

# BETWEEN HEAVEN AND EARTH

AN INTRODUCTION TO ASTROPHOTOGRAPHY

# AGENDA

But all you came here for was the free snacks...

- What is Astrophotography?
- What's Involved?
- Types of Amateur Astrophotography
- Equipment and Expectations
- How to do Nightscape Photography
- How to do Deep Sky Photography
- Art versus Photography
- Dark Skies and Preservation
- Questions

Natural Bridge, Albany  
Camera: Canon EOS6D modified  
Optics: Sigma 24mm f1.4 lens  
Image: 20 x panels @ ISO1600, 60s, f2.2



# WHAT IS ASTROPHOTOGRAPHY?

## So, what's it all about?

- Astrophotography is photography of astronomical objects, celestial events, and of the night sky in general.
- Typical targets include: stars, nebulae, galaxies, star clusters, the moon, the sun, and night landscapes.
- Amateur astrophotography often uses:
  - either consumer or specialized cameras to capture images;
  - consumer camera lenses or telescopes to frame targets;
  - equipment for tracking the motion of the sky (optional).

*The Cosmos is within us. We are made of star-stuff. We are the way for the Universe to know itself.*

Carl Sagan



Lake Brown, near Merridin  
Camera: Canon EOS6D modified  
Optics: Canon 50mm f1.2 lens  
Image: 56 x panels @ ISO3200, 30s, f3.2

# WHAT'S INVOLVED

So...what am I in for?

Amateur astrophotography involves:

- Going out at night (well, obviously)
- Being cold and miserable (sometimes)
- Driving for long periods on remote roads (sometimes)
- Sleeping in tents, sleeping bags, and even car seats (sometimes)
- Spending lots of money on all that “fancy stuff” (not necessarily true)
- Pondering why you didn't pick an easier hobby (almost always)

The Horsehead Nebula  
Camera: Canon EOS6D modified  
Optics: Skywatcher 120ED Refractor  
Image: 5 x panels @ ISO800, 5 x 300s

# WHY GET INVOLVED?

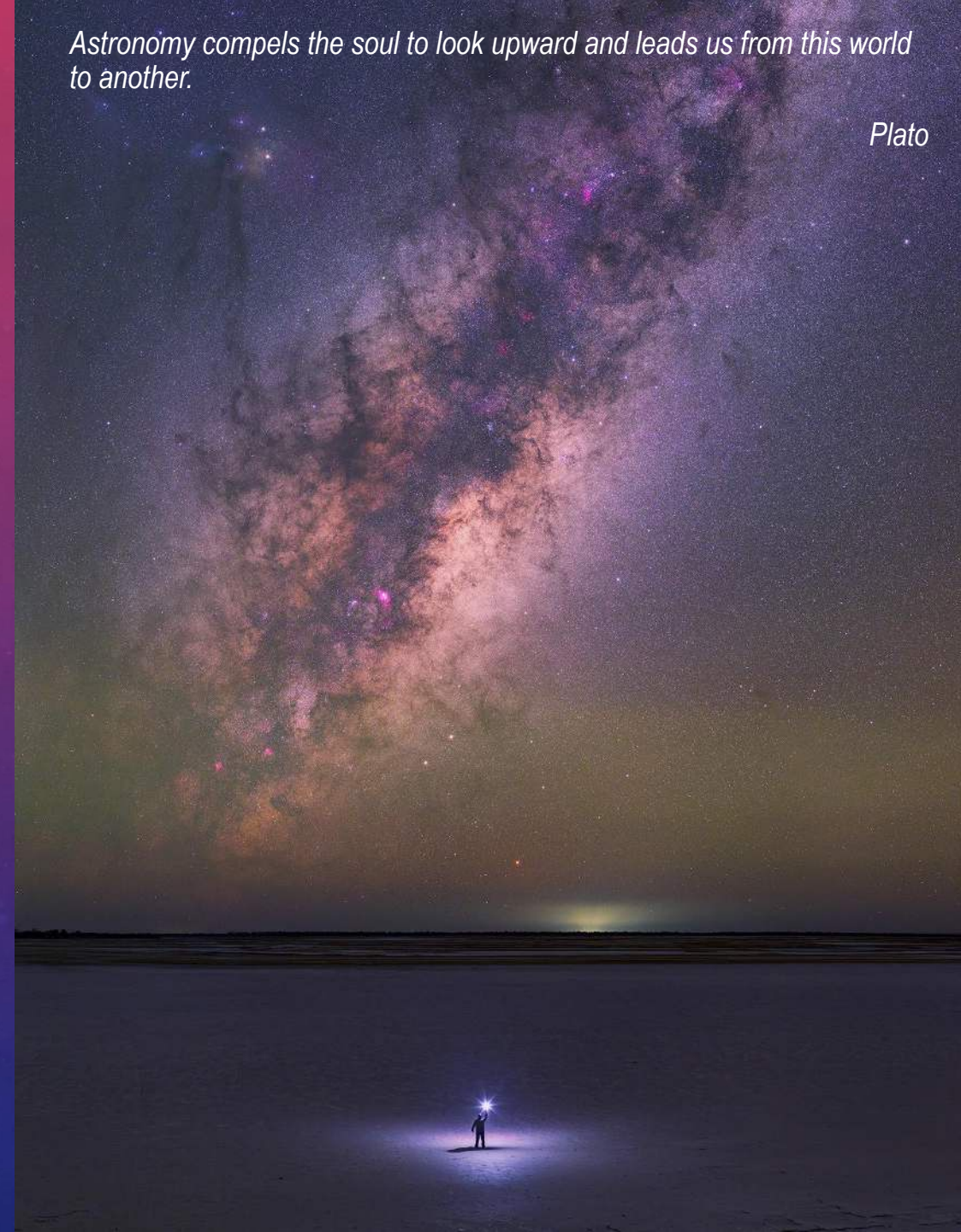
**Yeh, why bother? Seems like a hobby for chumps...**

- BUT before you get up and head for the door...
- Astrophotography can:
  - ...differentiate your photos from a thousand others
  - ...transport you to an entirely different world than the one you experience every day.
  - ...force you to get out and explore new places and take advantage of the abundant dark skies in WA.
  - ...teach you more about the universe.
  - ...push you and your camera to the limits of your skill and ability.

Lake Campion / Brown, Near Merridin  
Camera: Canon EOS6D modified  
Optics: Canon 85mm f1.2 lens  
Image: 21 x panels @ ISO3200, 30s, f3.2

*Astronomy compels the soul to look upward and leads us from this world to another.*

*Plato*



# MAIN TYPES OF AMATEUR ASTROPHOTOGRAPHY

The Core  
Camera: Canon EOS6D standard  
Optics: Canon 85mm f/1.2  
Image: 5 x panels @ ISO3200, 3 x 300s

*He who can no longer pause to wonder and stand rapt in awe, is as good as dead; his eyes are closed.*

*Albert Einstein*

# USING A CAMERA LENS

## Types of Astrophotography

### Nightscapes:

These are photos of landscapes at night but with a focus on the night sky, and by far the most popular form of astrophotography.

Guilderton Lighthouse  
Camera: Canon EOS6D modified  
Optics: Canon 50mm f1.2 lens  
Image: 49 x panels @ ISO3200, 57s, f3.2





## USING A CAMERA LENS

### Types of Astrophotography

#### Startrails:

These are many photos of the same scene stacked over a period typically of a few hours. They emphasise the movement of the sky through the “motion blur” of the stars, forming long arcing curves or circles.

Near Lake Perkolilli, near Kalgoorlie  
Camera: Canon EOS6D modified  
Optics: Samyang 14mm f2.8 lens  
Image: 498 x panels @ ISO3200, 30s, f2.8



# USING A CAMERA LENS

## Types of Astrophotography

### Timelapses:

These are many photos shown one after the other in quick succession to form a video. Whilst not a pure astrophotography technique, timelapses can also reveal the majestic motion of the sky.



Green Pools, near Denmark  
Camera: Canon EOS6D standard  
Optics: Sigma 24mm f1.4 lens  
Image: 330 x panels @ ISO3200, 20s, f2.0



## USING A CAMERA LENS

### Types of Astrophotography

#### Widefield:

These are images of wide regions of the night sky. Widefield images are typically captured using camera lens or short focal length optics and usually require an equatorial tracking mount to allow longer exposure times.

Widefield from the core to Antares  
Camera: Canon EOS6D modified  
Optics: Canon 85mm f1.2 lens  
Image: 4 x panels @ ISO3200, 480s, f4.0

# USING A TELESCOPE

## Types of Astrophotography

### Moon, Planets and the Sun:

The moon can be taken with a long focal length lens or a telescope, whilst planets will usually need a long focal length telescope.

The sun requires special solar filters, and there are even specialized solar telescopes.



*When I first looked back at the Earth, standing on the Moon,  
I cried.*

*Alan Shepard*

# USING A TELESCOPE

## Types of Astrophotography

### Deep Sky - Galaxies:

Galaxies can come in many different shapes and sizes, from spirals to ovals and even distorted shapes where one galaxy is “eating” another.

Often, galaxies require a longer focal length telescope.

M31 Andromeda

Camera: Canon EOS6D modified

Optics: Skywatcher 120ED Refractor

Image: 1 x panel @ ISO800, 19 x 300s

*Somewhere, something incredible is waiting to be known.*

*Carl Sagan*

# USING A TELESCOPE

## Types of Astrophotography

### Deep Sky - Nebulas:

There are a number of different types of nebulas - planetary nebulae, emission nebulae, reflection nebulae, dark nebulas and supernova remnants.

They are made up of interstellar dust or gas. Bright nebulas fluoresce due to their gas molecules being “energized” by the light of nearby stars. Other nebulas are may be dark, obscuring light from objects further in the background.

Some can span a large part of the sky that you can use a camera lens, but most will require a telescope.

The Orion Nebula

Camera: Canon EOS6D modified

Optics: Skywatcher 120ED Refractor

Image: 5 x panels @ ISO800, 5 x 300s

*We are not simply in the universe; we are part of it. We are born from it.*

*Neil deGrasse Tyson*

# USING A TELESCOPE

## Types of Astrophotography

### Stars and Star Clusters

As the name implies, star clusters are groups of stars that are gravitationally bound.

Stars and star clusters are wonderful targets for astrophotography.

The Pleiades

Camera: Canon EOS6D modified

Optics: Skywatcher 120ED Refractor

Image: 1 x panel @ ISO800, 25 x 600s

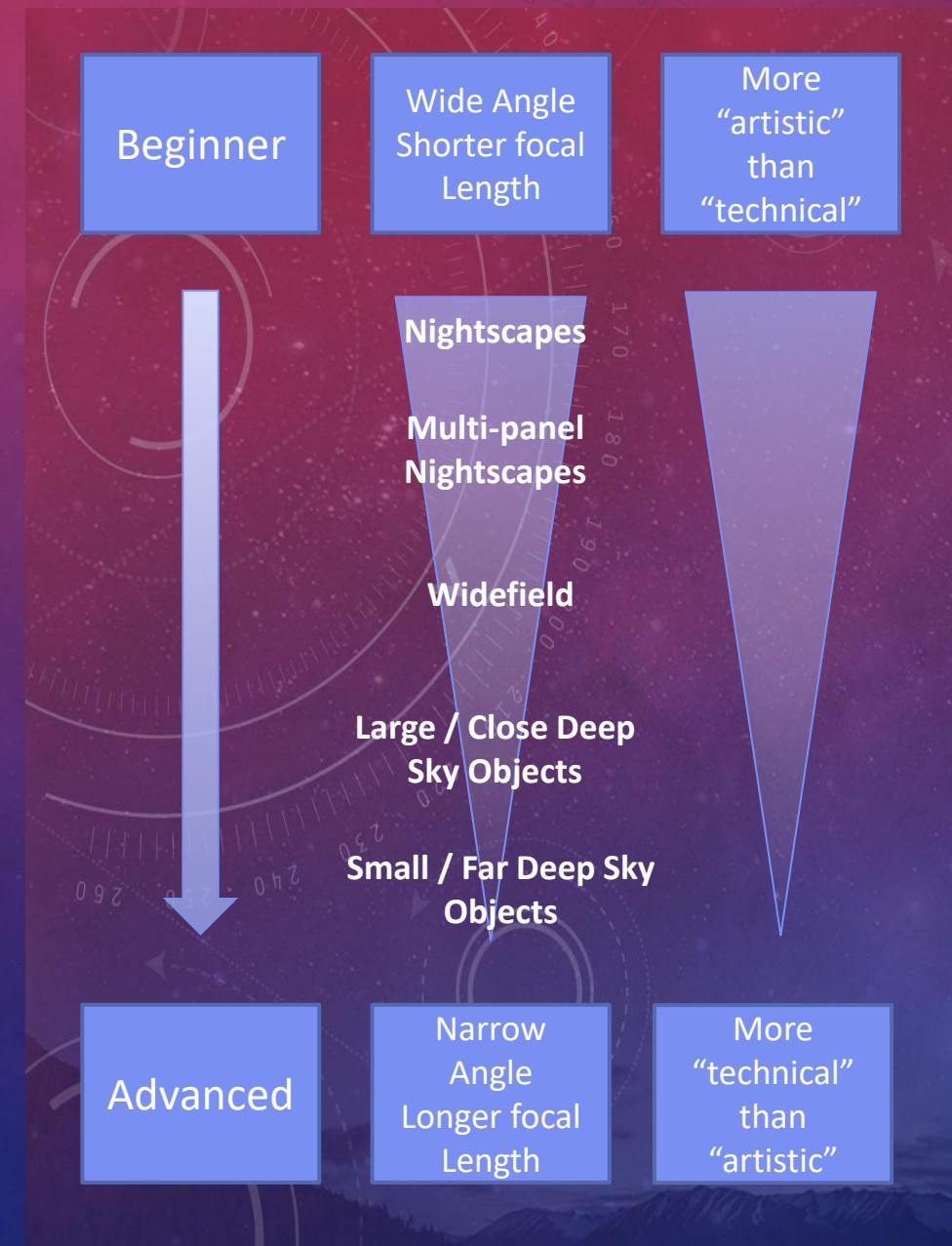
*Astronomy, as nothing else can do, teaches men humility.*

*Arthur C Clarke*

# STOP! DO NOT BUY THAT TELESCOPE!

## But, but...don't I need a telescope?

- Myth 1 – Astrophotography is expensive!
- Myth 2 – Astrophotography needs a telescope!
- In general, when beginning astrophotography you shoot at short focal lengths (i.e. wide angle).
- ...as you gain experience you increase to longer focal lengths.
- The longer your focal length:
  - the longer your exposures tend to be;
  - the more expensive the optics / telescope;
  - the more accurate the tracking of your target
  - the more complicated the post-processing
- What targets / focal length do you want to shoot???



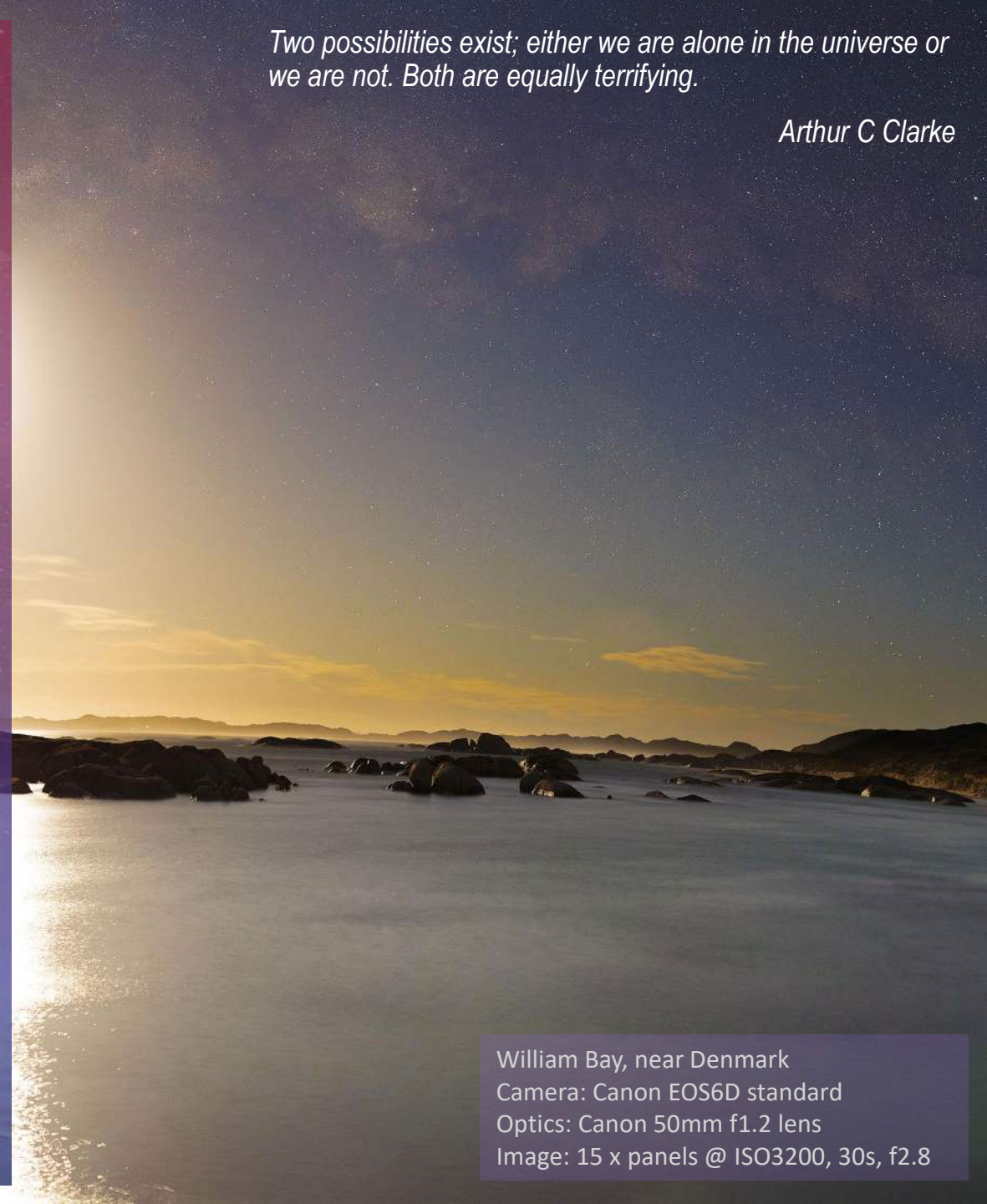
# WHAT EQUIPMENT WILL I NEED?

How much money do I need to take from my kid's uni funds...

- What equipment you will need depends upon what astrophotography you wish to do.
- This presentation won't recommend specific equipment and brands (boo!!!), but...
- ...the following slides provide a recommended path on navigating Astro equipment based on:
  - Limiting initial costs for beginning;
  - Delaying outlays on astrophotography specific equipment until later;
  - Avoiding equipment that commits one to a type of astrophotography too early on.

*Two possibilities exist; either we are alone in the universe or we are not. Both are equally terrifying.*

*Arthur C Clarke*



William Bay, near Denmark  
Camera: Canon EOS6D standard  
Optics: Canon 50mm f1.2 lens  
Image: 15 x panels @ ISO3200, 30s, f2.8



# EQUIPMENT AND EXPECTATIONS

So, if I buy "X" will I get "Y"

Beginner

## TYPICAL EQUIPMENT

- Mid-range Camera (with manual functions)
- Lens capable of Wide Angle (< 24mm)
- Stable Tripod / Mount

Intermediate



Experienced

Telescope  
Intermediate

## ENABLES

- Nightscapes
- Up to 30 second exposures

Telescope  
Experienced



Pinnacles, Nambung National Park  
Camera: Canon EOS6D standard  
Optics: Canon 17-55mm f2.8 lens  
Image: 1 x panels @ ISO16000, 25s, f2.8

# EQUIPMENT AND EXPECTATIONS

So, if I buy "X" will I get "Y"

Beginner

Intermediate

Experienced

Telescope  
Intermediate

Telescope  
Experienced

## TYPICAL EQUIPMENT

- Full-frame or High End Crop Camera
- Prime Wide Angle Lens ( $> f/2.8$ ,  $< 24\text{mm}$ )
- Stable Tripod / Mount



## ENABLES

- Brighter, less noisy nightscapes
- Panoramic nightscapes
- Up to 30 second exposures



Sand Dunes near Cervantes  
Camera: Canon EOS6D standard  
Optics: Samyang 14mm f2.8 lens  
Image: 1 x panels @ ISO3200, 30s, f2.8

# EQUIPMENT AND EXPECTATIONS

So, if I buy "X" will I get "Y"

Beginner

Intermediate

Experienced

Telescope  
Intermediate

Telescope  
Experienced

## TYPICAL EQUIPMENT

- Full-frame or High End Crop Camera, IR filter modified
- Longer length prime lenses ( $f > 2.0$ ,  $< 85\text{mm}$ )
- Portable tracking equatorial mount
- Intervalometer



## ENABLES

- Narrower multi-panel nightscapes
- Widefield astrophotography
- Up to 5-minute exposures (depending upon lens and whether doing nightscapes or widefield)

Orion and Flame Nebula  
Camera: Canon EOS6D standard  
Optics: Canon 70-200mm f2.8 lens  
Image: 1 x panels @ ISO6400, 53s, f2.8

Taken in 2014 with standard EOS6D camera,  
early in my deep sky career...

# EQUIPMENT AND EXPECTATIONS

So, if I buy "X" will I get "Y"

Beginner

Intermediate

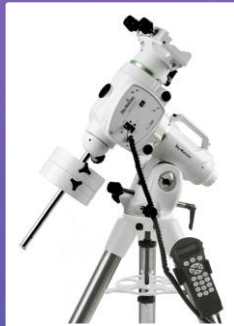
Experienced

Telescope  
Intermediate

Telescope  
Experienced

## TYPICAL EQUIPMENT

- DSLR Camera Modified
- Shorter focal length power telescope 250mm-800mm
- Computerised equatorial mount
- Auto-guider (on / off axis guider)



## ENABLES

- Widefield, Deep Sky, Star Clusters
- Long exposures, typically 5 – 10min

Rosette Nebula  
Camera: Canon EOS6D modified  
Optics: Skywatcher Esprit 120ED (840mm)  
Image: 1 x panel @ ISO800, 16x300s, f7.0

# EQUIPMENT AND EXPECTATIONS

So, if I buy "X" will I get "Y"

Beginner

Intermediate

Experienced

Telescope  
Intermediate

Telescope  
Experienced

## TYPICAL EQUIPMENT

- Specialised cooled astrocamera
- Telescope of any focal length (apochromatic)
- Computerised equatorial mount
- Auto-guider (on / off axis guider)
- Filters (Ha, SII, OIII)
- ...Laptop, smart devices, and much more



## ENABLES

- Deep Sky, Star Clusters, Galaxies, Planetary Nebulas, Planets (i.e. the Universe)
- Long exposures, typically 5 – 20min

Orion and Flame Nebula  
Camera: Canon EOS6D modified  
Optics: Skywatcher Esprit 120ED (840mm)  
Image: 2 x panel @ ISO800, 22x600s, f7.0

# HOW TO DO NIGHTSCAPES

| SESSION | WHAT To do            |
|---------|-----------------------|
| PRIOR   | Plan Sky and Moon     |
|         | Pick Location         |
|         | Track Weather         |
|         | Think Safety          |
| DURING  | Choose Lens v Scene   |
|         | Camera Settings       |
|         | Focus                 |
|         | Start Shooting!!!     |
|         | *Polar Align          |
|         | *Multiple Panels      |
| POST    | *Shoot for Stacking   |
|         | RAW Processing        |
|         | *Stitching            |
|         | Basic Post-Processing |
|         | *Stacking             |

*For my part I know nothing with any certainty, but the sight of the stars makes me dream.*

*Vincent Van Gogh*

Dumbleyung Lake, near Wagin  
Camera: Canon EOS6D standard  
Optics: Canon 50mm f/1.2  
Image: 15 x panels @ ISO3200, 30s, f2.8

|         |                       |
|---------|-----------------------|
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## WHAT

- Plan the date / time of your session based on the orientation of the night sky and moon.

## WHY

- Nightsapes are best when there is no moon or minimally illuminated moon in the sky.
- A bright moon will light up the night sky a will “drown out” the dim Milky Way, faint stars and nebulas.
- The location of where the Milky Way core (or your target) is in the night sky will determine in which direction you will need to shoot.

## HOW

- Use a software tool to determine days when there is no moon in the sky - e.g. [www.timeanddate.com](http://www.timeanddate.com) (free)
- Use a software tool to determine the orientation of the night sky on the target night - e.g. [Stellarium](http://Stellarium) (free)

Moonsrise, Moonset, and Phase Calendar for Perth, August 2021

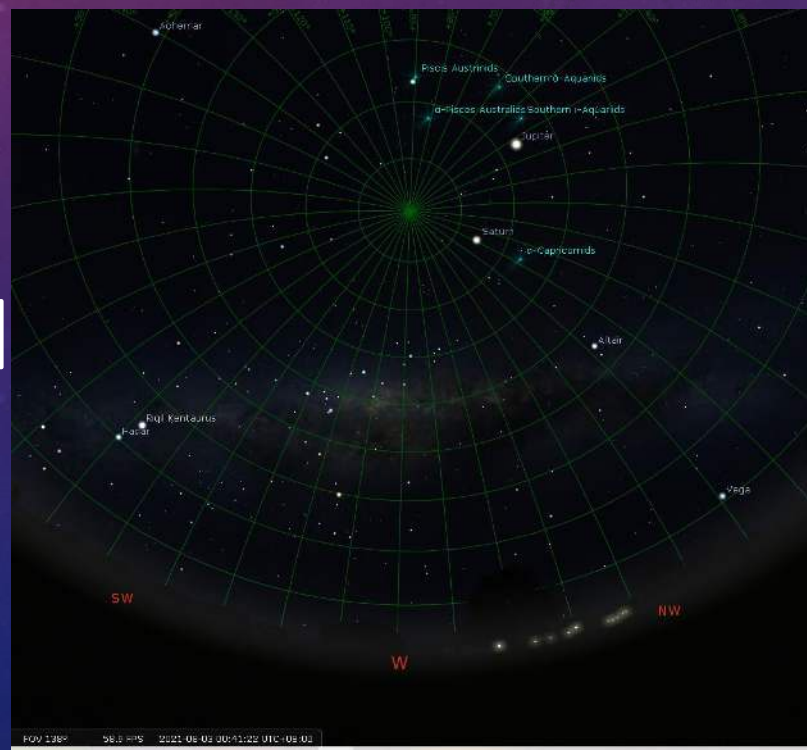
Month: August Year: 2021 Go

| 2021 Aug | Moonrise          | Moonset           | Moonrise | Meridian Passing | Time    | Distance (km) | Illumination |
|----------|-------------------|-------------------|----------|------------------|---------|---------------|--------------|
| 1        | 12:45 am ↙ (75°)  | 11:54 am ↘ (287°) | -        | 6:22 am (43.8°)  | 403,214 | 46.5%         |              |
| 2        | 1:41 am ↙ (70°)   | 12:26 pm ↘ (292°) | -        | 7:06 am (39.5°)  | 404,333 | 36.9%         |              |
| 3        | 2:37 am ↙ (65°)   | 1:02 pm ↘ (296°)  | -        | 7:51 am (35.9°)  | 404,133 | 27.8%         |              |
| 4        | 3:33 am ↙ (62°)   | 1:44 pm ↘ (299°)  | -        | 8:40 am (33.3°)  | 402,714 | 19.4%         |              |
| 5        | 4:29 am ↙ (60°)   | 2:31 pm ↘ (301°)  | -        | 9:30 am (31.9°)  | 400,260 | 12.2%         |              |
| 6        | 5:22 am ↙ (59°)   | 3:23 pm ↘ (300°)  | -        | 10:22 am (31.7°) | 397,023 | 6.4%          |              |
| 7        | 6:12 am ↙ (60°)   | 4:21 pm ↘ (299°)  | -        | 11:15 am (32.9°) | 393,291 | 2.3%          |              |
| 8        | 6:57 am ↙ (63°)   | 5:22 pm ↘ (295°)  | -        | 12:08 pm (35.5°) | 389,353 | 0.3%          |              |
| 9        | 7:38 am ↙ (68°)   | 6:25 pm ↘ (290°)  | -        | 12:58 pm (39.4°) | 385,470 | 0.6%          |              |
| 10       | 8:14 am ↙ (73°)   | 7:28 pm ↘ (284°)  | -        | 1:48 pm (44.3°)  | 381,844 | 3.3%          |              |
| 11       | 8:48 am ↙ (79°)   | 8:31 pm ↘ (277°)  | -        | 2:36 pm (49.9°)  | 378,606 | 8.5%          |              |
| 12       | 9:20 am ↙ (86°)   | 9:34 pm ↘ (270°)  | -        | 3:23 pm (56.0°)  | 375,819 | 15.8%         |              |
| 13       | 9:51 am ↙ (94°)   | 10:38 pm ↘ (263°) | -        | 4:10 pm (62.3°)  | 373,500 | 25.1%         |              |
| 14       | 10:24 am ↙ (101°) | 11:44 pm ↘ (256°) | -        | 5:00 pm (68.4°)  | 371,646 | 35.9%         |              |

12:00 am

Altitude -21°  
Heading - 82° E  
Position Moon under horizon

Rise 1:41 am 70°ENE  
Set 12:26 pm 292°WNW



|         |                       |
|---------|-----------------------|
| SESSION | WHAT<br>To do         |
| PRIOR   | Plan Sky and Moon     |
|         | Pick Location         |
|         | Track Weather         |
|         | Think Safety          |
| DURING  | Choose Lens v Scene   |
|         | Camera Settings       |
|         | Focus                 |
|         | Start Shooting!!!     |
|         | *Polar Align          |
|         | *Multiple Panels      |
| POST    | *Shoot for Stacking   |
|         | RAW Processing        |
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## WHAT

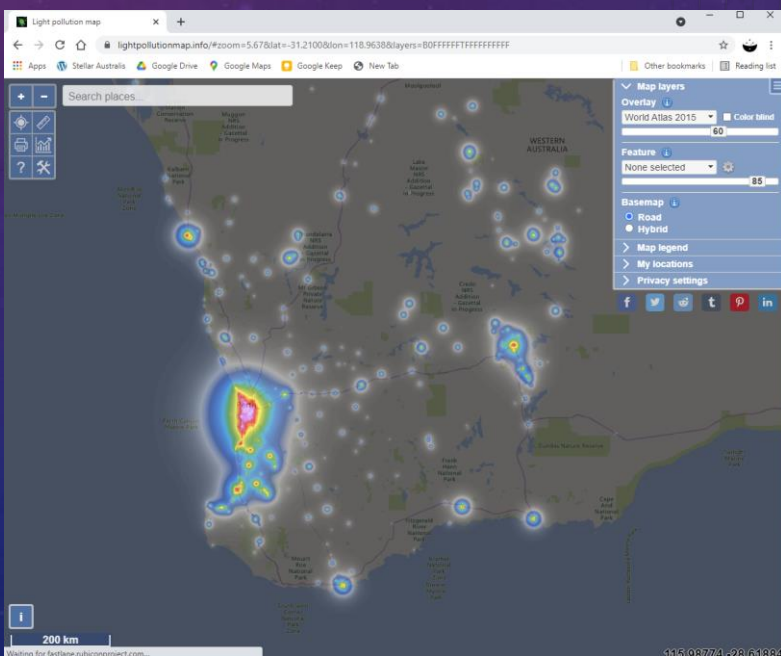
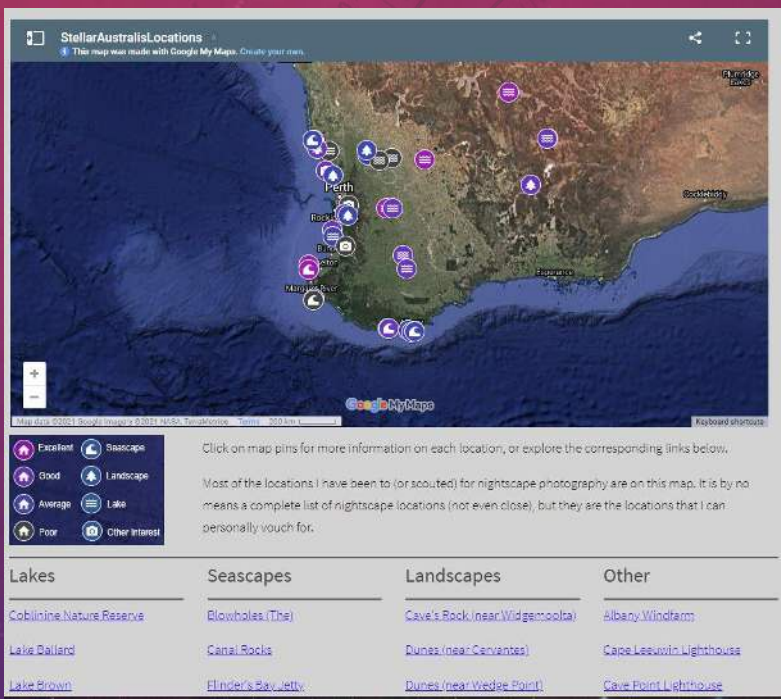
- Choose a location for your night photography and scout

## WHY

- Some locations suit different times of year (e.g. the Milkyway is mostly in the east in Autumn / Winter and in the west in Spring / Summer).
- Some locations may be impacted by light pollution.

## HOW

- Initially, choose remote landscapes that you've shot in the past (provided they have a good view of the sky)
- Talk on astrophotography forums (e.g. Perth Astrophotography on Facebook)
- I have a free map of nightscape locations in the south-west and write-ups on my website (<http://www.stellaraustralis.com/locations/>)
- Check light pollution maps – e.g. <http://lightpollutionmap.info> (free)





|         |                       |
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## WHAT

- In day(s) leading up to the planned session, track the weather.

## WHY

- For most astrophotography, the night skies must be clear of clouds (or mostly cleared of clouds) – otherwise you can't see the night sky.
- Partial clouds may make multi-panels shots difficult as clouds moving between will create discontinuities.

## HOW

- At less than a week, periodically check forecasts at your planned location, or short list of locations. E.g. [www.clearoutside.com](http://www.clearoutside.com) (free website).
- At less than a day, check BOM high definition satellite imagery to confirm the forecasts. E.g. BOM [www.bom.gov.au](http://www.bom.gov.au) (free website).
- A dedicated website for astrophotography weather forecast is [www.cloudfreenight.com](http://www.cloudfreenight.com) (free subscription)

Cloud Free Night  
Cloud Forecasts for Australia & New Zealand

Home Forecast Map Meteogram Satellite Camera Help

Cloud Free Night is an online weather forecast information service for the benefit of the Australian & New Zealand astronomy and photography communities. Near real-time weather forecasts from the United States GFS global model can be compared to higher resolution forecasts from the Australian Bureau of Meteorology ACCESS model, improving your confidence in the accuracy of these weather predictions.

\*\*\* LATEST NEWS \*\*\* Please be aware of occasional missing ACCESS or GFS model forecast updates. Check carefully the dates of model forecast products...  
- CFN Team (9 July 2021)

Cloud Free Night displays official forecasts from the Bureau of Meteorology, ACCESS and GFS model forecast maps and meteograms over specific Australian regions, New Zealand and locations, summarising the weather forecast over the next five days. Links to local (WeatherWatch, OzForecast) and overseas (Meteologix, 7Timer!, Yr, meteoblue, Clear Outside) forecasts enable further comparison of these weather predictions.

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## WHAT

- Think about your safety first.

## WHY

- No photography is worth embarrassment (if you get lost), or at worse, your life.

## HOW

- Tell someone where you are going and for how long.
- Ensure you plan your trip, particularly around fatigue management when driving. Beware of animals when driving at night in remote locations.
- Bring plenty of water.
- The GPS on your mobile is your friend, ensure that it is charged and on you at all times.
- Bring / wear warm clothes, torch, and head-torch.
- If you are uncomfortable going out alone – share the experience with a friend, or go out with other like-minded photographers.



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## WHAT

- Choose your lens (particularly focal length) to suit your type of nightscape and your planned exposure time.

## WHY

- For a static mount, shorter focal lengths allow longer exposure times and let you capture more of the landscape and sky in one shot.
- Longer focal lengths need shorter exposure times to avoid star trailing, or require a may tracking mount. You may require multiple panels to capture the scene.

## HOW

- Pick your lens with the understanding that shorter focal lengths are easier for beginners.
- Based on your focal length, the maximum exposure to avoid star trailing can be calculated by the “400” rule.
- Based on your focal length, determine whether you need to shoot multiple panels for your scene.



Image by: digiDirect staff

$$\text{max time (s)} = \frac{400}{\text{focal length (mm)}}$$

For example, a 24mm lens will give you ~17 second maximum exposure time.

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## WHAT

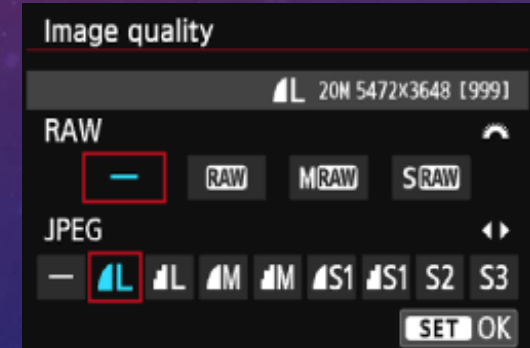
- Alter your camera settings for shooting nightscapes.

## WHY

- You need to maximise how much light is captured, minimise star trailing, and store the image uncompressed.

## HOW

- Set camera to MANUAL mode and turn off Auto-focus
- Turn off any long exposure noise reduction features.
- Set image format to RAW, or RAW + JPEG.
- Set exposure time per 400 rule or less on static mount.
- Use mirror lock-up.
- Set ISO to your camera's best low light setting, usually between 800 to 3200. Avoid extended ISO ranges.
- Set your aperture to the widest possible for the lens. Stop back a little if you are obtaining sufficient light.
- Set white balance to anything but auto.



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## WHAT

- Ensure you take time to focus properly on stars (and foreground)

## WHY

- Because who doesn't like blurry photos...
- It can be difficult to see in your camera screen if your night photos are blurry or not.

## HOW

- To focus on the night sky, turn on "live view" and point the camera at a bright star. Zoom in on the star in live view and manually focus to get the star nice and sharp.
- Usually for wide angle lenses you will not need to refocus when shooting the foreground.
- For narrower lenses, may need to focus on foreground. Turn on "live view" and point the camera at a target in the foreground. Light up the ground with a torch and manually focus.



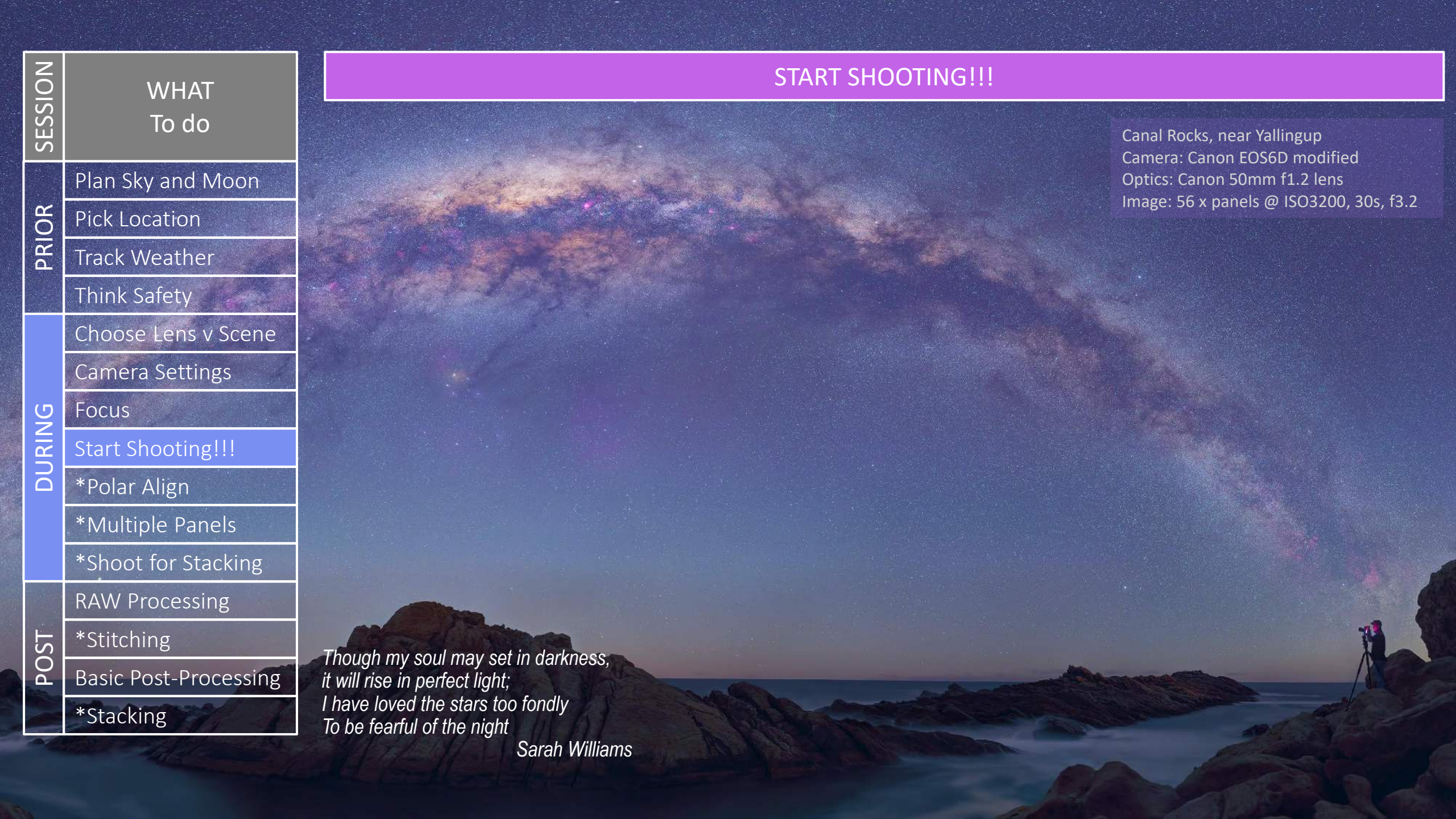
| SESSION | WHAT To do            |
|---------|-----------------------|
| PRIOR   | Plan Sky and Moon     |
|         | Pick Location         |
|         | Track Weather         |
|         | Think Safety          |
| DURING  | Choose Lens v Scene   |
|         | Camera Settings       |
|         | Focus                 |
|         | Start Shooting!!!     |
|         | *Polar Align          |
|         | *Multiple Panels      |
|         | *Shoot for Stacking   |
| POST    | RAW Processing        |
|         | *Stitching            |
|         | Basic Post-Processing |
|         | *Stacking             |

START SHOOTING!!!

Canal Rocks, near Yallingup  
 Camera: Canon EOS6D modified  
 Optics: Canon 50mm f1.2 lens  
 Image: 56 x panels @ ISO3200, 30s, f3.2

*Though my soul may set in darkness,  
 it will rise in perfect light;  
 I have loved the stars too fondly  
 To be fearful of the night*

*Sarah Williams*



| SESSION | WHAT To do            |
|---------|-----------------------|
| PRIOR   | Plan Sky and Moon     |
|         | Pick Location         |
|         | Track Weather         |
|         | Think Safety          |
| DURING  | Choose Lens v Scene   |
|         | Camera Settings       |
|         | Focus                 |
|         | Start Shooting!!!     |
|         | *Polar Align          |
|         | *Multiple Panels      |
| POST    | *Shoot for Stacking   |
|         | RAW Processing        |
|         | *Stitching            |
|         | Basic Post-Processing |
|         | *Stacking             |

## WHAT

- (optional – if using a tracking mount) Must align mount with the Southern Celestial Pole

## WHY

- Errors in alignment will show up as small trails in stars, even when tracking.
- The longer the focal length, the better the accuracy required.
- For nightscapes it allows you to expose for typically up to 1 minute. Longer times may result in “tearing” the horizon.
- For widefield astrophotography the maximum exposure time is limited only by tracking accuracy.



| SESSION | WHAT To do            |
|---------|-----------------------|
| PRIOR   | Plan Sky and Moon     |
|         | Pick Location         |
|         | Track Weather         |
| DURING  | Think Safety          |
|         | Choose Lens v Scene   |
|         | Camera Settings       |
|         | Focus                 |
|         | Start Shooting!!!     |
|         | *Polar Align          |
|         | *Multiple Panels      |
| POST    | *Shoot for Stacking   |
|         | RAW Processing        |
|         | *Stitching            |
|         | Basic Post-Processing |
|         | *Stacking             |

## HOW – The “Apus” Method

- Step 1 – Set-up your tracking mount and attach or unveil the polar scope.
- Step 2 – Align your tracker roughly to the SCP.
- Step 3 – Find the head of Apus.
- Step 4 – Follow the Tail
- Step 5 – Fine Tune
- Want more detail on the method, go to [www.stellaraustralis.com](http://www.stellaraustralis.com) , or search on other methods a go.





| SESSION | WHAT To do            |
|---------|-----------------------|
| PRIOR   | Plan Sky and Moon     |
|         | Pick Location         |
|         | Track Weather         |
|         | Think Safety          |
| DURING  | Choose Lens v Scene   |
|         | Camera Settings       |
|         | Focus                 |
|         | Start Shooting!!!     |
|         | *Polar Align          |
|         | *Multiple Panels      |
| POST    | *Shoot for Stacking   |
|         | RAW Processing        |
|         | *Stitching            |
|         | Basic Post-Processing |
|         | *Stacking             |

## WHAT

- (optional) Taking multi-panel images to stitch together to form a larger image.

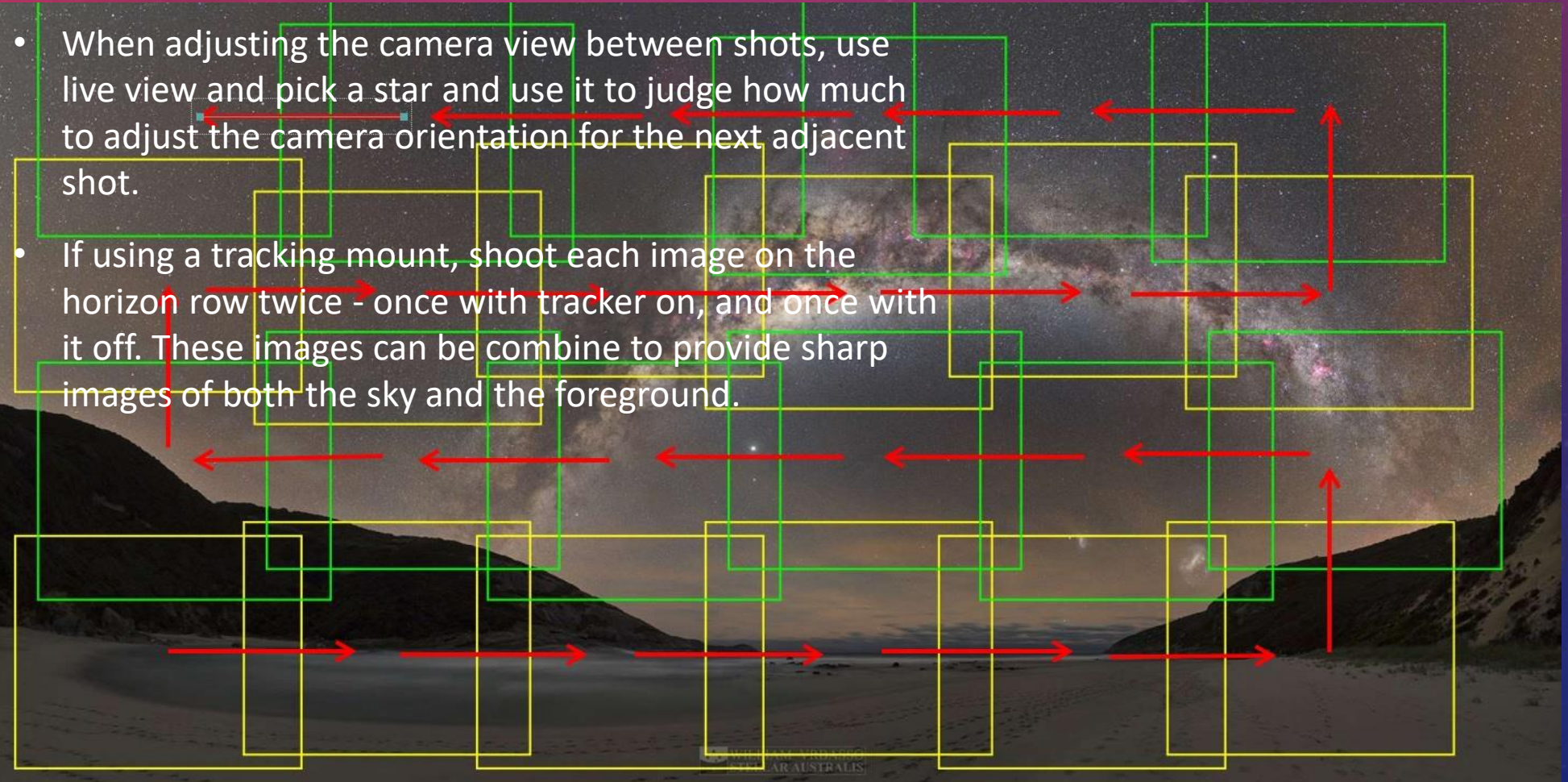
## WHY

- The shot we are after is wider than the field of view of the lens.

| SESSION | WHAT To do            |
|---------|-----------------------|
| PRIOR   | Plan Sky and Moon     |
|         | Pick Location         |
|         | Track Weather         |
|         | Think Safety          |
| DURING  | Choose Lens v Scene   |
|         | Camera Settings       |
|         | Focus                 |
|         | Start Shooting!!!     |
|         | *Polar Align          |
|         | *Multiple Panels      |
| POST    | *Shoot for Stacking   |
|         | RAW Processing        |
|         | *Stitching            |
|         | Basic Post-Processing |
|         | *Stacking             |

## HOW

- Shoot the panel by rows, i.e. shoot a row first then move up / down to next row. This limits “tearing” at the horizon.



| SESSION | WHAT To do            |
|---------|-----------------------|
| PRIOR   | Plan Sky and Moon     |
|         | Pick Location         |
|         | Track Weather         |
|         | Think Safety          |
| DURING  | Choose Lens v Scene   |
|         | Camera Settings       |
|         | Focus                 |
|         | Start Shooting!!!     |
|         | *Polar Align          |
|         | *Multiple Panels      |
|         | *Shoot for Stacking   |
| POST    | RAW Processing        |
|         | *Stitching            |
|         | Basic Post-Processing |
|         | *Stacking             |

TRACKER ON: The top image the stars are sharp while the foreground is slightly blurred

TRACKER OFF: The bottom image the stars are blurred while the foreground is sharp.



| SESSION | WHAT To do            |
|---------|-----------------------|
| PRIOR   | Plan Sky and Moon     |
|         | Pick Location         |
|         | Track Weather         |
|         | Think Safety          |
| DURING  | Choose Lens v Scene   |
|         | Camera Settings       |
|         | Focus                 |
|         | Start Shooting!!!     |
|         | *Polar Align          |
|         | *Multiple Panels      |
| POST    | *Shoot for Stacking   |
|         | RAW Processing        |
|         | *Stitching            |
|         | Basic Post-Processing |
|         | *Stacking             |

## WHAT

- (optional) Take multiple shots of the same view for “stacking”.

## WHY

- Reduce random thermal noise and increase signal to noise ratio by averaging multiple exposures.
- Multiple short exposures may be preferred over one longer exposure (e.g. eliminate need for tracking)
- Allow flexibility in stopping down your lens (i.e. reduce aperture to improve sharpness), increase ISO, etc.

## HOW

- Proceed as you would shoot normally, but instead of taking one shot at (e.g. 1 x 30 seconds), take multiple shots (e.g. 3 x 20 seconds) of the same view.
- Check that the stars are still sharp in each short exposure.
- The rest is taken care of in post-processing...explained later on.



| SESSION | WHAT To do            |
|---------|-----------------------|
| PRIOR   | Plan Sky and Moon     |
|         | Pick Location         |
|         | Track Weather         |
|         | Think Safety          |
| DURING  | Choose Lens v Scene   |
|         | Camera Settings       |
|         | Focus                 |
|         | Start Shooting!!!     |
|         | *Polar Align          |
|         | *Multiple Panels      |
| POST    | *Shoot for Stacking   |
|         | RAW Processing        |
|         | *Stitching            |
|         | Basic Post-Processing |
|         | *Stacking             |

## WHAT

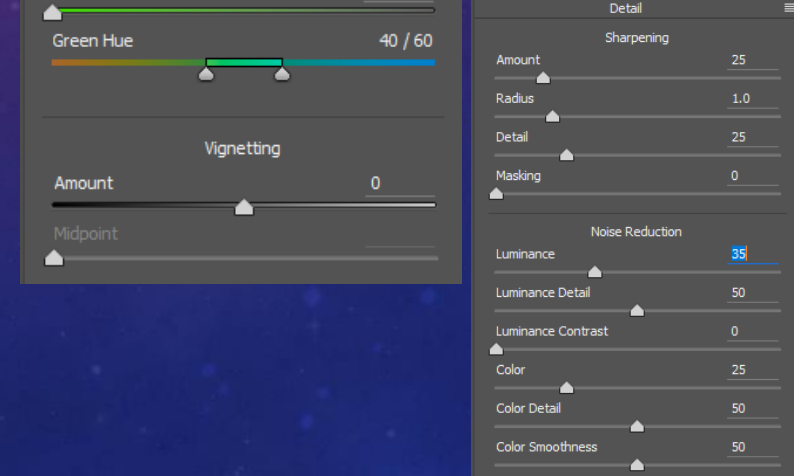
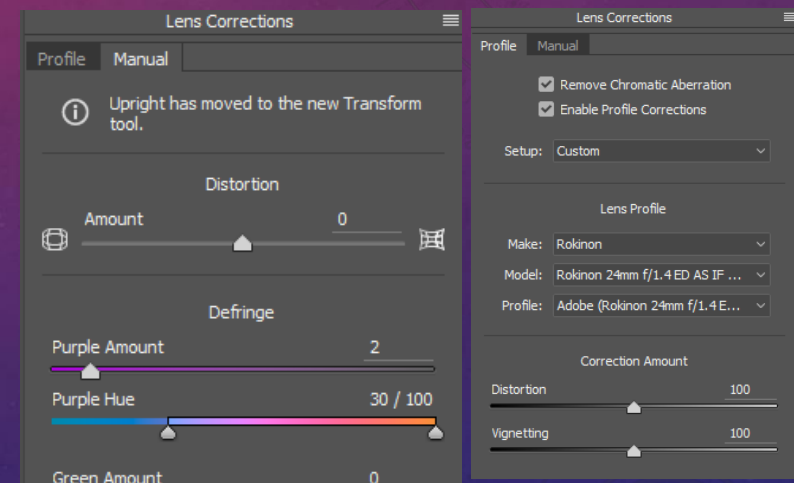
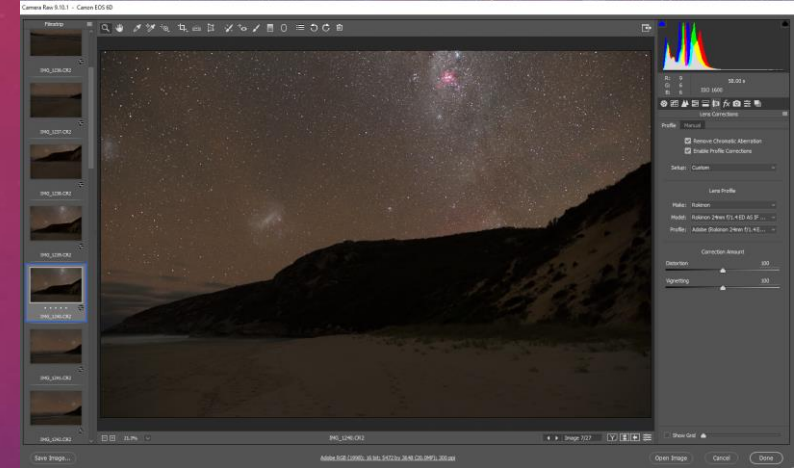
- Process the RAW image(s) from your camera.

## WHY

- Preliminary corrections should be performed prior to post-processing (i.e. before stitching or using a editing software like Photoshop).

## HOW

- Open all the RAW files in your RAW processing software which should come with your camera, or use Adobe's Bridge and Camera Raw.
- Adjust all photos for:
  - Lens correction (makes them easier to stitch)
  - Defringing (remove halos around stars due to lens)
  - Can do colour balancing and noise reduction, but this can wait until post-processing.
- Save in 16-bit format if possible for next step



| SESSION | WHAT To do            |
|---------|-----------------------|
| PRIOR   | Plan Sky and Moon     |
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| DURING  | Choose Lens v Scene   |
|         | Camera Settings       |
|         | Focus                 |
|         | Start Shooting!!!     |
|         | *Polar Align          |
|         | *Multiple Panels      |
| POST    | *Shoot for Stacking   |
|         | RAW Processing        |
|         | *Stitching            |
|         | Basic Post-Processing |
|         | *Stacking             |

## WHAT

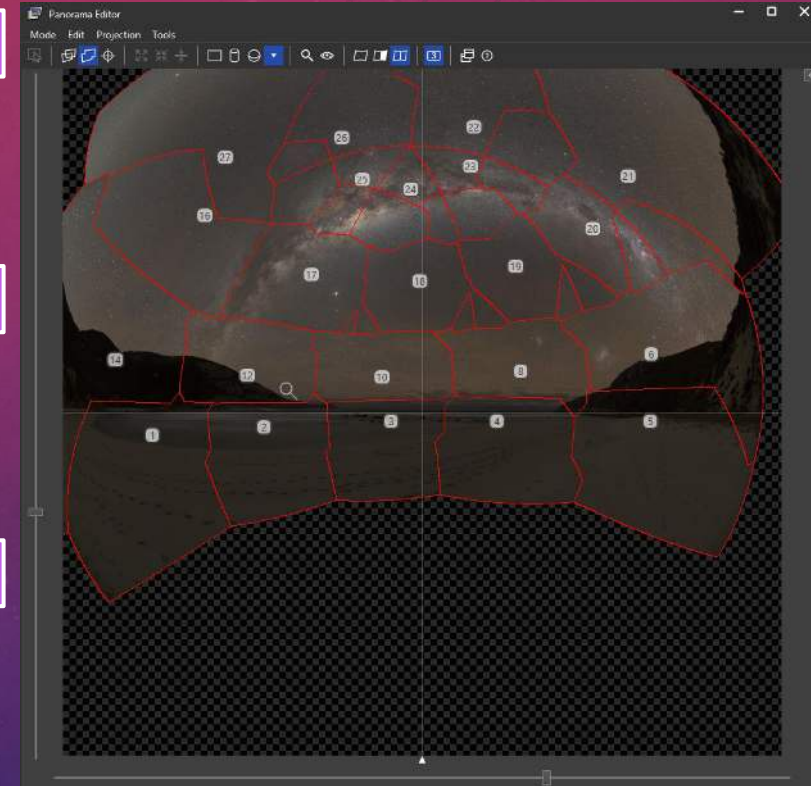
- (optional – only for multi-panel images) Stitch your image using a dedicated stitching software.

## WHY

- Dedicated stitching software makes it much easier to stitch images than, for example, Photoshop.

## HOW

- Good software include **Microsoft Ice** (free) and **PTGui Pro** (paid)
- Load all the images in your stitching software and allow it to stitch automatically.
- If you used a tracker, save one version with the sharp foreground horizon panels stitched, and then one version with the sharp sky panels stitched. These will be merged in post-processing.



| SESSION | WHAT To do            |
|---------|-----------------------|
| PRIOR   | Plan Sky and Moon     |
|         | Pick Location         |
|         | Track Weather         |
|         | Think Safety          |
| DURING  | Choose Lens v Scene   |
|         | Camera Settings       |
|         | Focus                 |
|         | Start Shooting!!!     |
|         | *Polar Align          |
|         | *Multiple Panels      |
| POST    | *Shoot for Stacking   |
|         | RAW Processing        |
|         | *Stitching            |
|         | Basic Post-Processing |
|         | *Stacking             |

## WHAT

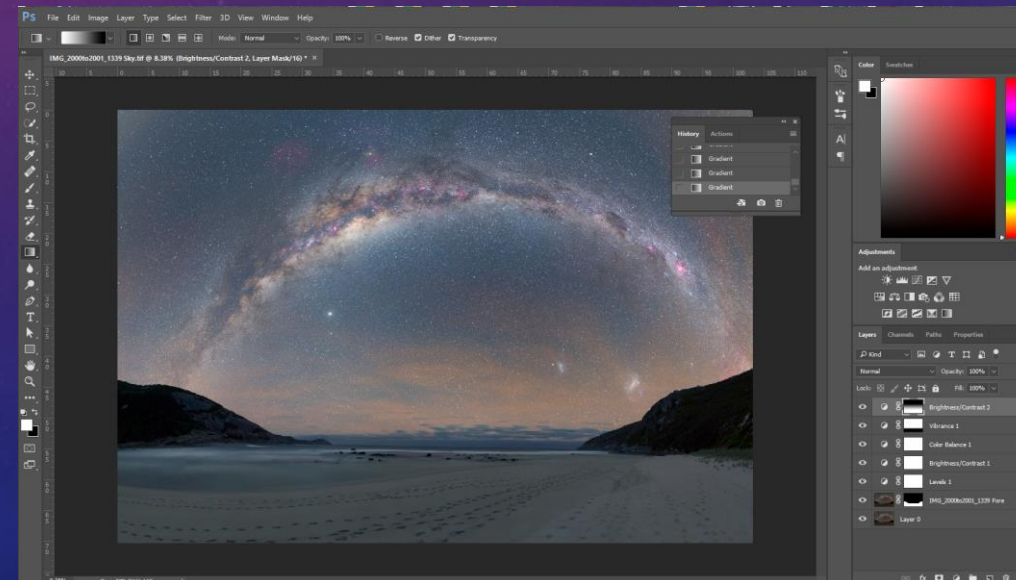
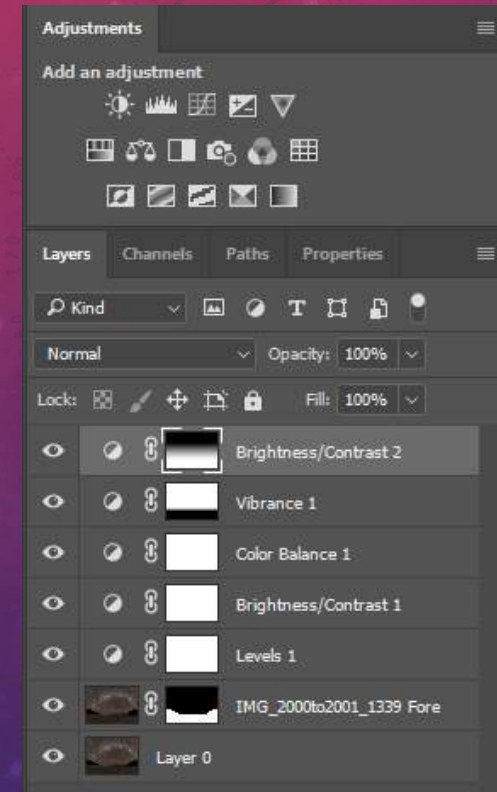
- Post-process your image(s).

## WHY

- As only minimal alterations have been done processing the RAW files, post-processing is required to improve the image.

## HOW

- Good software include **GIMP** (free) and **Photoshop** (paid).
- (optional) merge foreground and sky if using tracker
- Crop the image
- Adjust levels, brightness / contrast, and colour balance
- Add a little saturation
- Perform noise reduction



| SESSION | WHAT To do            |
|---------|-----------------------|
| PRIOR   | Plan Sky and Moon     |
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|         | Track Weather         |
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| DURING  | Choose Lens v Scene   |
|         | Camera Settings       |
|         | Focus                 |
|         | Start Shooting!!!     |
|         | *Polar Align          |
|         | *Multiple Panels      |
| POST    | *Shoot for Stacking   |
|         | RAW Processing        |
|         | *Stitching            |
|         | Basic Post-Processing |
|         | *Stacking             |

## WHAT

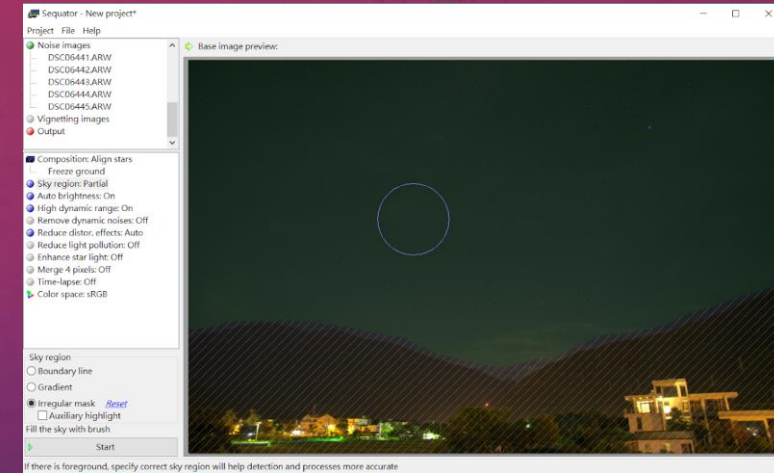
- (optional) Process multiple shots of the same view for “stacking”.

## WHY

- Reduce random thermal noise and increase signal to noise ratio by averaging multiple exposures.

## HOW

- Rather than take one shot (e.g. 1 x 30 seconds), take multiple shots (e.g. 3 x 20 seconds) of the same view.
- Use a program – e.g. **Sequator for Microsoft**, or **Starry Landscape Stacker** for Mac. These will stack your images to form one noise reduced image. They will also compensate for sky movement by aligning the stars before stacking.





# HOW TO DO DEEP SKY

| SESSION | WHAT To do        |
|---------|-------------------|
| PRIOR   | Plan Sky and Moon |
|         | Plan Framing      |
|         | Track Weather     |
|         | Think Safety      |
| DURING  | Plan Exposures    |
|         | Camera Settings   |
|         | Polar Align       |
|         | Focus             |
|         | Guiding           |
|         | Start Shooting!!! |
| POST    | *Dark Frames      |
|         | *Bias Frames      |
|         | *Flat Frames      |
|         | Stacking          |
|         | Stretching        |
|         | Post-Processing   |

*Astronomy's much more fun when you're not an astronomer.*

*Brian May*

The Blue Horsehead Nebula  
Camera: Canon EOS6D modified  
Optics: Williams Optic Redcat 51 250mm  
Image: 1 x panel @ 32 x ISO800, 360s

|         |                   |
|---------|-------------------|
| SESSION | WHAT To do        |
|         | Plan Sky and Moon |
| PRIOR   | Plan Framing      |
|         | Track Weather     |
|         | Think Safety      |
| DURING  | Plan Exposures    |
|         | Camera Settings   |
|         | Polar Align       |
|         | Focus             |
|         | Guiding           |
|         | Start Shooting!!! |
| POST    | *Dark Frames      |
|         | *Bias Frames      |
|         | *Flat Frames      |
|         | Stacking          |
|         | Stretching        |
|         | Post-Processing   |

## WHAT – Similar to Nightscapes

- Plan the date / time of your session based on the orientation of the night sky and moon.

## WHY

- Deep Sky photography is best when there is no moon in the sky (option to use narrowband filters otherwise).
- Make sure the target is greater than 30 degrees above the horizon during the entire session to avoid imaging through atmosphere.

## HOW

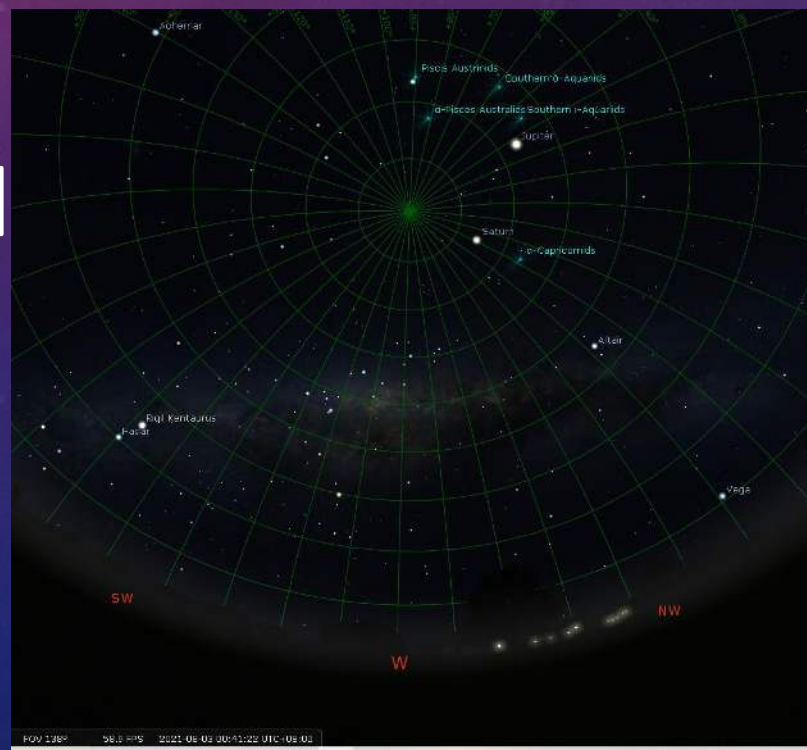
- Use a software tool to determine days when there is no moon in the sky - e.g. [www.timeanddate.com](http://www.timeanddate.com) (free)
- Use a software tool to determine the orientation of the night sky on the target night - e.g. [Stellarium](http://Stellarium) (free)

**Moonrise, Moonset, and Phase Calendar for Perth, August 2021**

Month: August Year: 2021

| 2021 Aug | Moonrise        | Moonset         | Moonrise | Meridian Passing | Time    | Distance (km) | Illumination |
|----------|-----------------|-----------------|----------|------------------|---------|---------------|--------------|
| 1        | 12:45 am (75°)  | 11:54 am (287°) | -        | 6:22 am (43.8°)  | 403,214 | 46.5%         |              |
| 2        | 1:41 am (70°)   | 12:26 pm (292°) | -        | 7:06 am (39.5°)  | 404,333 | 36.9%         |              |
| 3        | 2:37 am (65°)   | 1:02 pm (296°)  | -        | 7:51 am (35.9°)  | 404,133 | 27.8%         |              |
| 4        | 3:33 am (62°)   | 1:44 pm (299°)  | -        | 8:40 am (33.3°)  | 402,714 | 19.4%         |              |
| 5        | 4:29 am (60°)   | 2:31 pm (301°)  | -        | 9:30 am (31.9°)  | 400,260 | 12.2%         |              |
| 6        | 5:22 am (59°)   | 3:23 pm (300°)  | -        | 10:22 am (31.7°) | 397,023 | 6.4%          |              |
| 7        | 6:12 am (60°)   | 4:21 pm (299°)  | -        | 11:15 am (32.9°) | 393,291 | 2.3%          |              |
| 8        | 6:57 am (63°)   | 5:22 pm (295°)  | -        | 12:08 pm (35.5°) | 389,353 | 0.3%          |              |
| 9        | 7:38 am (68°)   | 6:25 pm (290°)  | -        | 12:58 pm (39.4°) | 385,470 | 0.6%          |              |
| 10       | 8:14 am (73°)   | 7:28 pm (284°)  | -        | 1:48 pm (44.3°)  | 381,844 | 3.3%          |              |
| 11       | 8:48 am (79°)   | 8:31 pm (277°)  | -        | 2:36 pm (49.9°)  | 378,606 | 8.5%          |              |
| 12       | 9:20 am (86°)   | 9:34 pm (270°)  | -        | 3:23 pm (56.0°)  | 375,819 | 15.8%         |              |
| 13       | 9:51 am (94°)   | 10:38 pm (263°) | -        | 4:10 pm (62.3°)  | 373,500 | 25.1%         |              |
| 14       | 10:24 am (101°) | 11:44 pm (256°) | -        | 5:00 pm (68.4°)  | 371,646 | 35.9%         |              |

12:00 am  
Altitude -21°  
Heading - 82° E  
Position Moon under horizon



| SESSION | WHAT To do        |
|---------|-------------------|
| PRIOR   | Plan Sky and Moon |
|         | Plan Framing      |
|         | Track Weather     |
|         | Think Safety      |
| DURING  | Plan Exposures    |
|         | Camera Settings   |
|         | Polar Align       |
|         | Focus             |
|         | Guiding           |
|         | Start Shooting!!! |
| POST    | *Dark Frames      |
|         | *Bias Frames      |
|         | *Flat Frames      |
|         | Stacking          |
|         | Stretching        |
|         | Post-Processing   |

## WHAT

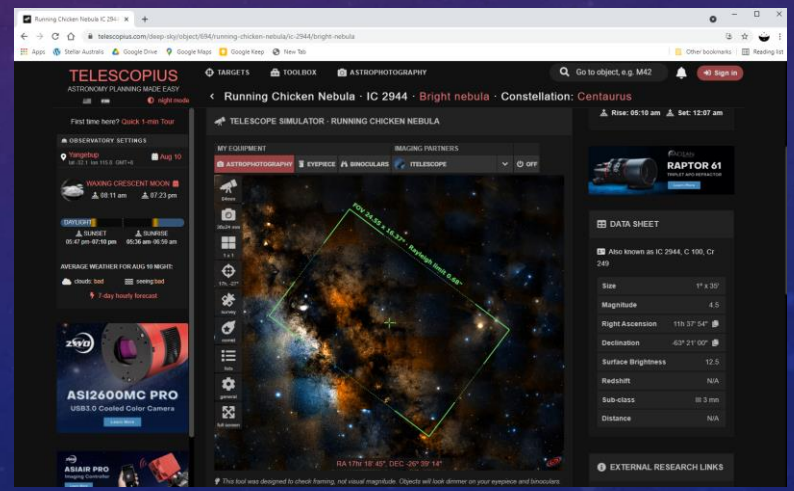
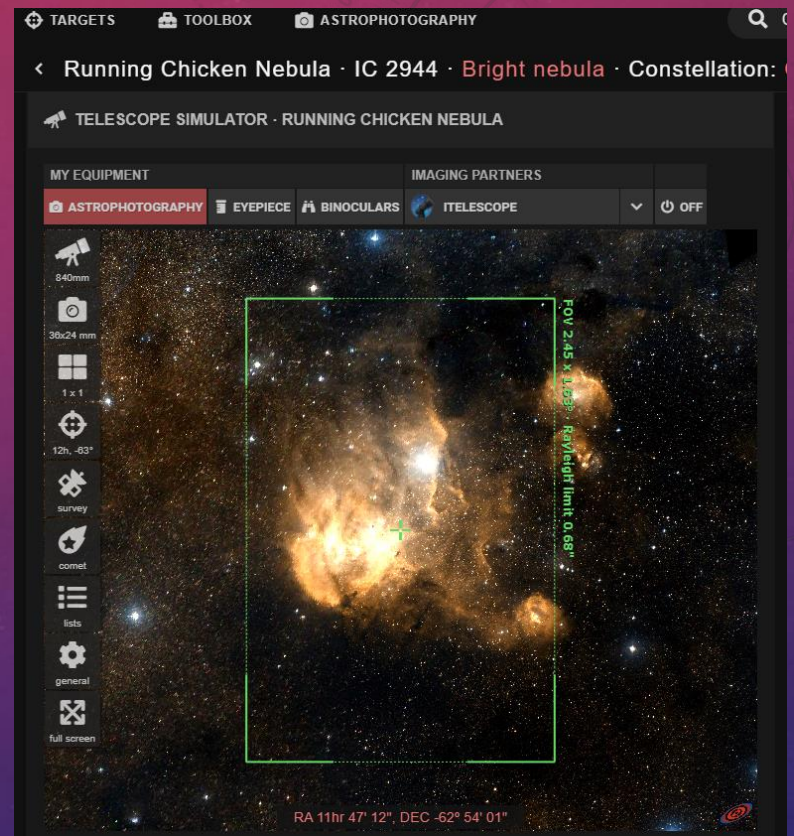
- Check the orientation and field of view for your images.

## WHY

- For beginners, the scale of objects in the night sky are and unknown and therefore there is uncertainty whether your lens / telescope is appropriate for it.

## HOW

- Without a doubt, [www.telescopius.com](http://www.telescopius.com) (free) is a brilliant tool to perform framing.
- Its even fun to scan the skies at your chosen field of view just to see what targets would suit.



|         |                   |
|---------|-------------------|
| SESSION | WHAT To do        |
|         |                   |
| PRIOR   | Plan Sky and Moon |
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| DURING  | Plan Exposures    |
|         | Camera Settings   |
|         | Polar Align       |
|         | Focus             |
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|         | *Bias Frames      |
|         | *Flat Frames      |
|         | Stacking          |
|         | Stretching        |
|         | Post-Processing   |

## WHAT – Similar to Nightscapes

- In day(s) leading up to the planned session, track the weather.

## WHY

- For most astrophotography, the night skies must be clear of clouds (or mostly cleared of clouds) – otherwise you can't see the night sky.
- Especially for telescopes – dew is a factor. If there is a good chance of dew then some thermal management will be required.

## HOW

- At less than a week, periodically check forecasts at your planned location, or short list of locations. E.g. [www.clearoutside.com](http://www.clearoutside.com) (free website).
- At less than a day, check BOM high definition satellite imagery to confirm the forecasts. E.g. BOM [www.bom.gov.au](http://www.bom.gov.au) (free website).
- A dedicated website for astrophotography weather forecast is [www.cloudfreenight.com](http://www.cloudfreenight.com) (free subscription)



Image credit: Astrobackyard

|         |                   |
|---------|-------------------|
| SESSION | WHAT<br>To do     |
| PRIOR   | Plan Sky and Moon |
|         | Plan Framing      |
|         | Track Weather     |
|         | Think Safety      |
| DURING  | Plan Exposures    |
|         | Camera Settings   |
|         | Polar Align       |
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|         | *Bias Frames      |
|         | *Flat Frames      |
|         | Stacking          |
|         | Stretching        |
|         | Post-Processing   |

## WHAT – Similar to Nightscapes

- Think about your safety first.

## WHY

- No photography is worth embarrassment (if you get lost), or at worse, your life.

## HOW

- Tell someone where you are going and for how long.
- Ensure you plan your trip, particularly around fatigue management when driving. Beware of animals when driving at night in remote locations.
- Bring plenty of water.
- The GPS on your mobile is your friend, ensure that it is charged and on you at all times.
- Bring / wear warm clothes, torch, and head-torch.
- If you are uncomfortable going out alone – share the experience with a friend, or go out with other like-minded photographers.



| SESSION | WHAT To do        |
|---------|-------------------|
| PRIOR   | Plan Sky and Moon |
|         | Plan Framing      |
|         | Track Weather     |
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| DURING  | Plan Exposures    |
|         | Camera Settings   |
|         | Polar Align       |
|         | Focus             |
|         | Guiding           |
|         | Start Shooting!!! |
|         | POST              |
|         | *Bias Frames      |
|         | *Flat Frames      |
|         | Stacking          |
|         | Stretching        |
|         | Post-Processing   |

## WHAT

- Plan how many exposures and for how long per target.

## WHY

- Deep Sky is all about **Signal-to-Noise** ratio!
- How to increase **signal**: bigger apertures, longer exposures
- How to decrease **noise**: stacking multiple images, using calibration frames, cooling your camera sensor, better sensors (higher quantum efficiency), etc.
- Most parameters are set by your equipment, so stacking is your best option to improve S/N.

## HOW

- There are multiple stacking algorithms, but the best ones require > 20 images (e.g. GESD)
- Plan how long you want to spend on your target and divide it by at least 20 to get your exposure time.
- However, is the calculated exposure time enough though??? It must be long enough to capture a signal!



For example, I want to spend 3 hours shooting the Lagoon nebula.

Therefore:  $3 \times 60\text{min} / 20 = 9 \text{ min exposures.}$

| SESSION | WHAT To do        |
|---------|-------------------|
| PRIOR   | Plan Sky and Moon |
|         | Plan Framing      |
|         | Track Weather     |
| DURING  | Think Safety      |
|         | Plan Exposures    |
|         | Camera Settings   |
|         | Polar Align       |
|         | Focus             |
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|         | *Bias Frames      |
|         | *Flat Frames      |
|         | Stacking          |
|         | Stretching        |
|         | Post-Processing   |

## WHAT

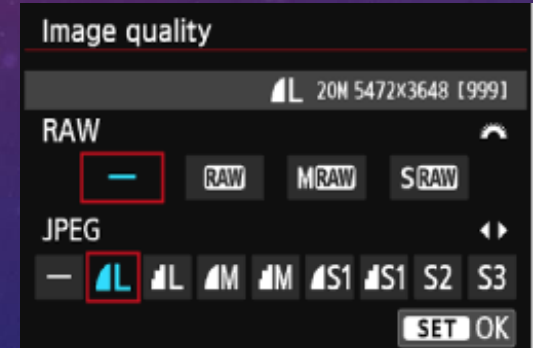
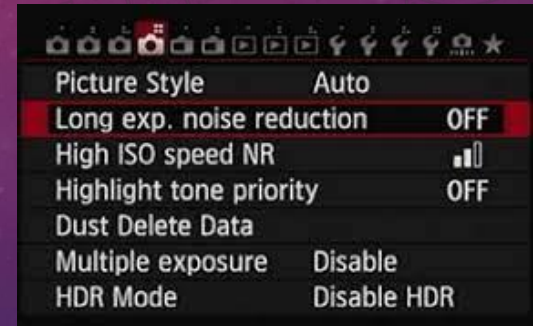
- Alter your camera settings for shooting deep sky (assumes use of a DSLR).

## WHY

- You'll typically need to shoot longer than 30 secs, so the camera will need to be externally triggered.
- Will need to capture a series of long exposures and save them in uncompressed format.

## HOW

- Set camera to BULB mode.
- Turn off any long exposure noise reduction features.
- Set image format to RAW, or RAW + JPEG.
- Use mirror lock-up.
- Set ISO to your camera's best low light setting, usually between 800 to 3200. Avoid extended ISO ranges.
- Set white balance to anything but auto.



| SESSION | WHAT To do        |
|---------|-------------------|
| PRIOR   | Plan Sky and Moon |
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| DURING  | Plan Exposures    |
|         | Camera Settings   |
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|         | *Flat Frames      |
|         | Stacking          |
|         | Stretching        |
|         | Post-Processing   |

## WHAT

- Must align mount with the Southern Celestial Pole

## WHY

- Errors in alignment will show up as small trails in stars, even when guiding (due to field rotation).

## HOW

- Can use the “Apus” method similar to the procedure explained under nightscapes.
- There are more automated methods that can assist, e.g. **Asiair Pro**.





|         |                   |
|---------|-------------------|
| SESSION | WHAT<br>To do     |
|         |                   |
| PRIOR   | Plan Sky and Moon |
|         | Plan Framing      |
|         | Track Weather     |
|         | Think Safety      |
| DURING  | Plan Exposures    |
|         | Camera Settings   |
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|         | Start Shooting!!! |
| POST    | *Dark Frames      |
|         | *Bias Frames      |
|         | *Flat Frames      |
|         | Stacking          |
|         | Stretching        |
|         | Post-Processing   |

## WHAT

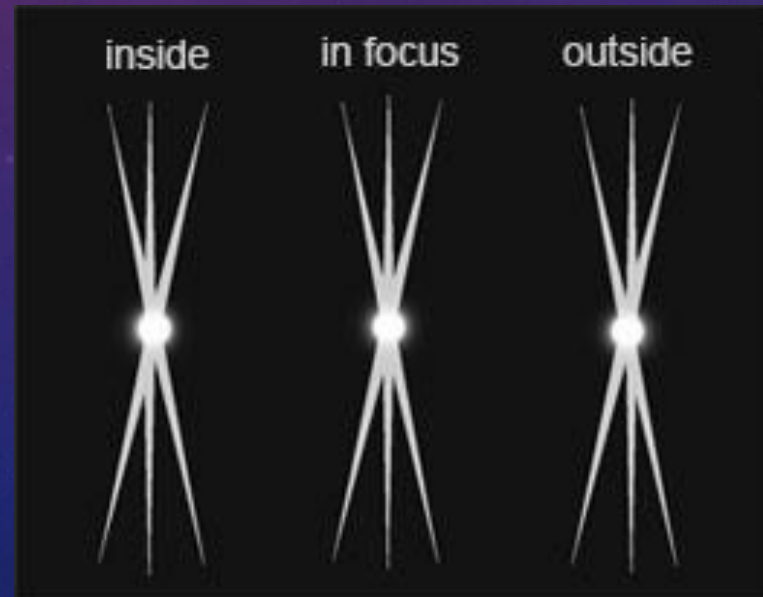
- Ensure you take time to focus properly on stars

## WHY

- It can be difficult to see in your camera screen if your photos are blurry or not.

## HOW

- One method is to turn on “live view” and point the camera at a bright star. Zoom in on the star in live view and manually focus to get the star nice and sharp.
- For more accuracy, use a Bahtinov mask.
  - Put the camera into live view center and zoom on a bright star.
  - Place the mask temporarily in front of your telescope or lens
  - The mask creates three angled lines for any point light source. Adjust focus so that the lines intersect each other at one point.



| SESSION | WHAT To do        |
|---------|-------------------|
| PRIOR   | Plan Sky and Moon |
|         | Plan Framing      |
|         | Track Weather     |
|         | Think Safety      |
| DURING  | Plan Exposures    |
|         | Camera Settings   |
|         | Polar Align       |
|         | Focus             |
|         | Guiding           |
| POST    | Start Shooting!!! |
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|         | *Bias Frames      |
|         | *Flat Frames      |
|         | Stacking          |
|         | Stretching        |
|         | Post-Processing   |

## WHAT

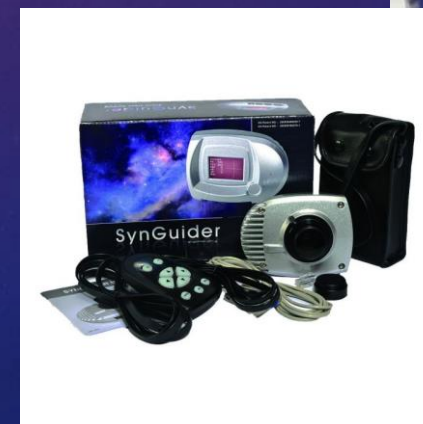
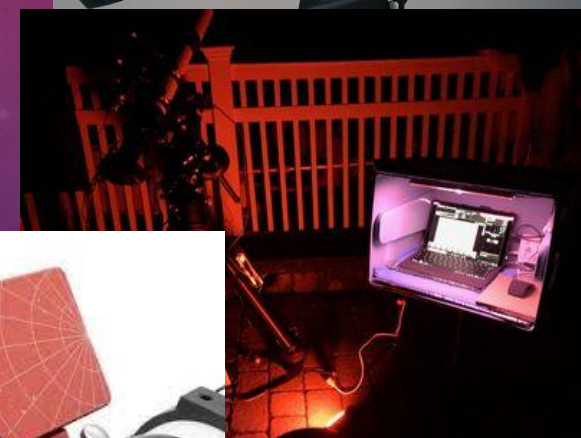
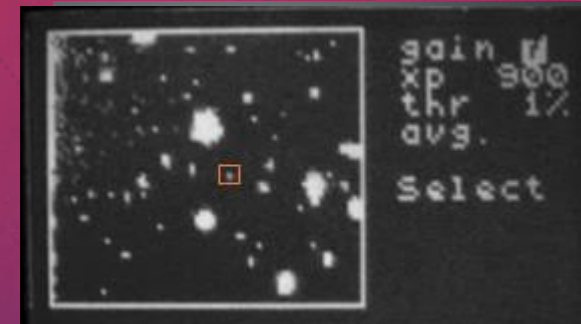
- Use the guider and guidescope (for on-axis guiders) to lock onto a “guide” star and start guiding the telescope.

## WHY

- At long focal lengths and / or long exposures, a tracking mount isn't sufficient.
- A guider uses a separate sensor to lock on to a star and provide corrections to the tracking mount.

## HOW

- Focus the guidescope (for on axis guiders)
- Use the guiding computer to lock on to a star that's in or close to the field of view of the main telescope.
- Guiding can be done by laptops with software (e.g. **Backyard EOS** or **PHD2**), smart device (e.g. **AsiAir**) or stand-alone “auto-guiders” (e.g. **Synguider** or **MGEN**)
- Initiate guiding calibration (automatic process)
- Start guiding.
- User “dither” functionality if available.



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| POST    | *Dark Frames      |
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|         | Stacking          |
|         | Stretching        |
|         | Post-Processing   |

START SHOOTING!!!

*My dear Kepler, what would you say of the learned here, who, replete with the pertinacity of the asp, have steadfastly refused to cast a glance through the telescope? What shall we make of this? Shall we laugh, or shall we cry?*

*Galileo Galilei*

California Nebula  
 Camera: Canon EOS6D modified  
 Optics: Skywatcher Esprit 120ED  
 Image: 1 x panel @ 25 x ISO800, 300s

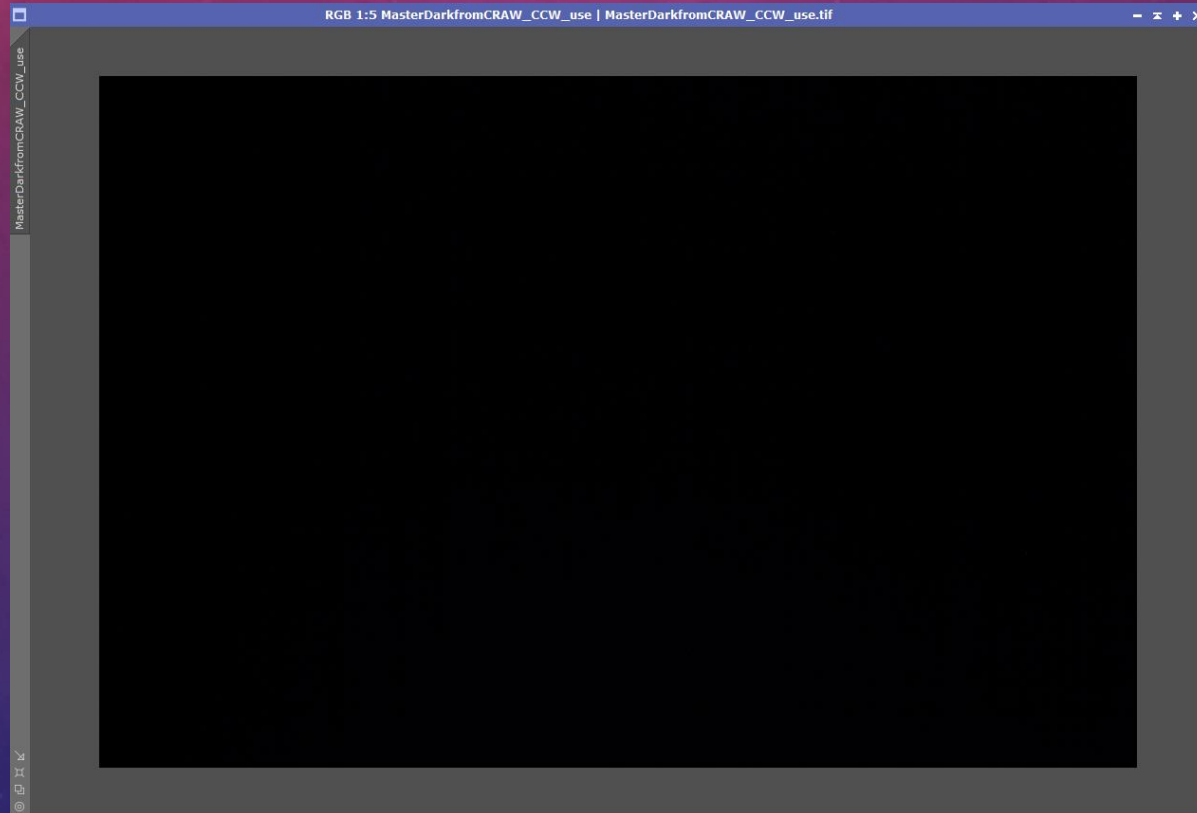
| SESSION      | WHAT To do        |
|--------------|-------------------|
| PRIOR        | Plan Sky and Moon |
|              | Plan Framing      |
|              | Track Weather     |
|              | Think Safety      |
| DURING       | Plan Exposures    |
|              | Camera Settings   |
|              | Polar Align       |
|              | Focus             |
|              | Guiding           |
|              | Start Shooting!!! |
|              | *Dark Frames      |
| *Bias Frames |                   |
| *Flat Frames |                   |
| POST         | Stacking          |
|              | Stretching        |
|              | Post-Processing   |

## WHAT

- (Optional) Prepare DARK calibration frames.

## WHY

- In addition to thermal noise, non-random fixed pattern noise, hot pixels, and amp glow produced by the sensor increase due to long exposure, ISO, and temperature.



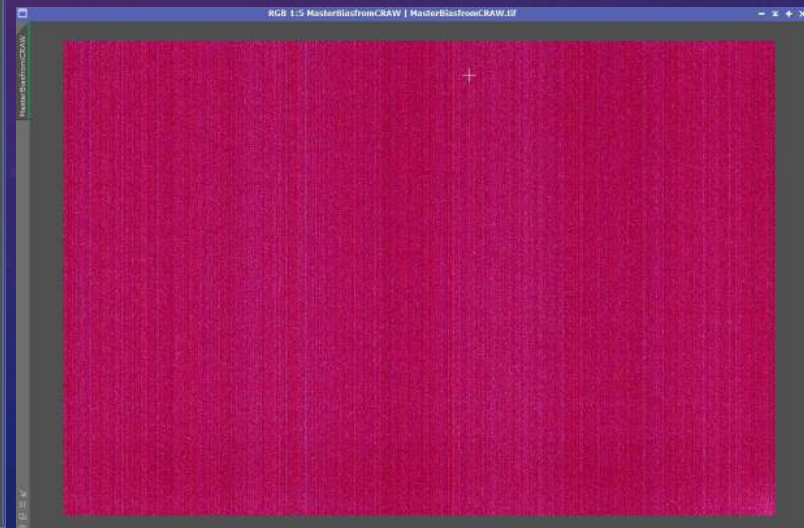
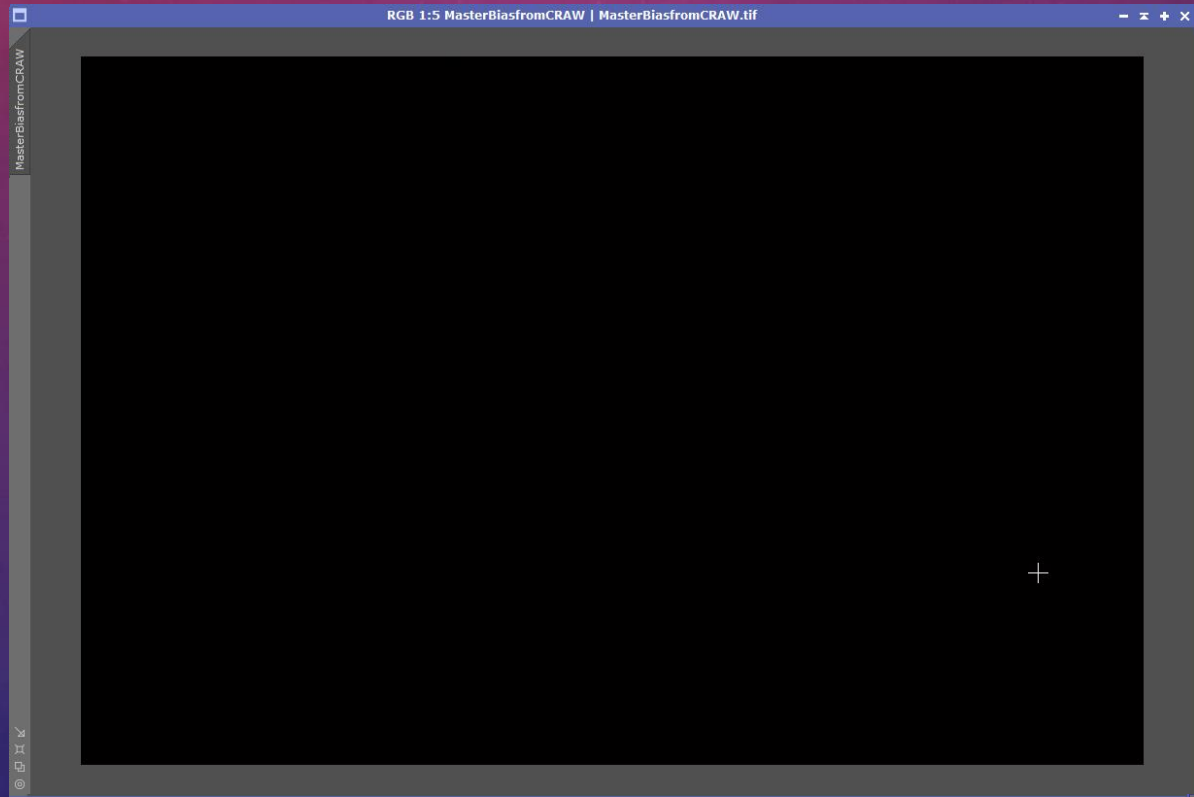
| SESSION         | WHAT To do        |
|-----------------|-------------------|
| PRIOR           | Plan Sky and Moon |
|                 | Plan Framing      |
|                 | Track Weather     |
|                 | Think Safety      |
| DURING          | Plan Exposures    |
|                 | Camera Settings   |
|                 | Polar Align       |
|                 | Focus             |
|                 | Guiding           |
|                 | Start Shooting!!! |
|                 | POST              |
| *Bias Frames    |                   |
| *Flat Frames    |                   |
| Stacking        |                   |
| Stretching      |                   |
| Post-Processing |                   |

## WHAT

- (Optional) Prepare BIAS calibration frames.

## WHY

- A camera sensor has an inherent “read-out” noise when reading each individual pixel (i.e. variations in reading each pixel even if they receive the same light).



| SESSION | WHAT To do        |
|---------|-------------------|
| PRIOR   | Plan Sky and Moon |
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## WHAT

- (Optional) Prepare FLAT calibration frames.

## WHY

- Given the same quantity of light, path through your optics will produce varying light read by your pixels due to lens vignetting, dust motes, etc.

## HOW

- Keeping your equipment set-up the same, cover or point the telescope at a uniformly illuminated light source (e.g. a light box / panel or cover with white tee-shirt and point at the sky).
- Take > 20 shots ensuring that the captured images are not over-exposed.
- These flat frames can be included as part of the stacking process.
- Flat frames are subtracted from the “light” frames in processing.



|         |                   |
|---------|-------------------|
| SESSION | WHAT<br>To do     |
|         |                   |
| PRIOR   | Plan Sky and Moon |
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|         | Track Weather     |
|         | Think Safety      |
| DURING  | Plan Exposures    |
|         | Camera Settings   |
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## WHAT

- Stack our images!!!

## WHY

- Stacking our images improves our signal to noise ratio by averaging out our random noise.
- If calibration frames are included, we also reduce non-random noise.
- This allows us to really amplify the image to see dim objects like nebula without noise swamping our hard earned work.



Single RAW Image



Single Stretched Image



Stacked Stretched Image

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|         | *Flat Frames      |
|         | Stacking          |
|         | Stretching        |
|         | Post-Processing   |

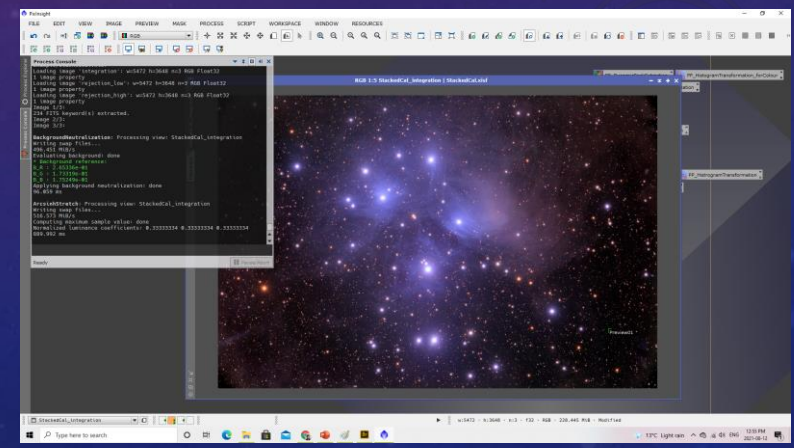
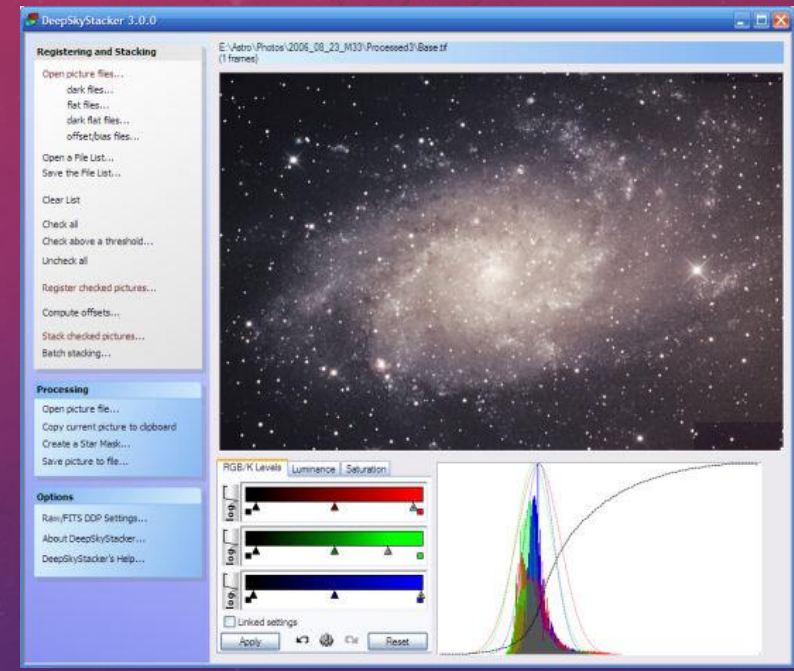




| SESSION         | WHAT To do        |
|-----------------|-------------------|
| PRIOR           | Plan Sky and Moon |
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|                 | Track Weather     |
| DURING          | Think Safety      |
|                 | Plan Exposures    |
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|                 | *Bias Frames      |
|                 | *Flat Frames      |
|                 | Stacking          |
| Stretching      |                   |
| Post-Processing |                   |

## HOW

- Use dedicated astrophotography software to perform stacking. E.g. **DeepSkyStacker** (free), **Pixinsight** (paid), many others.
- In the chosen software, simply add the Light frames, and optionally, your Dark, Bias, and Flat frames.
- The software will align the stars and perform all the complex processing for you.
- And then you will get this!



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|         | Stacking          |
|         | Stretching        |
|         | Post-Processing   |

## WHAT

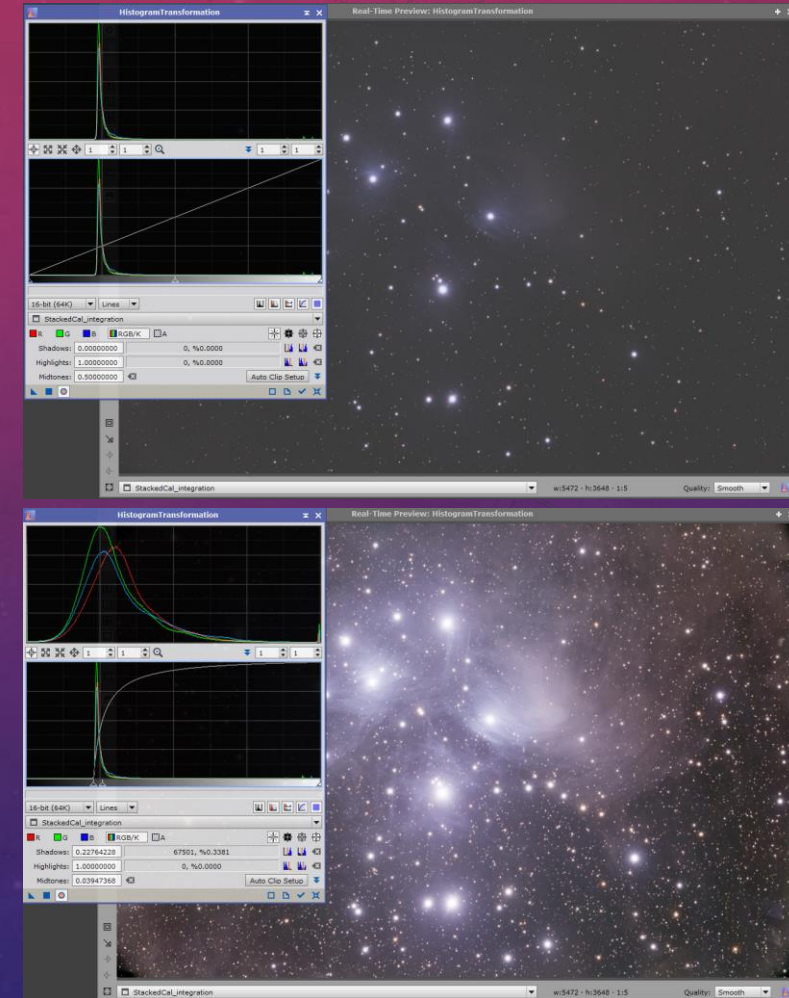
- Stretch the image to convert from linear to non-linear.

## WHY

- Most of our dim object is in the 2-5% of our histogram.
- Stretching performs a non-linear mapping to get that 2-5% to be up to, say, 50% of the histogram.
- This essentially “brings out” the dim signal of faint objects.

## HOW

- Your astrophotography software will have this function. E.g. **DeepSkyStacker** (free), **Pixinsight** (paid)
- First neutralize the background of the image (colour balancing so that empty space is “black”. This can be done later if your software doesn’t have it.
- Use your software’s stretch function. This can be a manual function which you manipulate the histogram, or automatic.



|         |                   |
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## WHAT

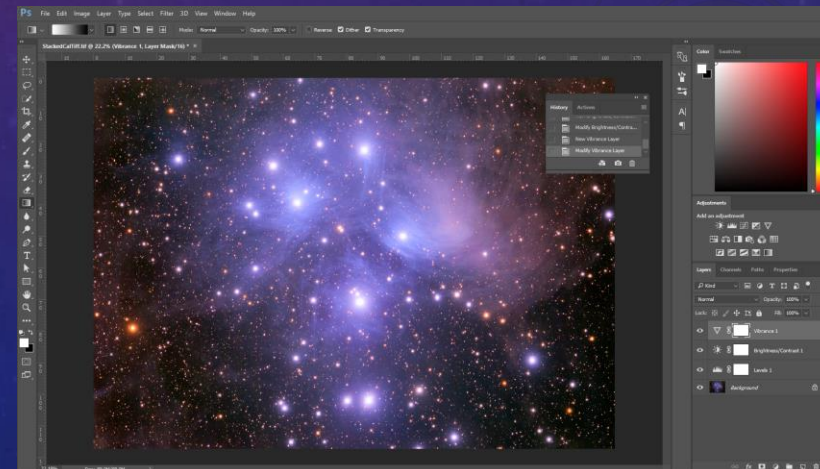
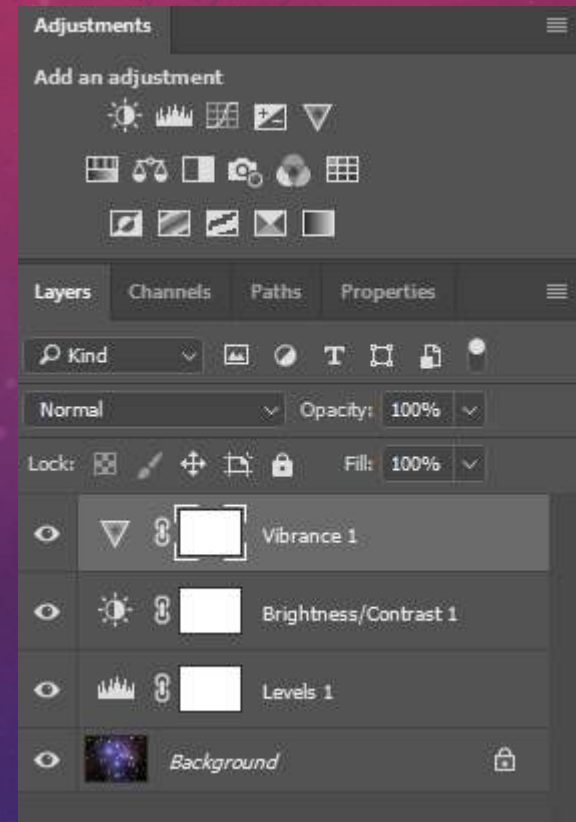
- Post-process your image(s).

## WHY

- You can do a lot of post-processing in your astrophotography software, but quick often its easiest to use a normal photo manipulation software.

## HOW

- Good software include **GIMP** (free) and **Photoshop** (paid).
- Crop the image
- Adjust levels, brightness / contrast, and colour balance
- Add a little saturation
- Perform noise reduction
- Sharpen (with star masking)





# ART VS PHOTOGRAPHY

## The big debate – what is “fake”?

- When does image manipulation turn a photograph into art? (mostly an issue with nightscapes).
- Is it when:
  - One manipulates colours, exposure, saturation, levels, etc to bring out the night sky?
  - One takes multiple photos one immediately after another to stitch together?
  - One takes a photo of the foreground at evening and then another photo of the sky at night and stitches them together?
  - One takes a photo of a foreground, and another of the different part of the sky at a different time and different location and stitches them together?
- You'll find many variations online.
- This session won't get into the debate too much – in the end it is for you to decide.
- My recommendation – be honest and up front with what techniques you used to produce your photograph / art.

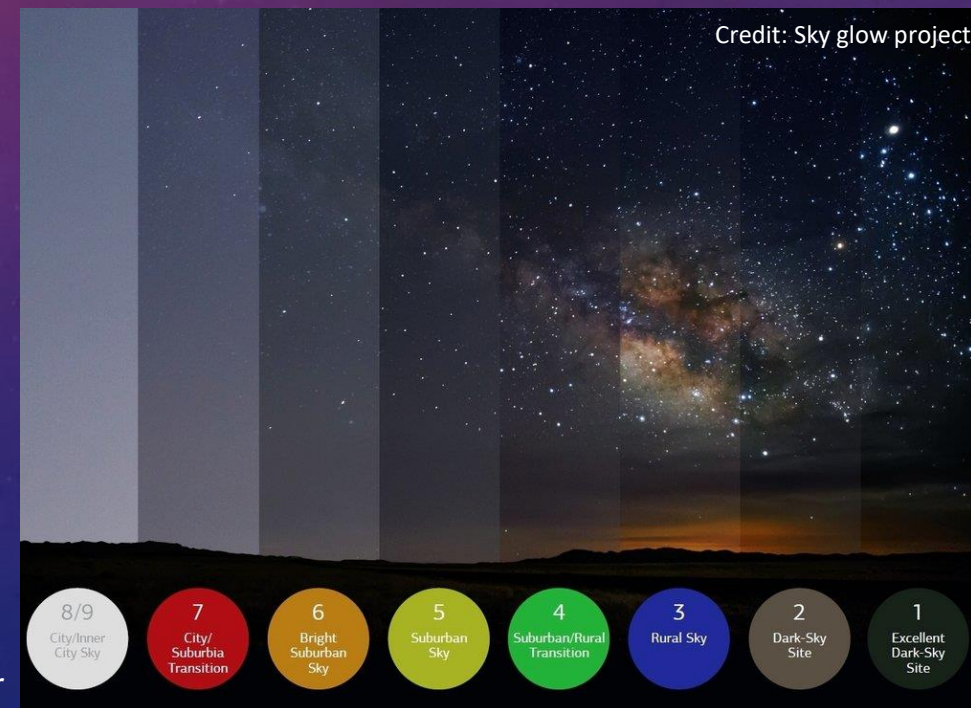
# DARK SKIES AND PRESERVATION

**But, but...it's the SKY. Its not going anywhere!**

- Light pollution is the “spilling” of light into the atmosphere causing the gas in the atmosphere to glow.
- This is called “sky glow” and if bright enough it can drown out the dim stars and nebula of the night sky.
- Light pollution impacts health of humans and animals, especially nocturnal wildlife, and disrupts ecosystems.
- It also leads to waste of large percentages of energy and the disruption of astronomical research.
- Light pollution runs counter to necessity for a green, sustainable future.



Credit: schoolsobservatory.org

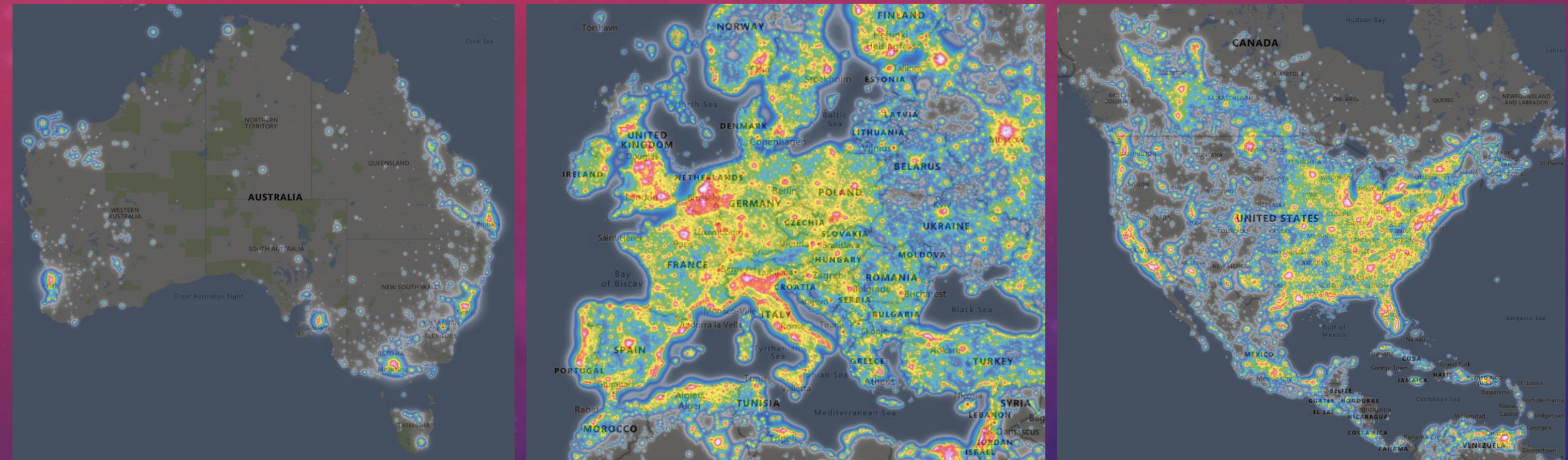


*Only in Darkness can you see the Stars.*

*Martin Luther King Jr*

# DARK SKIES AND PRESERVATION

Phew, thankfully we live in Australia!



Credit: Lightpollutionmap.org

- Over a third of the world's population cannot see the Milky Way.
- It is worse in developed nations – 80% of the population in the United States cannot see the Milky Way.

# DARK SKIES AND PRESERVATION

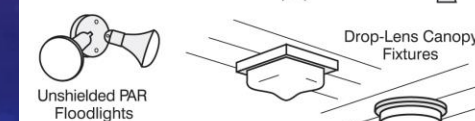
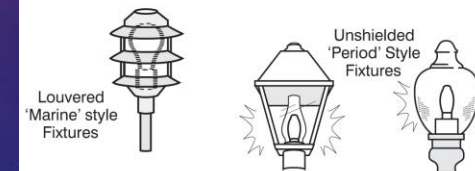
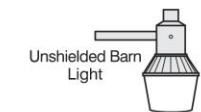
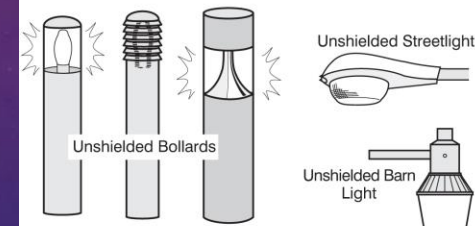
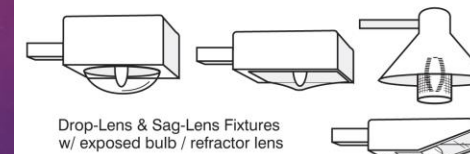
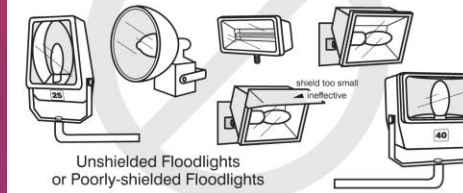
## So how do we preserve it?

- Of all the pollution we face, light pollution is perhaps the most easily remedied.
- Dark sky reserves and sanctuaries are being set-up around the world.
- Simple changes in lighting design and installation yield immediate changes in the amount of light spilled into the atmosphere and, often, immediate energy savings.
- Visit the International Dark Sky Association for more information [www.darksky.org](http://www.darksky.org)
- Locally, visit the Australian Dark Sky Alliance at [www.australasiandarkskyalliance.org](http://www.australasiandarkskyalliance.org)

## Examples of Acceptable / Unacceptable Lighting Fixtures

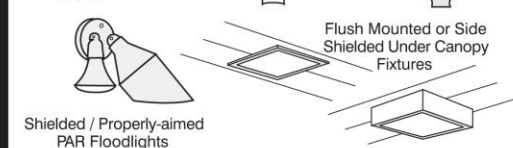
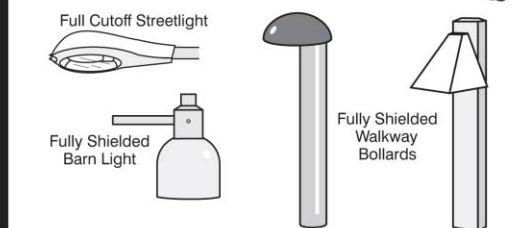
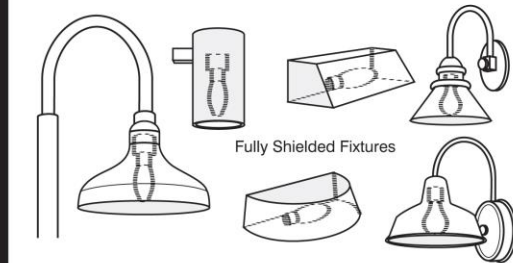
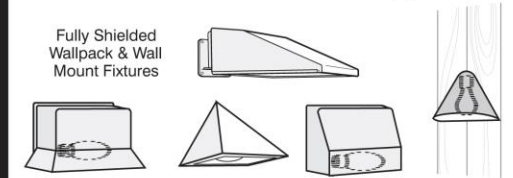
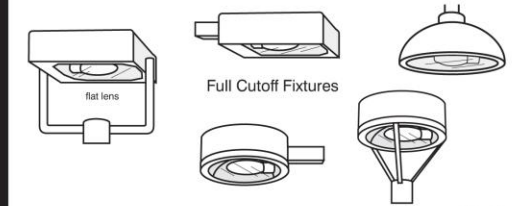
### Unacceptable / Discouraged

Fixtures that produce glare and light trespass



### Acceptable

Fixtures that shield the light source to minimize glare and light trespass and to facilitate better vision at night





# DARK SKIES AND PRESERVATION

**But, but...it's the SKY. Its not going anywhere!**

*Our fantastic civilization has fallen out of touch with many aspects of nature, and with none more completely than with night. Primitive folk, gathered at a cave mouth round a fire, do not fear night; they fear, rather, the energies and creatures to whom night gives power; we of the age of the machines, having delivered ourselves of nocturnal enemies, now have a dislike of night itself.*

*With lights and ever more lights, we drive the holiness and beauty of night back to the forests and the sea; the little villages, the crossroads. Are modern folk, perhaps, afraid of night? Do they fear that vast serenity, the mystery of infinite space, the austerity of stars? Having made themselves at home in a civilization obsessed with power, which explains its whole world in terms of energy, do they fear at night for their dull acquiescence and the pattern of their beliefs?*

*Be the answer what it will, today's civilization is full of people who have not the slightest notion of the character or the poetry of night, who have never even seen night. Yet to live thus, to know only artificial night, is as absurd as to know only artificial day.*

— Henry Beston, *The Outermost House*, 1928

# THANK YOU

CONTACT DETAILS / WHERE TO GO FOR MORE INFORMATION

Website: [www.stellaraustralis.com](http://www.stellaraustralis.com)  
Facebook: [www.facebook.com/stellaraustralis/](http://www.facebook.com/stellaraustralis/)  
Instagram: [www.instagram.com/wvrbasso/](http://www.instagram.com/wvrbasso/)  
Twitter: [twitter.com/StellarAustral1](http://twitter.com/StellarAustral1)  
Email: [housevrbasso77713m@gmail.com](mailto:housevrbasso77713m@gmail.com)

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