A Manual for use of the Ryerson Student's Observatory

Version 0.1
22 October 2005

1 Introduction and Scope

This document covers routine use of the Student's Observatory, operated by the Ryerson Astronomical Society. This observatory has been in use since at least 1897, and, built as an undergraduate observatory, is still maintained by undergraduate students.

You must be trained in person by a senior RAS member before attempting to operate the telescope by yourself, even if you are familiar with other telescopes. This manual is designed as a reminder for those who have already been trained.

This manual does not cover repair or maintenance of the telescope, use of the CCD camera, the 10-inch reflector, or the digital setting circles, though it may be expanded at some future point. It does cover the observatory dome, the 6-inch telescope, and the RAS office.

2 The Office

The Ryerson Astronomical Society's office is located on the fifth floor of Ryerson, room 550. It includes a photographic dark room, 551. Access to the various spaces is provided by keys:

building	key starts with ED
office	key starts with CB
dome	(same key as office)
roof	key starts with AA

In addition, access to the office can be gained by means of an access code. Ask another member for the current code.

There is a phone in the office, which also rings in the dome. It can be called from any other campus phone by dialling 2–7625, or from anywhere in the world at +1–773–702–7625. You can make campus calls, or local calls by dialling 9 for an outside line.

The office includes many tools, books, and other useful things; do not remove these useful things from the building without consulting an officer of the RAS, and always sign them out in the log book. If you bring tools up to the dome, be sure to return them to the office.

In the dark green filing cabinet, you will find the RAS eyepieces (in a black container that says "RAS" in white lettering), as well as some binoculars, and, hopefully, a copy of this guide. Take the eyepieces up with you to the dome if you plan to observe.

3 The Roof

Up the stairs you will find the roof. The roof is home to a few RAS ladders, the RAS hatchway, the main RAS dome, the RAS transit pier (and scope), and also some heating and cooling equipment that belongs to Facilities Services. Do not tamper with these heating/cooling units. Also, do not leave trash on the roof. There is a shovel in the office to make a path to the dome after a snowfall. In winter, ice often forms and the roof can be very slippery—be careful! Be sure to lock the door to the roof when you leave.

Occasionally, unauthorized persons make their way to the roof via the fire escape, and sometimes CS or math grad students come up the stairs if the door is unlocked. Do not be alarmed if you find yourself not alone.

4 The Dome and Telescope

This section tries to detail all of the tasks you may have to perform while doing routine observing. In the end, a paper document is no substitute for a flesh mentor.

4.1 Opening and Closing the Dome

Two ropes hang from the slit. Pulling on one will open the slit, pulling on the other will close it; in general, you will want to pull on the shorter one to change the state of the slit.

Select the rope you want and wrap it around the stick, which lives under the light switch, a few times, as high up as you can reach. Pull down hard using your body weight. It is important not to open the slit too forcefully, as doing so can get it jammed open. When closing it, however, a *slam* is the sound of a job well done.

Opening and closing the slit is somewhat of a binary affair. What this means is if you get it most of the way open, but want it more open, it will probably be necessary to close it again and open it anew. The same goes for partial closes.

Do not open or close the dome with the telescope covers off. If you must do so, try to position the telescope such that any dust or debris falling from the slit will not land on the lens.

4.2 Rotating the Dome

Rotating the dome is fairly easy: push or pull one of the two wooden paddles in the desired direction. It is good practice to make sure there is nothing (people, chariot, telescope, door) in the way of *either* paddle before rotating the dome. Note that if the chariot is too close to the wall, it may come in contact with a tornado hook even if it is not in the path of a paddle.

4.3 Removing Telescope Covers

There are two covers on the skyward end of the telescope – the 6-inch copper lens cap and the 10-inch plastic cover. Remove both, being careful not to scratch the lens. **Do not touch or breathe on the lens, or attempt to clean it!** Cleaning such a lens is a complicated (and rare) affair, and the dust that is sitting on it right now is almost certainly doing less harm to the viewed image than what you will do to it if you attempt to clean it or brush it off. Don't breathe on the lens, as your breath may condense on it. In short, interact as little as possible with the lens. You can rest the large caps against the south end of the pier, in a manner in which they will not be stepped on.

On the eyepiece end of the scope, you should remove the cap from the finder scope, and also

the clear eyepiece plug from the 6-inch. These typically sit on the top step of the chariot, next to the white box, or in the eyepiece case itself.

4.4 Moving the Telescope

The telescope is mounted on a German equatorial mount. The mount has two axes: one pointed to the celestial north pole (the north star), the other is perpendicular to the first axis. Each is independently operated. In each axis, you can slew the telescope by hand, or move it by means of the fine-adjust knobs.

The axis that points towards the celestial north pole is called Right Ascension, or R.A., and is measured in hours, minutes, seconds east of some arbitrary point (like longitude). Moving the telescope in this axis (east–west) causes the large counterweight to move. The other axis (north–south) is called Declination, or Dec, and is measured in degrees, (arc)minutes, and (arc)seconds north or south of the equator (like latitude).

4.4.1 By Hand

To move the telescope by hand, ensure that the R.A. and Dec clamps are unlocked. See below for how to do this. With the axes unlocked, you should be able to move the telescope freely—just be careful not to hit anything with the telescope or the counterweight. Things to avoid hitting include: people, chariot, pier, dome rotation paddles, &c. Note especially that the counterweight is precisely positioned to easily hit the head of someone standing at the laptop on the north side of the pier.

When moving the telescope by hand, the large counterweight should always remain below the telescope. Maintaining this state while pointing the telescope at your object of interest may require performing a German equatorial flip (see below for a description on how to do this).

4.4.2 Clamps and Fine Motion

Once the telescope is within a field of view of the object you are seeking, it is usually convenient to switch over from free hand control to fine motion control. To do this, one must first engage the clamp associated with the axis one wishes to control via the fine motion knob—usually (but by no means always) one will want to engage both the R.A. and Dec clamps at the same time.

Located near the focus knob are two shafts with two knobs each, running parallel to the tube of the telescope. One shaft controls the Dec (this shaft has dark, bumpy knobs) and one controls the R.A. (this shaft has lighter-colored, smooth knobs). On each shaft, the large knob is the fine motion knob and the smaller knob is the clamp (also called "clutch" or "lock"). To lock a clamp, rotate the small knob clockwise until it stops turning; to unlock a clamp, rotate counterclockwise until it moves freely (you don't have to turn very far; this usually takes less than a full turn). **Once you have engaged a clamp, do not attempt to move the telescope by hand in that axis.**

Once you have engaged the clamp, you can then make small adjustments to the telescope's position using the fine motion knobs. These are the larger knobs on the same shafts as the clamps. The first turn of the knob may just be removing backlash in the drive train, so you may have to give two or three twists before you see any motion.

The fine motion knobs move a piece of metal back and forth along a worm gear of finite length; as such, if you turn one of the knobs too many times in the same direction, you will hit the end of the worm gear. When this happens, the knob will suddenly become difficult to turn. If you encounter this problem, you should stop what you are doing, loosen the clamp, and twist the fine motion knob in question in the opposite direction many times (at least 20 or 30), and then re-locate the object, re-lock the clamp, and proceed as normal. **Do not attempt to turn the fine motion knobs past the end of their motion.**

Note that this problem occurs more frequently with the R.A. fine motion, for reasons that will become clear later in this manual (see under Engaging the Clock Drive).

4.5 The Clock Drive

The spinning earth gives stationary objects apparent motion in the sky; things rise and set. In order to keep a particular object in the field of view of the telescope, the telescope must be driven at the same rate as the earth's rotation, but in the opposite direction. In this manner, the telescope will follow the stars across the sky. This is known as "tracking".

To this end, the telescope is equipped with a sidereal clock drive. The clock drive is located in pier itself, accessible by two glass doors on either side. To function, the drive must be wound by hand approximately every hour.

4.5.1 Winding the Drive

To do this, open the glass door on the west side of the pier. Remove the small hand crank and attach it to the winding spindle. Wind in the clockwise direction; when you are done winding, release the pressure slowly from the crank—don't let go quickly.

If the clock drive has completely wound down, it takes about 12 cranks to wind it back up to full. You can watch the winding spindle fill up with metal cable, using a flashlight if necessary. Be careful not to keep winding past the end of the spindle. **Over-winding the clock drive can damage it.**

After winding, remove the hand crank, replace it in its storage position, and close the glass door so it doesn't get broken. Should you need it, there is a switch at the top of the clock drive assembly which turns it on and off (though most users just let it wind down on its own accord at the end of the evening).

You should never oil, clean, or adjust the rate of the clock drive without consulting an officer.

4.5.2 Engaging the Drive

With the telescope unclamped, the clock drive will not drive the telescope. To engage the drive, you must lock the R.A. clamp. In theory, this is a simple procedure—however, experience tells us that users of the telescope (especially new users) often have trouble getting the telescope to track. The result is that objects drift across the field of view.

If you are having trouble getting the scope to track, here are some tricks you might try:

1. Make sure the R.A. clamp is good and tight. Unlike the fine motions, it's alright to give this knob a good, firm twist.
2. Some long-time telescope users claim that twisting the R.A. fine motion knob two or three times in the clockwise (west) direction removes backlash from the system and causes the clock drive to engage. If rotating the fine motion knob causes the object to move, then the clamp is probably properly engaged.
3. Backlash or other delay-causers may exist. Try waiting 30 seconds and see if the object is still moving.
4. Check to make sure the clock drive hasn't run down; re-wind it if it has stopped spinning.

5. If nothing else works, unlock the Right Ascension clamp, re-center the object, and re-clamp. Make sure you clamp down tightly.

After the telescope has started tracking, you can use the fine motion knobs to center the object. Note that since objects move to the west, by far the most frequent adjustment with the fine motion knobs is to the west. As a result, the fine motion system tends to reach the end of its range of motion in the westerly direction quite frequently. The result is that you cannot turn the R.A. fine motion knob any further clockwise; to fix it, unclamp and turn the fine motion knob 20 or 30 times counterclockwise (see the above section on fine motion control). Actually, it's not a bad idea to pre-emptively turn the R.A. knob counterclockwise before moving to a new object.

Some objects (e.g. sun, moon) do not move at the sidereal rate. These objects will appear to drift very slowly even when the clock drive is engaged. You will have to re-center about every 15 minutes.

4.6 Focusing

To focus, turn the large focus knob which runs perpendicular to the telescope tube, about 6 inches from the eyepiece. If you wear glasses, you may prefer to take them off—you can compensate with the focusing knob (unless you have an astigmatism). Be aware that if you focus without your corrective lenses, it will be out of focus for other people.

To focus the finder scope, simply push in or pull out the eyepiece a small amount.

4.7 German equatorial flip

[Needs description.]

5 Eyepieces

At the time of this writing, the RAS has 7 commonly-used eyepieces ranging in focal length from 55mm to 7mm. Eyepieces are stored in the black carrying case with "RAS" in white lettering. This case, in turn, lives in the middle drawer of the dark green filing cabinet in the office. Take the case up to the dome when you observe, and return it to the filing cabinet when you are done.

Almost all of our eyepieces are 1.25-inch (diameter); the exception is the 55mm which is a 2-inch. The focuser on the telescope natively takes 2-inch eyepieces; an adapter is used used to fit the other eyepieces.

The magnification obtained with a particular eyepiece can be calculated by dividing the focal length of the objective (in the case of the 6-inch refractor, this is about 2000mm) by the focal length of the eyepiece (which is written on the side of each eyepiece). For instance, with the 55mm eyepiece, we have $2000/55 \approx 36$, or "36x magnification", and with the 7mm we have $2000/7 \approx 286$.

In general, you want to start with a low-power eyepiece to find an object and then step up to the desired magnification. Most telescope users locate objects with the 40mm (the lowest power 1.25-inch piece), which has a field of view of about 1/2 degree. Remember that changing the eyepiece does not change the amount of light entering the telescope. Magnifying the object more simply spreads the available light out over more space. In the case of faint objects, spreading the light out can make it too dim to see.

After switching eyepieces, you will probably have to re-focus and you may have to re-center.

There are some non-eyepiece optics-related things in the eyepiece case. Namely, there are filters (various colors, neutral density ("moon filter"), and emission nebula filter), and also a Barlow (2x magnification). The filters screw on to the telescope-side of the eyepieces. The Barlow goes between an eyepiece and the telescope.

6 The Sun

The RAS refractor can be used for solar observing, but only if a safe solar filter or projection technique is used. In addition, it is necessary to allow the scope to cool off every quarter of an hour or so. If you are interested in solar observing, get an experienced RAS member to show you how. It should go without saying, but **do NOT attempt to view the sun through any astronomical instrument without proper solar filters or a safe projection technique.** Doing so can result in severe eye damage.

7 How to Find Things

7.1 How to Find Bright Things

This is a general procedure to follow to find bright, naked-eye objects.

1. Locate item in night sky. This may require stepping outside of the dome.
2. Ensure that both clamps are unlocked, then point the telescope in the general direction of your object. Make sure not to run the telescope or counter-weight into people or objects, and don't let the counter-weight get above the telescope (perform a German equatorial flip if necessary).
3. Rotate the dome so you can see the object through the slit.
4. Align the telescope with the object by hand, peering along the tube of the scope.
5. Locate object in finder scope, and center on cross-hairs.
6. With the 40mm eyepiece in the 6-inch, any object on the cross-hairs in the finder scope should be visible in the main scope. If not, scan around in a circle. Center the object and focus.
7. Lock the Declination clamp.
8. Lock the Right Ascension clamp. It is important to clamp this down tightly, so as to engage the clock drive. Ensure the clock drive is wound. See above for tips on getting the scope to track.
9. Use fine motion knobs to center object.
10. Swap in desired eyepiece and re-focus.

7.2 How to Find Faint Things

[Need description.]

8 What to Look at

8.1 RAS list of good objects

8.2 Guidelines for selecting other objects

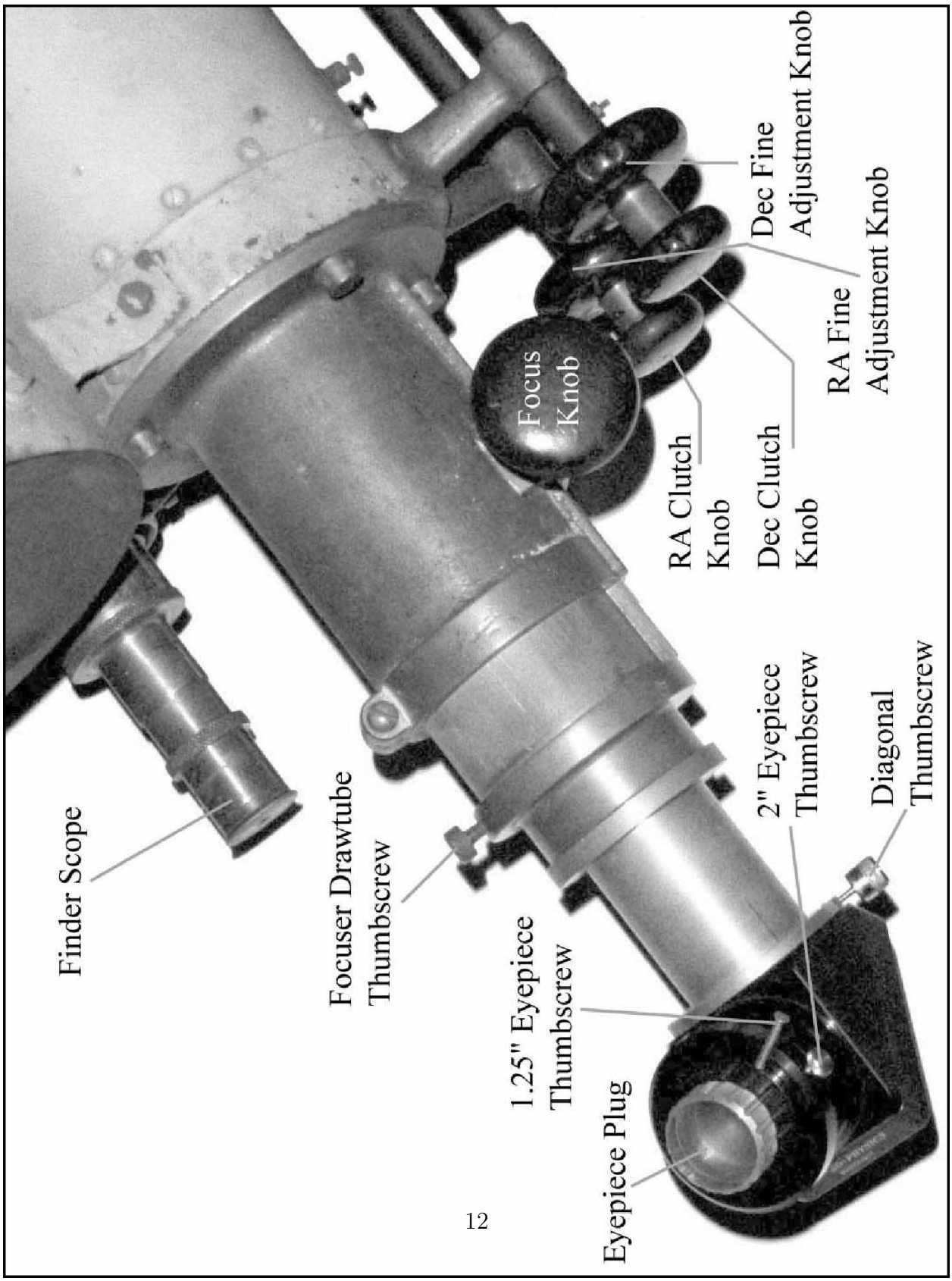
9 Opening Checklist

1. Get eyepieces from filing cabinet in office. Head up to dome.
2. Open the slit.
3. Remove two lens caps from each end of telescope.
4. Wind the clock drive.
5. You're ready to go!

10 Closing Checklist

1. Replace eyepieces in case.
2. Replace two lens caps on each end of telescope.
3. Put telescope in stow position: counterweight in lowest position, telescope tube running east–west, Dec clamp locked and R.A. unlocked.
4. Rotate the slit so it is facing south. Close the slit.
5. Turn off lights and anything else you turned on.
6. Close and lock door to dome, and also the door to the roof.
7. Return eyepieces to filing cabinet.
8. Make an entry in the log book.
9. When you leave, make sure to turn the lights off and close the office door.

11 Figures


Finder Scope
Focuser Drawtube Thumbscrew
1.25" Eyepiece Thumbscrew
Eyepiece Plug
Focus Knob
RA Clutch Knob
Dec Clutch Knob
2" Eyepiece Thumbscrew
Diagonal Thumbscrew
RA Fine Adjustment Knob
Dec Fine Adjustment Knob