? Fortunately there are other ways, such as using Einstein rings. Einstein rings are the circular image produced when a very heavy faint object intervenes between us and a very bright object. Basically the heavy object warps space enough to redirect light beams that were heading out into space. We see the redirected beams as a ring if everything is perfectly aligned. If not we see a number of partial images or arcs.

Astronomers at the Naval research Labs have used these facts to determine the mass of MG1654+1346, a not very popular galaxy that is right in front of an elliptical galaxy, both are at known distances so it is possible to calculate the mass of MG1654. Assuming the Hubble constant (a measure of how fast the universe is expanding) is indeed 100 km/sec/Mpc then this galaxy has the mass of 90,000,000,000 suns.

But 90 billion solar masses is utterly insignificant compared to what is unquestionably the "biggest" story of the millennium. Two Harvard-Smithsonian astronomers have plotted the locations of 30,000 galaxies and found a huge wall in space. Most amateurs have heard of, or will hear of superclusters, but the great wall is the ultimate in super clusters, 60 Mpc by 170 Mpc at LEAST, it runs off any known map. Yet this wall is maybe only 1 million lightyears thick. Basically it seems almost all the mass in the universe is in relatively dense walls with enormous voids (actually not empty, just empty relative to the walls) in between.