UNITRON INSTRUMENTS, INC.
Subsidiary of Ehrenreich Photo-Optical Industries, Inc.
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Unitron 6-inch Photo-Equatorial Refractor

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SPECIFICATIONS

Unitron Model 620 6-inch Photo-Equatorial Refractor

1. DIMENSIONS:

Length (eyepiece to dustcap)	8½ ft.
Height - ground to base of mount	70 in.
ground to cradle	9 ft.
ground to dustcap	14 ft.

2. WEIGHT:

Shipping weight	921 lbs.
Instrument in observing position	775 lbs.

3. OBJECTIVE:

Coated 2-element, air-spaced achromat.

Clear aperture	155mm	Resolving power	0".75
Focal length	2500mm	Min. mag. observable	+13.2
Focal ratio	f/16	Field of view	3°10'

4. VIEWFINDER:

Coated 2-element, air-spaced achromatic objective.
Coated Monochromatic 40mm crossline eyepiece, 12.5X, 1¼" ø.d.

Clear aperture	60mm	Resolving power	1".1
Focal length	500mm	Min. mag. observable	+12
Focal ratio	f/15	Field of view	3°22'

5. PHOTO GUIDE SCOPE:

Coated 2-element, air-spaced achromatic objective.

Clear aperture	102mm	Resolving power	1".1
Focal length	1500mm	Min. mag. observable	+12
Focal ratio	f/8.3	Field of view	3°22'

6. TABLE OF MAGNIFICATIONS:

Eyepiece Focal Length	Magnification	Field of view
04mm	625x	0°4'.8
05mm	500x	0°6'.0
06mm	416x	0°7'.2
AS 7mm	375x	0°8'.0
AS 9mm	277x	0°9'.75
K 12.5mm	200x	0°13'.5
K 18mm	138x	0°19'.5
R 25mm	100x	0°24'.0
*M 40mm	62x	0°38'.7
**K 60mm	42x	1°4'.0

* Must be used in Unihex or 1¼" i.d. holder.

** Must be used in Super Unihex or Super Rack and Pinion.

7. WARRANTY:

Full 5-year warranty. Written warranty can be obtained free of charge upon specific written request at the address shown below.

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WOODBURY, NY 11797 U.S.A.

The following components and accessories comprise the Unitron Model 620 6-inch Photo-Equatorial Refractor:

·Maintube with: coated, air-spaced, achromatic objective of 155 mm clear aperture, 2500 mm focal length, focal ratio f/16; Super Rack and Pinion focusing mechanism with reversible drawtube for 24.5 mm and 1¼-inch ø.d. eyepieces, provision for mounting the Kellner 60 mm eyepiece, coarse and fine focusing locks, and built-in metric focusing scale for astrophotography; large dewcap and dustcap with provision for mounting filters for solar photography.

·Ten coated eyepieces:

4 mm Orthoscopic (625X)	12.5 mm Kellner (200X)
5 mm Orthoscopic (500X)	18 mm Kellner (138X)
6 mm Orthoscopic (416X)	25 mm Ramsden (100X)
7 mm Achr. Sym. (375X)	40 mm Monochromatic (62X)
9 mm Achr. Sym. (277X)	60 mm Kellner (42X)

·2.4-inch Viewfinder with: coated, air-spaced achromatic objective of 60 mm clear aperture, 500 mm focal length, focal ratio f/8; Monochromatic 40 mm (12.5X) eyepiece with crossline; Standard Rack and Pinion focusing mechanism; star diagonal for 1¼-inch eyepieces; mounting brackets, with centering screws for collimation, on Uniclamps for mounting in any desired position.

·4-inch Photographic Guide Scope with: coated, air-spaced, achromatic objective of 100 mm clear aperture, 1500 mm focal length, focal ratio f/16; Deluxe Rack and Pinion focusing mechanism with coarse and fine focusing locks and reversible drawtube for 24.5 mm and 1¼-inch ø.d. eyepieces; mounting brackets, with centering screws for collimation, on Uniclamps for mounting in any desired position.

·Model 220 Astro Camera with: Thornton-Pickard air-operated curtain shutter with speeds of 1/10 to 1/90 sec., bulb and time; three double plate holders for 3¼" X 4¼" plates or cut film; ground glass focusing back; 30 mm eyepiece with filter and eyepiece holder; extension tubes with clamps; air release bulb; wooden cabinet.

·Model 80 Astrographic Camera with: Taylor-type three element coated astrographic objective of 80 mm clear aperture, 400 mm focal length, focal ratio f/5; six plate holders for 4" X 5" cut film or Polariod back; objective focusing collar; brackets for mounting on maintube cradle; dewcap and dustcap.

·Sun Projecting Screen Set with: 13" X 13" white projecting screen and black shade; extension rod; mounting brackets on Uniclamps.

·Sun Glass Filters for 24.5 mm and 1¼-inch ø.d. eyepieces.

·Herschel Wedge for 24.5 mm ø.d. eyepieces.

·Prismatic star diagonal for 24.5 mm ø.d. eyepieces.

·Super Unihex rotary eyepiece selector for: 1 Kellner 60 mm eyepiece, 1 Monochromatic 40 mm eyepiece and four 24.5 mm ø.d. eyepieces.

·Unibalance Tube Assembly with mounting brackets on Uniclamps.

·Synchronous Motor Drive.

·Equatorial Mount with: cradle with provision for mounting Model 80 Astrographic Camera; worm and spur gears; right ascension and declination coarse and slow motion control rods; setting circles and verniers on both axes; counterweights.

·Metal Pier with 24" X 30" base.

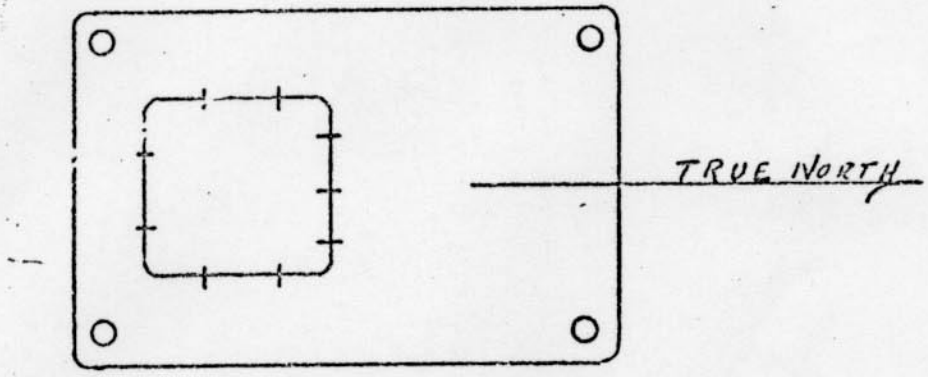
PART I - UNCRATING

Standard uncrating procedures may be followed for all items except the equatorial mount. The crate containing the mount can be identified by the fact that several bolt heads will be exposed on the sides of the crate. Long threaded rods have been passed through the crate to hold interior blocks in position to prevent shifting of the mount while in transit.

When uncrating the mount, the crate should be left standing so that the bolts and nuts are accessible. All of the threaded rods and nuts should be removed prior to opening the crate. Once the crate has been opened, four (4) bolts at the base of the mount will be exposed. Once these are removed, the mount may be slid out of the crate on its own base.

PART II - ASSEMBLY

1) PIER AND BASE: The pier base is secured to the observatory floor through the use of four bolt holes, each of which is located at one corner of the base. Before these bolt holes are drilled in the floor, and the bolts set, the long axis of the base must be oriented on true north as shown in the diagram below. Once the pier base is secured there is no provision for a shift in azimuth to orient the polar axis on true north.



The pier column is attached to the base through the use of nine (9) bolts. The column is properly oriented by matching the side of the column and the side of the pier base each having three (3) bolt holes. The bolts for securing the column and base are packaged in a separate, small carton.

The combined height of the base and column, measured from the base of the equatorial mount is 70". The base measures 24" X 30".

2) EQUATORIAL MOUNT: The mounting is attached to the top of the pier column by means of nine (9) bolts which are packaged in a separate, small carton. Again, proper orientation of the mount on the pier column is achieved by matching the sides having three (3) holes. Extreme care should be exercised in lifting and placing the mount as it constitutes a heavy, unbalanced load.

The counterweight rod should be threaded onto the end of the declination axis and one of the large counterweights threaded onto the rod. This will prevent the mount from revolving about the polar axis while the tube is being set in the cradle.

3) MAINTUBE: The Super Rack and Pinion focusing mechanism and the dew-cap have been detached from the maintube during shipment. The rack and pinion is attached to the maintube by means of five (5) screws placed in the base of the focusing mechanism housing. It should

be so placed that the engraved printing on the side of the housing is aligned with the "Unitron" label on the front end of the maintube.

The maintube should now be placed in the cradle and locked in position by means of the two cradle thumbscrews. These should not be overtightened as it may be necessary to slide the tube forward or backward within the cradle to accomodate, or most favorably position, the Photographic Guide Scope, Viewfinder and Unibalance Assembly when they are later added to the tube.

4) CONTROL RODS: After the tube has been secured in the cradle, the control rod support bracket should be clamped around the tube forward of the focusing mechanism. The four (4) control rods are attached to the mount by means of the slotted ends and threaded coupling collars. The other end of the rods are placed within the clamps and collars of the support bracket.

A) The right ascension coarse motion clamp may be identified by the 3-pronged handle and telescoping rod. This clamp locks the telescoping rod. This clamp locks the telescope on the polar axis and should be kept tightened except when making major changes in right ascension. It is attached at the points marked "B".

B) The right ascension slow motion control rod, by turning a worm acting on a sector gear, permits fine adjustments in right ascension. It may be identified by the long, black handle and telescoping rod. It attaches to points "A".

C) The declination slow motion control rod is similar to the R.A. rod, but does not telescope. It permits fine adjustments in declination by turning a worm which acts on a sector gear. This rod attaches to points "C".

D) The declination coarse motion clamp may be identified by the 3-pronged handle. When loosened, it permits major changes in the position of the telescope in declination. Attach this rod to points marked "D".

The right ascension and declination coarse motion clamps should be tightened sufficiently to prevent movement. Do not over tighten.

When making major changes in the position of the telescope tube in right ascension or declination, do not grasp the declination coarse motion clamp or declination slow motion rods as they may pull out of their clamps resulting in possible damage to the instrument.

When the right ascension clamp is loosened, major changes in the position of the tube in R.A. is possible by turning the large, 8-inch diameter wheel located at the end of the polar axis.

5) OBJECTIVE: In order to prevent the possibility of damage, the objective lens and cell should not be screwed into the end of the tube until the major assembly of the refractor, as describing in the foregoing paragraphs, has been completed. After the objective has been

screwed into the end of the tube, the dewcap and dustcap should be immediately added in order to protect the objective lens.

PART III - ORIENTATION OF EQUATORIAL MOUNT

Unitron's massive 6-inch equatorial mount is constructed to the highest standards of precision, using oversize components throughout. A sturdy cradle of 17-inch overall length clamps the tube firmly in position. Provision is made for attaching the Model 80 Astrographic Camera directly to the top of the cradle.

The polar axis rotates in its housing on tapered roller bearings. Power from the weight-driven clock or synchronous motor drive is transmitted to the 1 5/8-inch diameter worm through a bevelled gear assembly. The worm is provided with both radial and thrust ball bearings and drives a 9 3/4-inch diameter spur gear turning on a tapered roller bearing assembly.

Two extension control rods terminate at the eyepiece end of the telescope for adjustments of the right ascension coordinate. The first control activates a clamp for locking the tube in position. The second rod provides micrometric slow motion control by means of a worm/sector gear mechanism. For rapid changes in R.A., the first rod may be loosened and the tube assembly turned by a large, 8-inch diameter, wheel located at the end of the polar axis.

The declination axis rotates smoothly in its housing on roller bearings. Two extension control rods terminate at the eyepiece end of the maintube and provide for adjustments of the declination coordinate. The first control activates a clamp mechanism for locking the tube in position. The second rod provides micrometric slow motion control by means of a worm/sector gear mechanism.

The large setting circles are easy to read and are provided with verniers on both sides of the circles. The hour circle is divided into units of 10 minutes and reads to 1 minute by vernier. The declination circle is divided into units of 2 degrees and reads to 5 minutes by vernier. Accurate adjustment of the latitude angle is insured by a fine adjustment mechanism. A number of counterweights of varying size are provided to balance the maintube and additional accessories.

1) LEVELING: Leveling and azimuth orientation of the mount must be accomplished at the time that the pier base is secured to the observatory floor. No other adjustment is provided.

2) BALANCING:
   a) Loosen the right ascension fast motion clamp and place the declination axis in a horizontal position (a small hand level may be helpful). Move the counterbalance weights along the counterweight rod until the declination axis remains balanced in the horizontal position, unsupported.

   b) With the declination axis balanced and locked in the horizontal position loosen the declination locking rod and rotate the telescope tube to a horizontal position. Loosen the cradle locking screws and slide the tube, in the cradle, as required to permit balancing. The addition of accessories, such as the Photographic Guide Scope and Astro-Camera, will require the use of auxiliary equipment for balancing the tube. The Unibalance Assembly will serve to balance the weight of these accessories.

c) It may be found, while observing, that the telescope may seem to be out of balance in certain viewing positions. This results from a displacement of the center of gravity and minor adjustments of the counterweight, tube position, and location of the Unibalance weight should be made as necessary. Proper balance is especially important for smooth operation when the synchronous motor drive is in use. Even for manual operation, proper balance will reduce gear wear and eliminate "chatter."

3) LATITUDE ADJUSTMENT: In order to align the mount so that it tracks accurately in right ascension and declination, the polar axis must be inclined to the horizontal plane at an angle equal to the observer's latitude.

A) Determine your latitude as accurately as possible, i.e. from a map or atlas.

B) Position a spirit level/angle finder on the polar axis of the mount.

C) Turn the latitude screw until the needle of the angle finder reads your determined latitude.

Note: Do not loosen or tighten the trunnion nuts during this adjustment as these are adjusted at the factory. Over-tightening these will result in damage to the main gears of the mount. The latitude adjustment is permanent as long as the location of the instrument remains unchanged.

4) SETTING CIRCLES: Before proceeding further with the orientation of the mount, it is necessary to understand how to read and adjust the setting circles. All Unitron equatorial mounts are provided with setting circles for both right ascension and declination. Since they are graduated differently, they will be discussed separately.

A) Declination circles: Declination is measured in degrees, minutes and seconds of arc. Declination corresponds to latitude on earth and is a measure of the angular distance that a celestial body lies north or south of the celestial equator. Declination is measured from 0° at the celestial equator to +90° and -90° at the north and south celestial poles, respectively. Since most positions on the earth permit the observation of some celestial bodies both north and south of the celestial equator, the declination circle is graduated from 0° to 90° in both directions.

B) Hour circles: The hour circle is used to set the local hour angle of a celestial body on the telescope mount. The hour circle is graduated in hours, minutes and seconds of arc since the local hour angle (and right ascension from which it is derived) is measured in those terms. Right ascension for a celestial body is obtained from a star chart or ephemeris. The R.A. is a measurement on the celestial sphere that corresponds to longitude on the earth's surface. By comparing the R.A. of a celestial body with the observer's longitude, the local hour angle may be determined. The local hour angle is the angular distance between the observer's meridian and the celestial body measured east or west,

and it is the local hour angle that is actually used in orienting the telescope.

5) READING THE SETTING CIRCLES: The setting circle may be read with a great degree of accuracy through the use of verniers, which are short graduated scales on each side of the circles. The hour circle is divided into units of 10 minutes and reads to 1 minute by vernier. The declination circle is divided in units of 2° and may be read to 5 minutes by vernier.

Read the upper scales of the declination circle and vernier for objects north of the celestial equator and the lower scale for southern objects. Read the upper scales of the R.A. circle and vernier for objects east of the meridian and the lower scales for western objects.

6) ALIGNMENT OF POLAR AXIS AND ORIENTATION OF SETTING CIRCLES: Precise alignment of the polar axis with the north celestial pole is required for accurate visual observations and, especially, for astrophotography. The imaginary line between Mizar (ζ Ursae Majoris) and Ruchbah (δ Cassiopeiae) can be used to determine the position of Polaris with respect to the north celestial pole. For accurate refinements of the latitude adjustment Polaris should be observed at eastern or western elongation. Should azimuth adjustment be necessary, Polaris should be observed at upper or lower culmination. Since one revolution of Polaris about the north celestial pole occurs about one every 24 hours, the star is alternately at elongation or culimation every 6 hours. During the alignment procedure, the telescope should be equipped with a crossline eyepiece.

A) Latitude - Polaris at eastern or western elongation.

1-Place, and lock, the declination axis in a horizontal position. Place a bubble level or angle finder on the shaft housing and center the bubble by turning the right ascension slow motion control rod in the appropriate direction.

2-Without disturbing the position of the declination axis, loosen the declination lock rod and set the refractor tube approximately horizontal. Place the level on the tube and, using the declination slow motion control rod, level the tube precisely.

3-Loosen the locking screw at the base of the declination setting circle. Turn the circle so that the co-latitude (90° - observer's latitude) appears opposite the zero on the vernier. Tighten the locking screw to set the circle in place.

4-Loosen the knurled locking ring at the base of the right ascension circle, between the circle and the hand wheel. Turn the circle until a reading of 6^h appears opposite the zero on the vernier. Tighten the ring to lock the circle in place.

5-Set the eyepiece such that the horizontal and vertical crosslines exactly correspond to east-west and north-south motions, respectively.

6-Loosen the declination lock rod and move the refractor until the declination circle reads +90° exactly.

7-While observing through the eyepiece, adjust the latitude screw until Polaris falls exactly on the horizontal crossline of the eyepiece. Since Polaris is on the declination of the north celestial pole (+90°) when at elongation, the latitude angle of the polar axis is properly set.

Note: At eastern elongation, place the refractor tube on the east side of the pier and read the upper scales of the declination circle and vernier.

At western elongation, place the refractor tube on the west side of the pier and read the lower scales.

B) Azimuth - Polaris at upper or lower culmination.

1-Set and level the declination axis in a horizontal position as above.

2-With the declination circle calibrated and set as above, move the refractor tube to obtain a reading of +90° on the circle.

3-Set the eyepiece so that the horizontal and vertical crosslines exactly correspond to the east-west and north-south motions, respectively.

4-Without disturbing the orientation of the declination axis, set the R.A. circle to obtain a reading of 6^h or 18^h.

5-Loosen the R.A. lock rod and turn the mount about the polar axis until the R.A. circle reads 24^h.

6-If Polaris does not lie exactly on the vertical crossline of the eyepiece, it will be necessary to loosen the bolts holding the pier base and shift the entire instrument in order to obtain proper azimuth alignment.

Note: Read the upper scales of the R.A. circle and vernier if moving the mount from east to west.

Read the lower scales if moving the mount from west to east.

PART IV - OPERATION OF THE OPTICAL SYSTEM

1) FOCUSING: The Unitron 6-inch Refractor is equipped with the Super Rack and Pinion focusing mechanism. This heavy-duty unit is equipped with a graduated metric focusing scale for astrophotography locks on the coarse- and fine-focus tubes, drawtube with reversible eyepiece holders for 24.5 mm and 1¼-inch ø.d. eyepieces, and provision for mounting the Unitron 60 mm Kellner eyepiece. Standard focusing procedures may be followed with the exception that the focusing locks must be disengaged during focusing. They may then be retightened to prevent accidental movement of the mechanism.

The Super Rack and Pinion drawtube has a reversible eyepiece holder. The eyepiece holder collar may be unscrewed and reversed 180° to provide a holder of the desired size. This unit also features a double drawtube. The outer drawtube, approximately 58 mm in diameter, permits the use of the 60 mm eyepiece. In addition, its removal permits the use of the Super Unihex. The inner, smaller tube holds the drawtube with reversible eyepiece holders. Removal of the inner drawtube permits the use of the Model 220 Astro Camera.

If the observer is unfamiliar with high powered telescopes, it is desirable to practice focusing the instrument during daylight on a distant object. Select a low-power eyepiece and insert it directly into the end of the drawtube. The magnification, or power, will be determined by dividing the focal length of the objective by the focal length of the eyepiece. The focal length of each ocular, in millimeters, is shown on the top of each eyepiece along with a letter indicating its design-type, i.e. Monochromatic (Mono.), Ramsden (R), Kellner (K), Achromatized Symmetrical (Sym.) and Orthoscopic (O). To obtain an approximate focus, disengage both locks and, by turning one of the two fine focusing knobs, move the fine focusing sleeve until it is approximately at the center of its total travel. Next, while sighting through the eyepiece, slowly pull out the drawtube until the distant object is as close as possible to being in focus. A sharp focus can then be obtained by adjusting the fine focus knobs. The focusing locks may then be tightened to maintain focus. As eyepieces are changed, a minor adjustment in fine focus will be necessary to achieve maximum definition.

2) VIEWFINDER: The 2.4-inch viewfinder is a relatively low-power, wide field telescope which aids in locating objects to be viewed with the main instrument. Focusing is accomplished as with the Super Rack and Pinion focusing mechanism, with the exception that there are no focusing locks on the viewfinder. The 40 mm eyepiece has a built-in crossline which permits an object to be centered in the field of view.

Before the viewfinder can be used, its optical axis must be carefully aligned with the optical axis of the main telescope. During daylight hours, select a well-defined, distant object such as a flagpole or church steeple. Using a low-power eyepiece, center the object in the field of the main telescope. Next, while looking through the viewfinder, adjust the collimating screws on the rear mounting bracket, nearest the eyepiece to move the viewfinder until the object is centered on the crosshairs.

This is easily done by backing off on one screw and tightening the others. If exact centering is not possible, adjust the viewfinder as close as possible to exact alignment and repeat the adjustment using the collimating screws on the forward bracket. By adjusting either or both sets of collimating screws it is possible to achieve the required alignment.

To improve this adjustment, select a well-defined celestial object, such as a planet or prominent star. Polaris is an excellent choice as its extremely slow apparent motion allows sufficient time for accurate alignment. Repeat the procedure as outlined above for daylight alignment.

3) PRISMATIC STAR DIAGONAL: The star diagonal is a special right angle eyepiece holder designed to permit comfortable viewing regardless of the position of the telescope tube. It is designed for astronomical observation only, as the image viewed through the star diagonal will be upright, but reversed right to left. To use the star diagonal, insert the drawtube end (chrome tube without slots) into the eyepiece holder of the telescope drawtube. An eyepiece is inserted in the diagonal's eyepiece holder, and the telescope is focused by using the procedure previously outlined.

4) SUPER UNIHEX: The Unihex is a multiple eyepiece holder which contains a right angle prism to permit comfortable viewing at all angles of elevation. In addition, it holds six (6) eyepieces simultaneously which permits rapid changes of magnification by simply rotating the turret. This eliminates the inconvenience and possible damage to eyepieces resulting from the use of conventional eyepiece holders which only permit using a singl eyepiece. The eyepiece holders consist of 1 58 mm holder for the 60 mm eyepiece, 1 1¼-inch holder and 4 24.5 mm holders.

A) Assembly - First thread the chromium drawtube into the Unihex turret. Remove the outer drawtube (58 mm ø.d.) from the Super Rack and Pinion focusing mechanism. Lastly, insert the Unihex drawtube into the rack and pinion sleeve in place of the regular drawtube.

B) Operation -

1-The eyepiece holders are of various lengths. The eyepieces should be arranged in the holder in order of decreasing focal length with the longest focal length eyepiece in the longest holder. This arrangement will require the minimum focus adjustment when changing magnification.

2-The index arrow on the rear plate of the turret indicates the positio of the prism. The eyepiece holder in line with the index arrow is the one which is in position for viewing. The entire Unihex may be rotated within the rack and pinion mechanism, repositioning the prism if viewing from either side of the telescope is more convenient.

3-Focus initally by sliding the entire Unihex in or out of the rack and pinion sleeve, using a low power eyepiece. When an approximate focus has been obtained, engage the coarse focus lock

on the rack and pinion sleeve. This will prevent the Unihex from sliding out of the instrument and will retain the coarse focus position. Refine the focus by using the rack and pinion mechanism.

4-To change magnification, rotate the turret in a clockwise direction until the desired eyepiece is in line with the index arrow. Clickstops are provided at each of the six positions, assuring positive alignment of the selected eyepiece with the prism. If the eyepieces have been arranged by focal length, only a minor adjustment of the rack and pinion should be required to bring each eyepiece into sharp focus.

5) 60 mm KELLNER EYEPIECE: The Unitron K 60 mm eyepiece has a cell of 58 mm ø.d. It is designed for use in either the Unitron Super Rack and Pinion focusing mechanism or the Unitron Super Unihex eyepiece holder. To afford maximum light transmission the optical surfaces have been coated. Extreme care must be taken when cleaning the optical surfaces to prevent scratching or removal of the coating.

A) Use with Super Unihex - The Super Unihex eyepiece holder has one extra-large receptacle which is designed to accept the 60 mm eyepiece. The threaded end of the eyepiece cell can be screwed directly into the large holder.

B) Use with Super Rack and Pinion - A black plastic bushing is provided with the eyepiece to permit adaption of the threaded eyepiece cell directly to the drawtube of the rack and pinion mechanism. To install the eyepiece unscrew the black reducing cap from the end of the large drawtube and replace it with the adapter bushing and focus in the normal manner

6) SUNSCREEN SET: The safest method of viewing the sun requires the use of a sun projecting screen apparatus, which is included with the Unitron 6-inch Refractor. When sun projection screens are used, the sun's image is projected on a white metal screen where it may be viewed safely with the naked eye. This method also has the advantage of permitting several persons to view the projected image simultaneously.

The sunscreen mounting brackets are attached to Uniclamps. The sunscreen support rod is inserted through the mounting brackets and screwed in place by means of the knurled thumbscrews. The sunscreen plates are then slid onto the rod and locked in place. The black screen with the hole in the center is used as a shade to prevent the direct rays of the sun from striking the white screen and "washing out" the projected image of the sun. The black screen should, therefore, be slid onto the rod in front of the white screen. The size of the projected image can be regulated by moving the white screen along the rod. The sun's image can be sharply focused by use of the drawtube and rack and pinion mechanism.

7) HERSCHEL WEDGE: The Herschel Wedge (Sun Diagonal) is similar in appearance to the star diagonal. It is recommended that the Herschel Wedge be used in conjunction with the Sunglass filter for safe, direct solar observations. The wedge-shaped prism of the sun diagonal reflects only some 5% of the incident radiation toward the eyepiece. When the hinged door of the diagonal is opened, the balance of the heat and light is either absorbed or reflected safely away.

8) SUNGLASS FILTERS: Two Sunglass Filters are provided with the Unitron 6-inch Refractors. One will fit 24.5 mm ø.d. eyepieces and the second is for 1¼-inch oculars. They may be found attached to two of the eyepieces, but may be removed by simply loosening the thumbscrew and transferred to the eyepiece of your choice.

Extreme care must be exercised when the Sunglass Filter is employed for solar observations. The high magnifications employed in astronomical telescopes produce an intense concentration of heat and light at the eyepiece. Unless proper precautions are taken, this concentration is sufficient to damage the eyepiece and/or the filter. Severe eye damage can result if this occurs.

For large-aperture instruments, a solar aperture diaphragm is essential. This is built into the dust cap and is simply a small hole in the cap's center. There is, in addition, a filter placed in the aperture. This filter may be threaded out of the aperture and replaced, or additional filters added to the cell. The solar aperture diaphragm will reduce the intensity of heat and light at the eyepiece.

It is also recommended that the Herschel Wedge, described above, be used in conjunction with the Sunglass Filters for safe solar observations.

When viewing, the telescope should be frequently turned away from the sun and allowed to cool. Do not continue observation for longer than thirty (30) minutes. The viewfinder and guide scope should be covered to prevent accidental exposure of the naked eye to the sun's rays passing through the accessory soppe.

9) UNIBALANCE ASSEMBLY: The Unibalance Assembly is used to balance the refractor about the declination axis when accessories such as guide scope and cameras are mounted on the telescope. It is placed on the objective-end of the refractor tube. The Unibalance weight may be placed at any location along the mounting rod to achieve the desired balance.

10) 4" PHOTOGRAPHIC GUIDESCOPE: The 4-inch Photographic Guide Telescope is supplied with collimating brackets mounted on Uniclamps. The optical axis of the guidescope is aligned with the axis of the main refractor by the method previously outlined for the 2.4-inch viewfinder.

11) MODEL 220A ASTRO-CAMERA: This light-weight camera has been designed especially for astronomical photography using the objective lens of the telescope as the principle optical element. Taking first-class celestial photographs is an accomplishment in which you can feel pride. Become familiar with the Astro-Camera before using it so that you may operate it in the dark with ease. Take care to focus accurately. Since in astronomical photography the proper exposure time will depend on unpredictable factors such as atmospheric transparency, it is adviseable to take a series of exposures bracketing the "correct" exposure time. Such subjects as the sun and sunspots, the moon and eclipses require only short exposure times, whereas deep-sky subjects require long exposures. You will find it most helpful to keep a careful record of the exposure times, type of film or plate, and development for each photograph. In this

way, you will profit from experience to find the most suitable combination for a particular subject.

A) List of Parts:

- Camera body with ground glass focusing back.
- Camera tube with eyepiece holder.
- Extension tube.
- Two clamps.
- 30 mm focal length eyepieces.
- Filter.
- 3 double plate holders for 3¼" X 4¼" plates or cut film.
- Wooden cabinet.

B) The Plateholders: Three double plateholders are furnished with the Astro-Camera 220. Extra plateholders are available at additional cost. The plateholders are designed to use either 3¼" X 4¼" glass plates or cut film. In the case of cut film, adapters must be used. These cut film adapters may be purchased from a photographic dealer or directly from Unitron in sets of six (6).

To insert the plateholders in the camera, unlock the latch at the top of the camera, swing the ground glass frame downward on its hinges, and slip the plateholder into position. Secure the plateholder in place using the two locks at the top. Prior to exposing the film, the plateholder slide is pulled upward. Not that this slide is designed so that it cannot be completely removed from the plateholder; this makes it easy to replace the slide after the exposure has been completed.

C) Attaching Camera to Telescope:

1-For prime focus photography, the camera is positioned so that the plane of the film falls at the prime focus of the objective. A relatively small image is produced but exposure time will be less than with photography by projection. In this case, only the shorter camera tube (B) is used, and without the camera eyepiece. The camera tube threads directly onto the camera body and will fit directly into the small, inner drawtube of the rack and pinion mechanism. Use of the clamps (C) will insure a tight connection between the camera tube and rack and pinion.

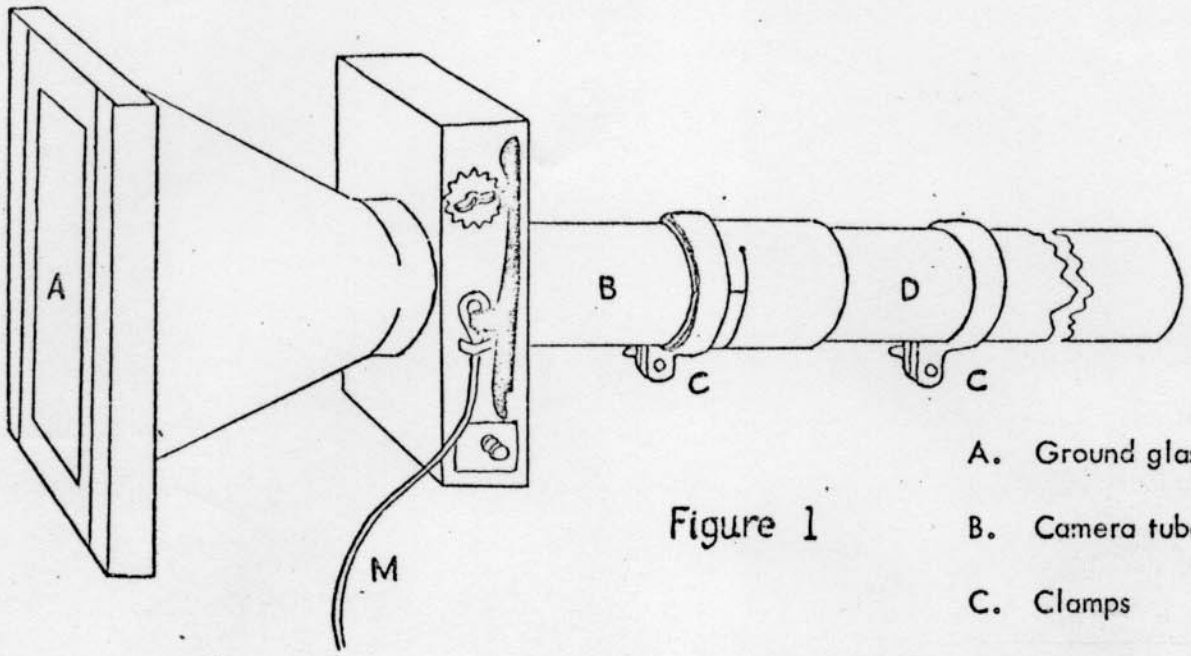


Figure 1

A. Ground glass screen

B. Camera tube

C. Clamps

D. Extension tube

M. Rubber tube from shutter release bulb

2-In eyepiece projection, the 30 mm eyepiece projects an enlarged image onto the film. Place the eyepiece (E) in the holder (F) as shown in figure 2. (Other Unitron eyepieces of relatively long focal length may also be used.) If desired, the filter holder (G) may be threaded into the eyepiece holder as shown. Insert the camera tube (B) into the extension tube (D) and lock the clamp (C) as shown in figure 1. Insert the extension tube into the rack and pinion tube and secure the two by means of the second clamp (C).

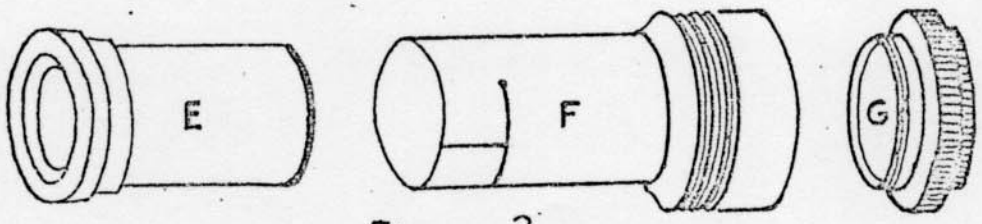


Figure 2

E. Eyepiece

F. Eyepiece holder

G. Filter

D) Operating the Shutter: The Astro Camera 220 uses an air-operated, curtain shutter of the Thornton Pickard type. Speeds of 1/15 - 1/90 second, bulb and time may be obtained. As the speed selector knob (H) is turned, the tension on the curtain shutter mechanism is increased so that shorter exposures result. The actual shutter speed

which will be obtained for any given setting of the knob is indicated by the dial (I). To set the shutter speed to a lower value than indicated by the dial, merely push the lever (K) to the right (which will unwind the shutter) and rewind to the desired speed.

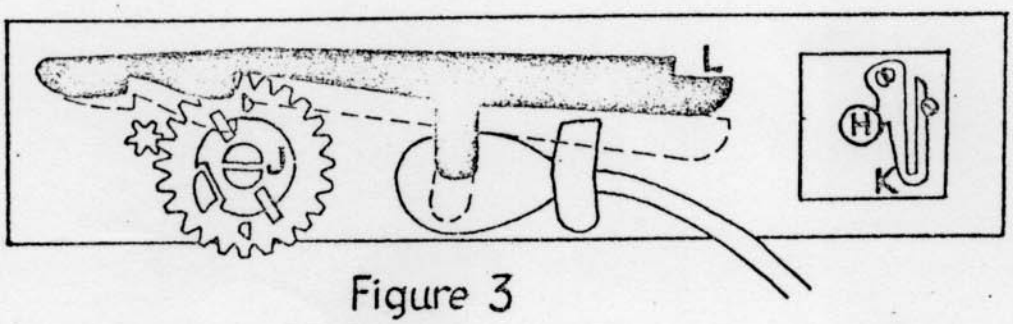


Figure 3

H. Speed selector knob

I. Shutter speed indicator

J. Shutter winding knob

K. Lever to unwind shutter

L. Shutter release lever

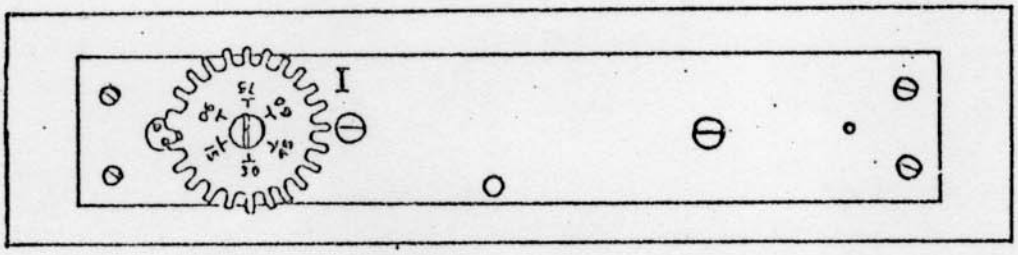


Figure 4

The shutter release lever (L) may assume two positions. In the position shown in figure 3, the shutter will take instantaneous exposures of 1/15 - 1/90 second.

To move the shutter to its second position, as indicated by the dotted lines in figure 3, press the end of lever (L) and move it downward. This second position is used for taking "bulb" exposures.

To wind the shutter for an exposure, turn the knob (J) one complete revolution clockwise. Two clicks will be heard while turing the knob. When the lever (L) is in position for instantaneous photography, squeezing the rubber bulb shutter release will give a film exposure corresponding to the reading shown on the dial (I). When the lever (L) is in position for "bulb," squeezing the rubber bulb will open the shutter and it will remain open until pressure on the bulb is released.

For a "time exposure," position the lever (L) in the position for instantaneous photgraphy and turn the shutter winding knob (I) clockwise one-half revolution until a single click is heard. This will open the shutter. Squeezing the rubber bulb will close the shutter and end the exposure.

Look into the opening in front of the camera and note that as you turn the shutter winding knob (J), the slit in the curtain moves across the opening and admits light into the camera. Therefore, the knob (J) should never be turned unless the plateholder slide is closed; otherwise, accidental exposure of the film will result. It is a good rule always to squeeze the rubber bulb before withdrawing the plateholder slide to ensure that the shutter is closed.

E) Focusing the Camera: The quality of the final photograph will depend critically on the pains taken in securing the sharpest possible image on the ground-glass focusing screen. If the image is too faint for sharp focusing, as may be the case with stars, spread a thin film of glycerin on the ground side of the glass to brighten the image. You may also find a pocket magnifier to be useful in focusing.

When taking photographs with a refractor, remember that the optical correction of the objective is for visual light with the result that without a filter (supplied with the camera) the position of sharpest focus as seen on the ground glass is not necessarily the position of sharpest focus for the film. In this case, keep the yellow filter on the camera tube and use a panchromatic emulsion.

F) Photographing the Sun: The sun is unique among subjects for astronomical photography in providing too much light, rather than too little. Therefore, use slow, fine grain film, the shortest exposure time and always use the yellow filter.

The solar heat concentrated at the focus of your telescope is so great that care must be taken not to damage the cloth curtain of the shutter. The practical rule is never to let the sun's heat fall on the shutter for more than a few seconds at a time. Keep the dustcap on the objective until you are ready to focus. Open the shutter, remove the dustcap and focus. Replace the dustcap and close the shutter. Insert the plateholder, withdraw the slide and, as rapidly as possible, make the exposure and replace the dustcap and the plateholder slide.

G) Lunar Photography: Whether you employ prime focus or take an enlarged photo through the eyepiece, it is advisable to make a series of photos with different exposure times. Although it is advisable to use the fastest emulsion possible, a trade-off must be made between exposure time and film grain. Since the surface brightness of the moon changes markedly with phase, no simple rule for exposure time can be given.

H) Stellar and Planetary Photography: The chief consideration here is that the objects are faint light sources. Again, a trade-off between film speed and grain must be made. For best results, particularly on long exposures, careful and continuous guiding is necessary. A guide star must be kept on the crosshairs of the guide scope at all times. Whenever the star drifts off the crossline it must be brought back into register with the aid of the slow motion controls.

12) MODEL 80 ASTROGRAPH: The Unitron Astrographic Camera is especially designed to meet the requirements of wide-field astrophotography. It features a highly corrected three-element Taylor - type astrographic objective. Because of its fast speed and wide field of view, the Astrograph is well suited to photographs of constellations, star fields and panoramic views of the moon and planets.

A) List of Parts:

- Camera with ground-glass Graflok focusing back, dewcap and dustcap.
- 2 mounting brackets.
- 6 double film holders for 4" X 5" cut film.

B) The Film Holders: Six double film holders are supplied with the Model 80 Astrograph. Extra film holders are available at additional cost. The holders are designed to hold 4" X 5" cut film.

To insert the film holder in the camera, lift the Graflok back against its tension springs and slide the holder under the back. Prior to exposing the film, be certain that the film holder is held tightly in position by the tension springs of the focusing back. The dark slide is pulled out of the film holder in order to expose the film: the slide is replaced in the holder at the completion of the exposure.

You may also use Polariod 4" X 5" film with the Model 80 Astrograph. The Polariod film holder is inserted in the camera in the same way that the standard film holder is mounted.

C) Attaching Camera to Telescope: The two mounting brackets are attached to the top of the cradle in the holes provided for this purpose. Open the clamps, insert the camera and secure it in place by tightening the wing nuts on the clamps.

D) Operating the Camera: The Model 80 is a shutterless camera intended for time exposures of several minutes to hours in length. The exposure time is controlled by removing and replacing the dustcap as desired.

After focusing on the ground glass back, place the dustcap over the objective. Insert the film holder or Polariod back and remove the dark slide. Then carefully remove the dustcap and replace it at the completion of the desired exposure. Return the dark slide to its position in the film holder and remove the holder from the back. The dustcap may then be removed and the next shot lined up. The telescope drive should, of course, be in operation during this procedure to insure that the object to be photographed remains in the field of view.

E) Focusing the Camera: The quality of the final photograph will depend critically on the pains taken in securing the sharpest possible image on the ground-glass screen. If the image is too faint for sharp focusing, as may be the case with stars, spread a thin film of glycerin on the ground side of the glass screen to brighten the image. A pocket magnifier may also prove useful in focusing.

The 80 mm objective is mounted on a helical focusing collar which is supplied with a scale to aid in the focusing procedure. While viewing the image on the ground glass, turn the focusing collar until a sharp focus is obtained. At this point, the exposure may be made using the procedure previously outlined.

13) SYNCHRONOUS MOTOR DRIVE: The Unitron 6-inch Refractor employs a synchronous motor drive designed to operate from 110 volts, 60 Hz, A.C. At this output, the motor will make one complete revolution in 6 minutes. To prevent possible shock, the green wire should be connected from the motor housing to any appropriate ground. To start the motor, simply plug the line cord into any standard 110-120 V, 60 Hz. A.C. source.

After attaching the motor shelf to the pier in the holes provided, place the motor on the shlef and secure it in place with the two wing nuts. The short universal is attached to the motor output shaft by threading it on in a counter-clockwise direction. Connect the motor to the gear box on the end of the pinion shaft using the coupling rod supplied for this purpose.

PART V: USING THE EQUATORIAL MOUNTING

The data necessary to point the telescope at a given celestial object are the declination and right ascension. This information can be obtained from several sources, i.e., star charts, ephemeris or current periodicals.

The declination may be taken directly from the chart or ephemeris and "dialed into" the declination circle to orient the instrument in declination. The right ascension is converted to Local Hour Angle which is then used with the hour circle of the instrument.

1) DETERMINING LOCAL HOUR ANGLE: Local Hour Angle (LHA) is the difference between Local Sidereal Time (LST) and the right ascension of the celestial object to be observed. Sidereal time is based on the stars but our clocks keep time based on the sun. Furthermore, since we are constantly moving with respect to the sun, time based on the sun, without some modification, would be different for every point on the earth. Our watch time is actually a local standard time (ST) based on the time zone in which we live. The earth is divided into 24 standard time zones, each approximately 15° of longitude in width. The continental United States spans four of the zones. Each time zone has a central time meridian which is the line of longitude passing through the zone as follows

Eastern Standard Time Zone (EST) - 75°

Central Standard Time Zone (CST) - 90°

Mountain Standard Time Zone (MST) - 105°

Pacific Standard Time Zone (PST) - 120°

The first step in determining sidereal time requires you to convert your watch time to the Local Mean Time (LMT) for your location. Determine your longitude from an atlas or survey map to the nearest ¼° (15'). If you are located west of your central time meridian, add 4' for each degree of longitude (1' per ¼°). If you are east, subtract 4' per degree.

This a constant for a given location and should be recorded for future reference. On each occasion that sidereal time is to be determined apply this constant to the local time in order to determine Local Mean Time. An additional correction must be applied when Daylight Saving Time is in effect to correct to the standard time of the zone before determining the Local Mean Time.

The following example is based on an observer located in Boston, Mass. whose watch is operating on Eastern Standard Time.

Observer's location: Boston, Mass., Eastern Standard Time Zone, longitude 71°03' (71° to nearest ¼°)

EST (watch time): 8:00 P. M.

Date: 14 August 1977

Central Time Meridian: 75°

Difference between longitude and central time meridian: 75° - 71° = 4°

Time correction: 4° X 4' = 16 m (to be subtracted from EST since Boston is east of meridian)

8:00 P. M. EST - 16 m = 7h 44m LMT

The Local Mean Time just determined must then be converted to sidereal or star time (ST). This is easily accomplished by referring to tables of sidereal times as in the American Ephemeris and Nautical Almanac. Use of these tables will give the sidereal time equivalent to 8:00 P. M. (or any other hour) Local Mean Time for any date of the year. In actual use, you may reset your wrist watch or clock for the sidereal time if an actual sidereal clock is not available. Since the difference between sidereal and standard time is only about 4 minutes per day, the watch setting will be sufficiently accurate for use throughout an evening of observing.

Example continued:

Determining the sidereal time equivalent for 14 August 1977, we find that 8:00 P. M. LMT = 17h 33mm sidereal time. (Since sidereal time is measured from 0h to 24h, 12 should be subtracted from any result greater than 12h to permit setting on a standard wrist watch dial.) At 7:44 P. M. EST, the Boston time equivalant to 8:00 P. M. Local Mean Time, the observer's watch should be set to read 5:33 (17h 33 m - 12h 00 m). The sidereal time can then be read directly for the balance of the evening by simply reading the watch time plus 12h. Hence, at 9:00 P. M. EST the sidereal time would be 18h 49 m (6h 49 m from the watch plus 12h).

We stated earlier that the Local Hour Angle which will be set on the telescope's hour circle is the difference between sidereal time and right ascension. If the Boston observer wishes to view the globular cluster M13 in Hercules, a star chart would indicate the declination as +36° 32' and the right ascension as 16h 40 m.

To point the telescope at M13 at 9:00 P. M. EST, loosen the declination lock rod and swing the telescope tube until a reading of +36° 32' appears on the declination circle. Final adjustment should be made with the slow motion control rod.

Next, determine the Local Hour Angle (LHA) by taking the difference between the right ascension and sidereal time:

18 h 49 mm (ST) - 16 h 40 m (RA) = 2 h 09 m (LHA)

If the RA is greater than ST, the LHA is east of the observer's meridian. If the RA is less than ST, the LHA is west of the meridian. In this case, the RA being less than ST, M13 lies 2h 09 m west of the meridian. Loosen the right ascension lock rod and turn the instrument until a reading of 2h 09 m is obtained on the lower scale of the hour circle.

Once the object has been acquired in the field of view, it may be continuously tracked through the use of the right ascension slow motion control rod, a synchronous motor drive or weight driven-clock. This same procedure may be used for locating bright stars and planets during daylight hours. If the mounting has been properly oriented, the declination and right ascension determined from an ephemeris or star chart will permit the location of objects normally invisible to the naked eye.

2) CONVERSION OF LOCAL MEAN TIME TO SIDEREAL TIME:

A) Convert Local Mean Time (LMT) to Greenwich Mean Time (GMT) for your time zone (our observer in Boston must add 5h to LMT to obtain GMT).

B) If the resultant LMT is greater than 24h, it is the next day GMT. For instance, 28h GMT on 14 August is 4h GMT on 15 August.

C) Find the correction factor of Mean Solar Time to Mean Sidereal Time for the interval over 24h. Use Table IX in the American Ephermeris.

D) Also from the American Ephemeris, determine the Greenwich Sidereal Time (GST) for the date in question (next day of conversion is over 24h).

E) Add the results of C and D.

F) Subtract the LMT-GMT conversion factor (5h for Boston).

G) The result is the Equivalent Sidereal Time.

Example: determine the Equivalent Sidereal Time for 8:00 P. M. LMT, 17 August 1977 at Boston, Mass.

1) 8:00 P. M. = 20h 00 m.

2) 20h 00 m LMT, 17 August + 5h 25h 00 m = 1h 00 m GMT, 18 August.

3) Correction for 1h = 1h 9.8 s (from Table IX)

4) GST for 18 August = 21h 44 m 58.7 s (from Ephemeris)

5)
```
 21h 44 m 58.7 s
+ 1h 00 m  9.8 s
 22h 44 m 68.5 s = 22h 45 m 8.5 s
```

6)
```
 22h 44 m 68.5 s
- 5h
*17h 45 m  8.5 s Sidereal time
```

3) A SIMPLE METHOD FOR USING SETTING CIRCLES: This method, somewhat simpler than the one discussed earlier, is based on the fact that all celestial objects move across the sky at the same rate. Therefore, the change in hour angle for one star represents the change for all others.

Begin by choosing a "clock" star whose motion will serve as a base for