



CAMBRIDGE UNIVERSITY ASTRONOMICAL SOCIETY

Observing Guide

Members of CUAS have the opportunity to use both the Northumberland and the Thorrowgood telescopes whenever they like, as well as all the other observing equipment stored in the alcove in the Northumberland dome. To do this, you will need an ObsCard, and to get an ObsCard, you need to have attended two ObsDemos and passed a very simple test (ObsTest). Firstly, this guide will go through how to get hold of the keys, and general housekeeping points about observing once you have an ObsCard. The second part of the guide will go through all you will need to know about the telescopes in order to pass your ObsTest.

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1 Observing On Your Own

The Northumberland telescope is over 180 years old, and the Thorowgood is only 30 years younger; both are historical relics in their own right, and still provide fantastic views of the night sky. For many years, CUAS members have had full use of the telescopes.

1.1 Before Going to the Telescopes

You cannot open the roof of the telescopes if it is raining, not to mention that it would be too cloudy to see anything anyway. This means you need to check the weather first, by looking out the window before you leave, and/or using one of the other options:

- **Checking in advance**

For the general forecast, check any decently reliable local weather forecast, like at the Met Office website: www.metoffice.gov.uk/public/weather/forecast/cambridge. For more detailed information on clouds, rain and wind (the clouds being the most relevant ones for observing, of course), you can check <https://clearoutside.com/forecast/52.21/0.12>. It is usually possible to do some observing if there is only high cloud. Alternatively there is also: <http://meteox.co.uk/forecastloop.aspx?type=4&continent=europa>.

- **Current weather situation**

The Institute of Astronomy (IoA) has an online all-sky camera at <http://tel05.ast.cam.ac.uk>. Will it Rain Today www.raintoday.co.uk is useful to see where it is currently raining in the UK, the satellite image at www.sat24.com/gb shows the cloud cover above the UK.

You may need a torch once you are there, but remember to use a red light to save your night vision (e.g. the rear bike light may be useful for that). Note that the telescopes are used by the IoA for **Public Observing** on Wednesday evenings from October to March in conjunction with the Cambridge Astronomical Association (CAA), and so the telescopes are unavailable for individual use then - however you should feel free to join those events if you have time; usually a large array of IoA and CAA-owned telescopes is used, and the events can give you more insight into the sky-watching community.

You can check any advance telescope bookings at www.ast.cam.ac.uk/public/telescope_booking. Additionally, the Cambridge Astronomical Association (CAA) occasionally runs its own **events** and **courses** at the IoA, which may include the use of Northumberland and Thorowgood telescopes: www.caa-cya.org.

1.2 Getting Hold of the Key & the Alarm Code

To get hold of the key, go to **Churchill College** Porters' Lodge. You must sign for the key there in the ObsBook. Make sure you have the key with you at all times, particularly when you leave the domes. The entrance doors to both domes lock upon closing, and you don't want to be stranded

outside at night¹.

It goes without saying that you should never hand the key over to anyone that doesn't have their ObsCard, but if you wish to hand over the key to another observer, this second observer will need to have signed, as otherwise the first observer will be held accountable if the key is missing. If need be, the second observer can sign at Churchill and then instead hand their ObsCard to the first observer, who can then swap their ObsCard when they get back to Churchill. The second observer can then pick up their ObsCard at the end when they hand back the key. If such an event occurs, it should be documented in the book in the Northumberland annexe and countersigned by both parties.

Bringing along a few friends is fine, but if you would like to bring a large group, i.e more than 5 people, please ask an ObsSec first (the numbers and email addresses are at the end of the guide). Alcohol and observing do not mix, so don't try it. Remember that you are dealing with very precious, historical instruments!

If you wish to use the Northumberland dome, make sure you know the code to disable the alarm in it. The alarm has been installed mainly due to recent refurbishment of the dome (it is now made of copper) and starts sounding immediately when you unlock and open the door. If you have an ObsCard from before 2014 but have not (yet) been given the code by the Observational Secretary (ObsSec), you can still use Thorrowgood telescope and equipment within. Upon request by the Institute of Astronomy, the code will only be given to you when you complete the ObsTest, and even if you are an old user, we suggest you attend one of the ObsDemos and contact the ObsSec about your situation.

If you do accidentally open Northumberland dome without knowing the code, **don't panic!** Enter the dome, turn on the lights and use the telephone installed there to call **University Security at 31818**. Explain the situation to them, and they should be able to advise you further. As the alarm is rather loud, it may be difficult to have a conversation from within the dome, so alternatively you can call them from your mobile phone; the external number is **01223 331818**.

1.3 Keeping record

Before observing, head straight to the Northumberland dome. To the left of the alcove with the computer in it, there is a desk with two books that need to be filled in.

- **Attendance Book**

Sometimes called the "LogBook". This must be filled in every time you use the telescopes.

- **ObsBook**

Put in here notes about any observing you did, and also any problems you noticed with the telescopes, like the RA screen in Northumberland not working, or the RA cylinder of Thorrowgood not being calibrated properly. If you notice that the telescope had not been properly put away by the person before you, or if you notice any defect or even if you

¹If you **do** get stranded outside, you have three options: **A.** If you're at the telescopes during working hours (9-5) for some reason when this happens, go to the reception of the IoA (Holye Building) and ask for help. **B.** If you have a phone on you, or you somehow managed to leave the door to Northumberland open, you can contact **University Security at 01223 (3)31818**. **C.** If you do not have a phone on you and can't easily get hold of it, go to Churchill College Porter's Lodge and ask the porters to call University Security for you.

happen to break something, do report it. Be honest, everybody makes mistakes and it is just very important that everything is documented so that the people of the IoA who look after the telescopes have it easier to fix it.

1.4 General Observational Equipment

1.4.1 Binoculars

If using the large Vixen binoculars, record all observations in the ObsBook – they are on loan from Jonathan Shanklin (the CUAS Senior Treasurer). They should be used with the large wooden tripod and binocular mount found in the Northumberland dome alcove. Only use them if you are confident you are able to handle them properly; you should contact an ObsSec if you are unsure. Feel free to use the other binoculars at your leisure.

1.4.2 The David Payne Telescope

A 12.5 inch handmade Dobsonian telescope, currently situated in Thorrowgood dome, has been donated to CUAS and is quite simple to use, but please bear these points in mind:

1. Firstly, remove the telescope tube from the base, then take the base outside and then the telescope. This is most easily done with more than one person. Set it up on the grass; not on the cycle path – you don't want to be run over by a cyclist while you're observing!
2. There are some eyepieces for it in a plastic box in the alcove (the one labelled "David Payne"). The eyepiece holder doesn't hold the eyepiece in very securely, so make sure the telescope is the right way up such that the eyepiece points upwards so it can't fall out. It is best to only put the eyepiece in once you have the telescope set up.
3. Remember to replace the plastic cover protecting the mirror of the telescope from dust after use.

It is an altitude-azimuth mounting so bear this in mind when trying to find objects using star charts. If the image quality seems poor, please contact an ObsSec. They will then investigate the state of collimation and correct it if necessary, or look into cleaning of the main mirror. Dobsonian telescopes (a type of Newtonian, or reflecting, telescope) are ideal for observing deep sky objects.

1.4.3 Meade LX200

This is an 8-inch modern computerised telescope on loan from Jonathan Shanklin. It is stored disassembled in the Northumberland dome alcove and is used as an additional telescope for ObsNights. Additional special training for this telescope for members may occur later in the year.

1.4.4 Celestron CPC800

This is another 8-inch modern computerised telescope donated by Prof. David Cope, and is stored disassembled in the Northumberland dome alcove and is used as an additional telescope for ObsNights.

2 Using the Telescopes

This will guide you through how to use the telescopes in the domes, and should contain everything you need to operate them safely, although it is no substitute for two ObsDemos. Many initially find observing difficult, but with much practice get better. When observing, please remember,

- Never leave the domes unattended! Close the door of the Northumberland dome when you are going to use the Thorowgood telescope, and vice versa (again: don't forget to take the key with you!).
- In the case of rain, close all domes immediately.

2.1 The Northumberland Telescope

This is the large telescope in the large dome. It is a 12-inch refractor, and has a 20 ft focal length (6096 mm, $f/20$). It was built in 1838, from a design by George Airy. The telescope is very famous, and was one of the largest when it was built. Interestingly, James Challis observed Neptune with it but didn't report it. The telescope has been refurbished, and its copper dome is brand new (2013).

Upon arrival, check everything is left properly. If not, note this in the ObsBook. In particular make sure it is unclamped at the base before moving it.

2.1.1 Opening the Dome

1. Unlock the dome by pulling the rope with the metal latch locking it. Sometimes this can take some force, but make sure you're pulling it in the right direction; the side of the rope with the weight attached is the one to pull to unlock the latch.
2. Open the slit of the dome. Make sure the latch does not fall back, preventing you from opening it. Don't open the slit beyond the point when it's not at all visible from the inside.

Rotate the dome roof slowly. You cannot move it through the north part where there are struts, so beware the momentum of the dome, or it will jam.

2.1.2 Remove Lens Cap

Always move the telescope slowly. Do not grab it at the eyepiece, focuser or finderscope, but at the main body. Only move in right ascension (RA) by turning the main column, rather than pulling the telescope tube. Move in declination (DEC) by grabbing the main telescope tube; use the rope if necessary, but be careful about the momentum of the tube. Only move it in RA if the clamps are unclamped and, more importantly, the worm from the motor is disengaged. There is a plastic bag covering the end of the telescope, which also has a lens cap underneath; both must be removed.

- Never ever point the telescope below the horizontal (roughly below metal railing on dome wall). The lens is not secured and will misalign or even fall out if you do this!
- Remove the plastic bin-bag, metal lens cap and the metal cap on the finderscope.

2.1.3 Find Your Object

Many people will use star charts to find objects, but using the computer is quite simple and quick to find any object in the sky. In most cases, a terminal should be open already and the program ("tcs") running. If not, to start up the program, bring up a terminal (there is a shortcut button on the right hand side of the taskbar), type TELESCOPE and then press Return/"Enter".

"Telescope" gives the telescopes current Right Ascension and Declination; the right ascension can also be read from the display above the computer.

"Target" gives the position of the target. There is a pure declination scale which matches up with the central rib of the telescope.

To find a target using the computer, use the following commands in the terminal:

- **Deep Sky or Stellar Target**
Type `gocat x` where `x` is the name of the object followed by return.
- **Planetary Target**
Type `planet x` where `x` is the name of the planet, followed by RETURN. Then type `next` and hit RETURN.

Then, move the telescope to the right ascension that it gives you. The box at the bottom left will go green when you are close and disappear when you are very close. Please **do not** turn off that computer: it is the one running the right ascension display, and you do not have the password to turn it back on. If the computer is turned off, or the RA display is otherwise faulty, note that in the ObsBook.

Alternatively, there are several useful apps available for smartphones, and programmes for laptops (e.g. [Stellarium](#) is a free, open-source one). There is a large star chart next to the computer, and several star atlases which you can use if you know how to.

2.1.4 Using the Motor Drive

When the motor is engaged, the telescope will move with the sky, keeping your object in view. This new drive system was installed in October 2009, and to ensure it lasts many years, we need to take care to ensure the various parts do not get worn down.

1. With the worm disengaged, and the 3 hand-wheel clamps unclamped, verify that the wheel is free to rotate independently of the polar axis of the telescope.
2. Engage the worm with the wheel, and allow it to mesh fully, so that the load is not taken only on the tips of the threads.
3. Switch on the power to the controller box, by turning the rotary switch clockwise.
4. Tighten the hand-wheel clamps at the lower edge of the wheel, as well as the clamp at the top edge. You should notice the right ascension display slow down and stop.
5. Your target will have moved in RA since you located it: use the guiding and setting motions provided on the hand-paddle, with the buttons labelled '+' and '-'. Guiding motion lasts only for about the first two seconds; after that the motor accelerates (or slows down) smoothly. Ensure that the buttons are held down, so that the motor rate changes smoothly. Watch the RA display to see how far you have moved.
6. There is a large rectangular push button (half red, half yellow) near the rotary switch. These select either a **sidereal rate** (red) or a **"lunar rate"** (yellow), which is 3 per cent slower. The default is the sidereal rate, but it changes instantly and you will see the result in the RA display.
7. When packing away, first disengage the wheel from the telescope via the clamp. Then disengage the worm. In the end, turn off the motor. Note that this is **not** the reverse of the procedure to turn the motor on.

It is very important that you get this procedure right, and so if you have any questions contact an ObsSec. Overall, remember:

- Do not move the telescope manually in right ascension while the worm is engaged and the clamps are fixed! You are free to move it in DEC - in fact you should be careful not to accidentally nudge the telescope while observing, as it can get off the target quite quickly, especially at high magnifications.
- If you wish to observe a new object, follow point 7 above, move the telescope in RA as required, and then continue with steps 1 through 6 as before.

2.1.5 Eyepieces

Eyepieces are very delicate, just as the telescopes are. Never touch the glass surfaces. There are 2 boxes. The lower the focal length of an eyepiece, the higher the magnification. With the long focal lengths of Northumberland and Thorrowgood, longer focal length (i.e. low power) eyepieces are best suited for most objects.

- **Ordinary Eyepieces**

For ordinary use, take the ones which are in the box labelled 'Northumberland Dome' on the main shelves of the alcove. They are a mix of Orthoscopic and Kellner eyepieces and should usually be sufficient for most observations. Note that the box lid is currently broken; make sure it covers the box well whenever you close it (so as to prevent dust settling onto the eyepieces).

- **Meade Eyepieces**

The other box, on a separate low shelf at the right of the alcove, contains more modern Meade Plössl eyepieces. Do not move that box or turn off its heating. These eyepieces need extra care in handling as they are expensive to replace. In particular, be extra careful not to touch the lenses as they are coated and it could damage the coating.

Never attempt to clean any lens or eyepiece yourself. If it is dirty, note it in the ObsBook and someone will do it properly. Make sure the eyepiece boxes are closed and the newer eyepieces are put back in their plastic cases (if applicable) before leaving.

2.1.6 After Observing

When you have finished observing, follow this procedure:

1. Replace all lens caps and the bag.
2. Make sure the worn silver-topped 40 mm eyepiece is in the telescope (to prevent spiders and insects getting into the telescope). Usually that is the one in place in the telescope when you arrive.
3. Point the telescope away from the slits before closing the dome.
4. Make sure you leave the slits away from any electrical equipment in case it rains.
5. Close dome and lock the latch. Be gentle, but firm when doing this.
6. Return the telescope to a vertical position, as there is least mechanical strain on the lens in this position.
7. Make sure the motor is switched off and all three clamps are disengaged. Do not turn it off at the plug.
8. Sign out in the ObsBook and Attendance book on the desk.
9. As the last thing to do before you exit the dome, turn the alarm back on. You can do that by keying in the code, waiting for the display to say "Welcome back CUAS" and in a second or two "Do you want to arm system?", at which point you need to press the "Yes" button at the bottom left of the keypad. The alarm will start sounding immediately; you have around 20 seconds to leave the building before the University Security is notified, in which time you should exit the dome and close the door (don't forget the keys!). With everyone outside and the door closed, the alarm should change its tone and then switch off the sound, and the University Security. It will still be primed to sound when the door is open again (e.g. when another visitor wants to use the telescope, see **Section 1.2**).

2.2 The Thorrowgood Telescope

This is the smaller of the two telescopes, found in the smaller wooden dome. It is an 8-inch refractor, built in 1864. The focal length is 114 inches (2896 mm, f/14). The mounting is an example of the 'German' form of equatorial mounting, which means the entire night sky is visible. It was bequeathed to RAS in 1928, and is now actually on extended loan to the IoA from them. Due to its analogue dials and specifics of the dome, it is somewhat more comfortably used if two experienced people work on it at the same time, though it is very much possible for one person to operate it all, too.

2.2.1 Moving the Telescope

When first arriving at the telescope, you should find that there is a wooden apparatus affixed to the viewing end. This is the solar projection unit, and the telescope is not balanced without it – it must be clamped in DEC unless it points vertically upwards or you are moving it. Use the octagonal knob (the shortest handle) to do so. As with the Northumberland, never point the telescope below the horizontal. Be sure to move the telescope slowly. The dome is (very slightly) too small, so there is a risk of touching parts of it with the telescope while moving it, and the telescope tube is likely to hit the mounting column it stands on if not handled carefully. Lower rotation speed means less possible damage in this case. The dome is rotated with a pulley system and should also be moved slowly for the same reason. There are two pulleys, one on either side of the dome; if two people are using the telescope, they can move the dome more smoothly by pulling at both pulley systems simultaneously. To open up the dome and prepare the telescope,

1. If the telescope is capped, open the right slit first, then the left one, with the hooked pole in the dome. It will not work the other way round! Make sure the slits are locked when open, by e.g. tugging gently at them with the hooked pole. If uncapped, point the telescope away from the slits first.
2. Remove the lens caps on the main telescope and the finderscope. It is safer to do this whilst the solar projection unit is still inserted, as the balance results in the telescope pointing upwards if the DEC is left unclamped whilst near the horizontal.
3. Remove the solar projection unit. To do this, point the telescope vertical and simply remove the entire drawtube and the wooden section as one, or – if you know what you are doing – remove the wooden unit itself: first pull out the metal pins and then pull the two wooden parts of the unit apart. The eyepiece itself is a wide-angled one, suitable for e.g. observation of comets.
4. Replace the solar projection eyepiece with a normal one from the wooden box. Alternatively, you could just use the solar projection eyepiece for its wider angles of view.

The telescope has a German equatorial mount. This means that – unlike the Northumberland – you can observe all parts of the sky, including the northern celestial pole. To move the tube across the meridian from the eastern to the western side of the pillar, you have to move it via south, i.e. over the pillar. Otherwise the tube will collide with the mount (which is not good).

2.2.2 Reading the DEC and RA dials

The declination (DEC) dial is part of the large wheel on the opposite side of the mount from the telescope tube, so you cannot see it directly when you move the telescope in DEC. On the dial, there are two short, diametrically opposite metal sections with engraved notches for precise determination of current DEC. The arrow at one end of that section (as opposed to the zero at the other end) marks the current declination of the telescope. Both sections show the same DEC reading, so you only need to check one of them.

To aid the reading of the dial in the dark, there are two magnifying glasses with red lights beside them, one on each side of the dial, which can be, if required, moved around the circle independently of the DEC of the telescope and positioned where convenient.

The RA dial, or as it should be called for the reasons explained here, the hour angle dial (hereby abbreviated to H.A.), sits at the bottom of the equatorial column of the telescope. While the RA display in Northumberland automatically tracks the RA of the direction the telescope is pointing towards at any given time, Thorowgood is rather more analogue in that respect, which means that to properly position it towards an object in the sky you either need a program which gives you the current hour angle of any chosen object (**Stellarium**, for example, is good for that), or else you must delve into a small amount of maths, the inverse of which the computer terminal in Northumberland is doing for you all the time.

For a chosen object, and modulus 24 hours,

$$\text{H.A.}_{\text{object}} = \text{LST} - \text{RA}_{\text{object}}$$

where LST stands for **Local Sidereal Time**, which is what the black GPS-controlled clock shows. This can also be found in the "tcs" window of the computer terminal in Northumberland, or in several dedicated webpages and phone apps. LST is, essentially, set such that at noon (GMT), the hour angle of the Sun is zero, which in turn means that LST gives you the R.A. of the objects passing through the zero meridian at any given time.

The hour angle is read on the dial directly. Similarly to the DEC dial, there are two short metal segments above the dial, one labelled B, and the other one labelled A diametrically opposite it. The dial itself remains stationary when the telescope is moved in RA, and the two metal segments above it move together with the circular disk they are attached to. There are two arrows, A and B, for use when the telescope is on the western and eastern sides of the mount respectively. The telescope can only be pointed at things in the eastern sky when on the western side of the mounting and vice versa. The process of moving the tube to the other side of the mounting is called a meridian flip and results in the A and B arrows being 12h away from each other. When the telescope motor drive is engaged, the A and B markers will slowly progress around the dial (one minute per minute), following the hour angle of the observed object.

The metal segment attached below the dial is only used for calibrating the dial. The dial itself should not be turned, as it will then not be calibrated any more. Like the DEC dial, this one also has an independent movable section with a magnifying glass and a red light, which can be used to aid the reading of the dial in the dark. If the light does not seem to be working, the problem may be in the contact of the batteries in the black box beneath the magnifying glass.

2.2.3 Using the motor drive

This will track your object round the sky for you. The motor drive in the Thorrowgood is quiet, so listen hard to check it is on, or check the sidereal/lunar rate light is switched on, or that the small cogs are turning.

1. **Turn the motor on at the switch on the wall.** If the rotary switch is off, switch that to the "1" position, too. Sometimes it takes a while before the telescope starts tracking properly, so it may be necessary to get your desired object back into the field of view.
2. **Engage the RA clamp**
Engage the right ascension clamp, which is the T-shaped brass clamp. Use the metal pole if the RA clamp is out of reach.
3. **Use the hand-paddle for fine adjustments in RA** Do not attempt to pull the telescope manually while the motor is tracking. Due to people attempting that in the past, the RA axis is already loose, so the telescope can be accidentally (by nudging the main tube) moved in RA even when the system is securely clamped; note that in your observations, but do not purposefully nudge the tube even more.

The two remaining knobs by the telescope tube are for slow-motion fine adjustments in DEC (the long one) and RA (the shorter one). These tilt the telescope on its mounting and can be used safely whilst the motor is switched on. There is a limited traverse, so if the telescope reaches a hard stop, the slow motion handles must be turned the other way. These do not change the position as read on the setting circles so introduce an offset to the readings. Don't forget to re-centre the slow motion controls between objects or after a session to make objects easier to find.

2.2.4 Solar Observations

Can be very hazardous, so be careful. Use the solar projection unit in tandem with the eyepiece for solar projection. Do not use another eyepiece, as it may be damaged. It hardly needs to be said, but please:

- Do not look directly into the sun, especially not through a telescope. This may immediately cause severe damage to your eyes!

There are cardboard aperture-reducing plates ("stops") for solar observations. The chart on the wall tells you which you need to use at what times of day and year.

2.2.5 Closing Thorrowgood

1. Make sure the motor is switched off.
2. Point the telescope vertical towards the zenith.
3. Replace the solar projection unit. Be careful to place the wooden parts together the right way, if you took them apart. The side saying TOP should point upwards.

4. Replace both lens caps. The main cap is somewhat battered and may need some trial and error before it fits on nicely.
5. Close the slits, doing the left one first. To do so, pull the cable next to the slit to unlock the slit and then gently let them fall shut, while preventing a sudden fall with the hooked pole. Take care; the slits are rather heavy.
6. Rotate the dome roof to line up its corners with the corners of the walls, otherwise there is more draught, and a chance of rain (and animals!) getting inside. Do not park the slits above the signs telling you not to do so.
7. Leave the telescope vertical and unclamped in both axes.

3 Astrophotography

Both Northumberland and Thorrowgood can be used for astrophotography. We are in possession of a camera adapter suitable for compact cameras. This may be used with each of the telescopes for astrophotography via the afocal method – i.e. photographing the image produced by an eyepiece. This is best performed on bright targets, especially the Moon. The adapter, found in the Northumberland alcove, simply clamps on the telescope drawtube. A 1/4" 20TPI standard tripod screw enables the attachment of a camera. Adjustment knobs allow centring of the camera lens along the image axis of the eyepiece.

We recently obtained a 2" to T-adapter to enable more advanced astrophotography using digital SLR cameras, for which you will require appropriate adapters: a T-mount ring for your brand of camera. This will allow "prime focus" astrophotography on Northumberland. Please be careful with the mounting, as heavy items may fall out of the telescope drawtubes if not secured properly. The focuser for Thorrowgood is of a non-standard size, thus the only adapter we have is the push-fit eyepiece holder. It is not recommended to connect heavier cameras to this 1.25" adapter. If you know what you're doing, feel free to use them for that purpose. We would very much like to see the results of such sessions, and – if permitted by you – share them with the rest of the society.

So, that is (hopefully) all you need to know about using the telescopes, though it does not replace the practice of actually using them. This guide will be updated if/when required. You should print it out as a reference for when you've done both of your ObsDemos and want to observe on your own, though there should always be a copy of it in Northumberland and Thorrowgood. If you have any queries whatsoever, or just want some ideas about observing, feel free to contact us using the contact details below. If you think that this guide is missing something, i.e. something has changed that we're not aware of, or is unclear anywhere, please send us an e-mail to cuasobserv@gmail.com and we'll make sure to update it. Apart from that – happy observing!

CUAS Observation Secretaries 2017-2018

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