A cardboard solar projection box

By Bob Oseman, Mid-Kent Astronomical Society

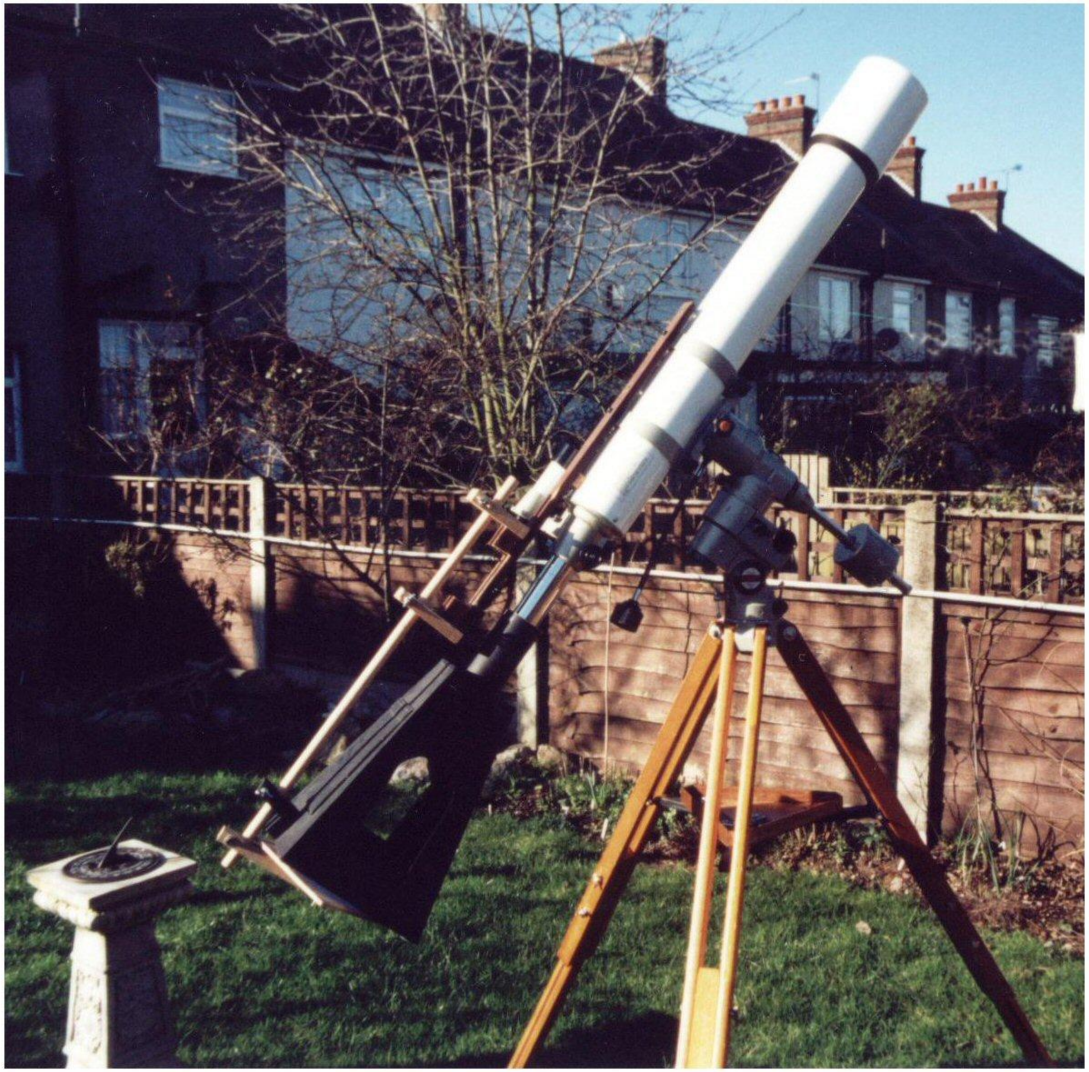
Figure 1a. Vixen GP102M, with solar projection box

I possess a Vixen GP102 refractor, which uses the Vixen Great Polaris equatorial mount and whilst I'd used a Baader Astrofilm filter to observe sunspots directly, this didn't enable me to produce sunspot drawings with reasonable precision. A projection box was called for, one that was robust, rigid, yet light in weight.

This article describes a solar observation box, built using using cardboard. Having been a model maker all my life, I've learned that cardboard of an appropriate thickness, properly braced and glued can be used to make very strong, robust structures, capable of standing up to quite rough handling. It has the added benefit of being easy to handle, requiring simple tools and fixings in construction.

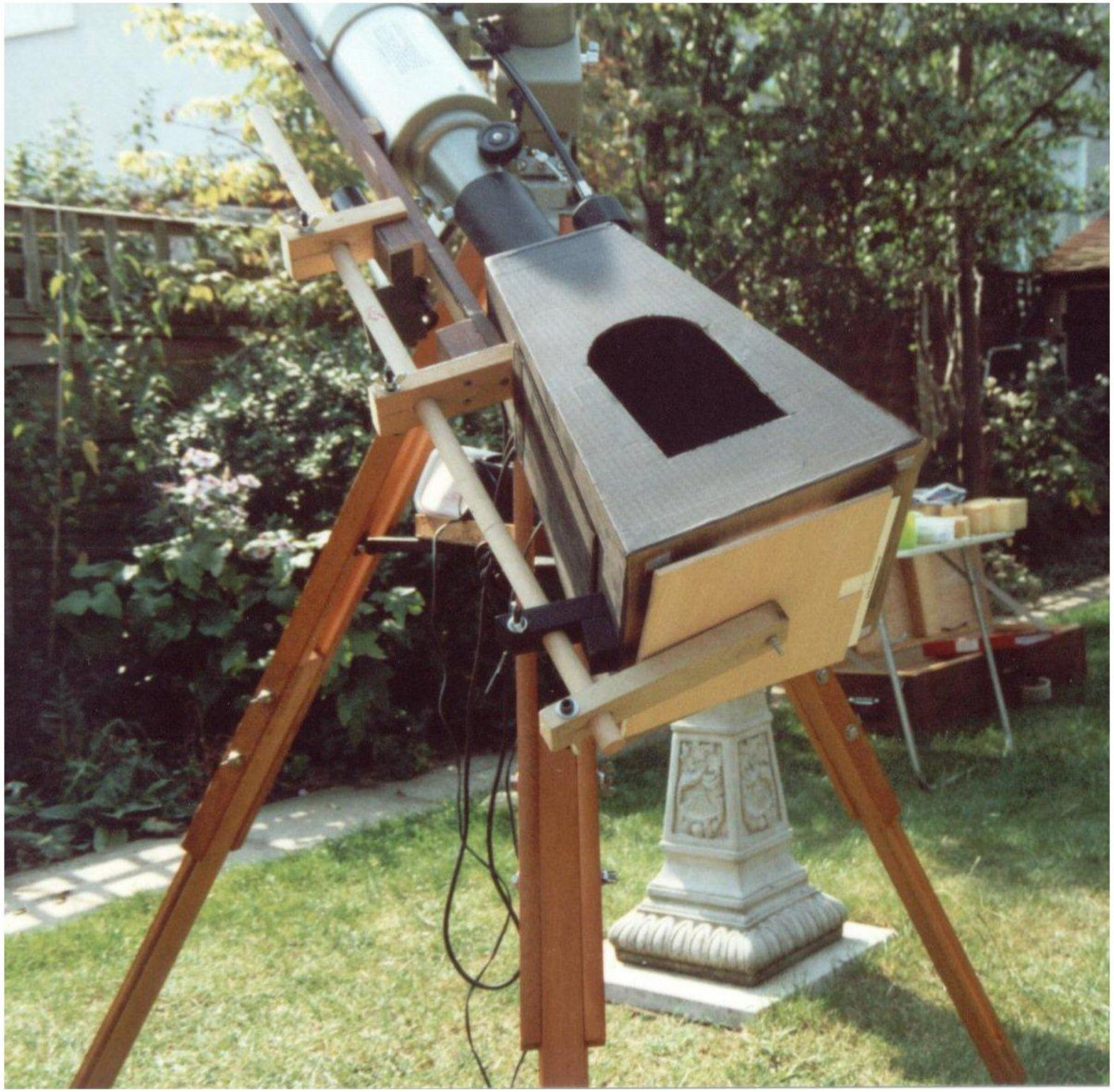
Practically all consumer goods are transported nowadays in cardboard boxes. From bananas and televisions, apples to freezers, cardboard boxes and cartons provide the first layer of protection to a wide range of goods that may travel many hundreds of miles from manufacturer to the purchaser. The boxes must therefore be designed and constructed for robustness and strength and are usually formed from a sandwich of a layer of thick brown paper surrounding a layer of corrugated cardboard.

Figure 1b. Vixen GP102M, with solar projection box



An alternative view.

Figure 2. Closeup of solar projection box



The Hovermower box

The inspiration for my projection box was the redundant box that had contained a hovermower. The box material couldn't be too heavy, for obvious reasons. Neither should it sag. The hovermower box was just right.

Figure 2 shows the completed projection box, with one of the viewing apertures open.

Why a Box?

Several designs for solar projection have been published in recent months describing simple and effective designs that can be made simply and quickly. However, they are of open construction and, whilst good for "public" displays, I found that small spots will be missed in the high ambient light surrounding the projected solar image and you will be unable to draw a complete picture of the Sun on that day. By "complete" I mean as complete a picture as you, your equipment and seeing conditions will allow.

Viewing Apertures

Because the orientation of the telescope and box will vary considerably as the angle of the Sun changes with the time of day and the viewing circumstances, it was necessary to cut observation windows in all four sides of the box to allow the Sun's image to be seen from any direction.

Rotating Screen

The screen-holder was made to rotate, so that the grid on the screen could be aligned with the diurnal motion of the Sun. It also makes for ease of locating sunspots on your drawing.

Figure 3. Closeup of solar projection box

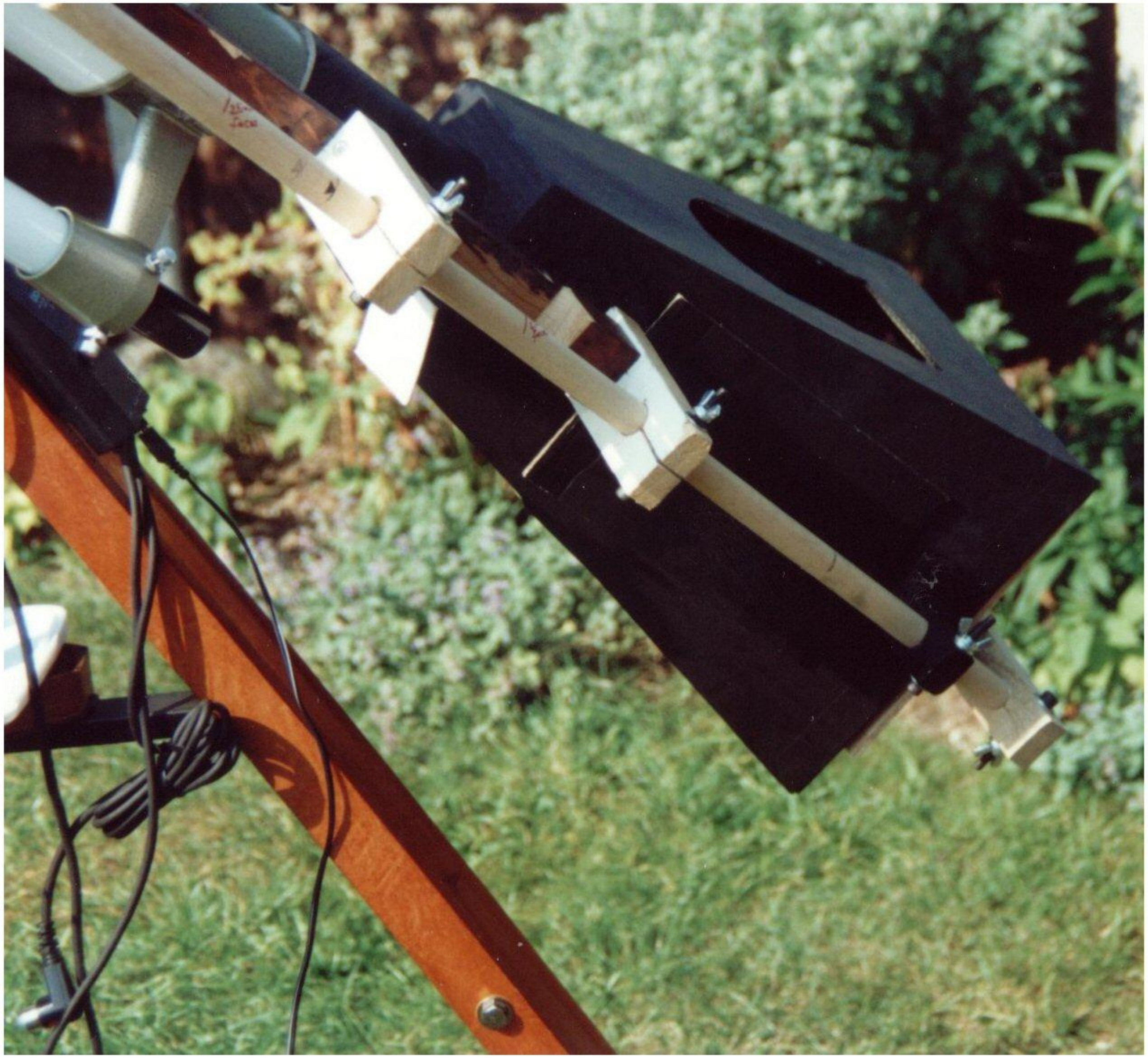


Fig. 4. Fixing the projection box to the telescope

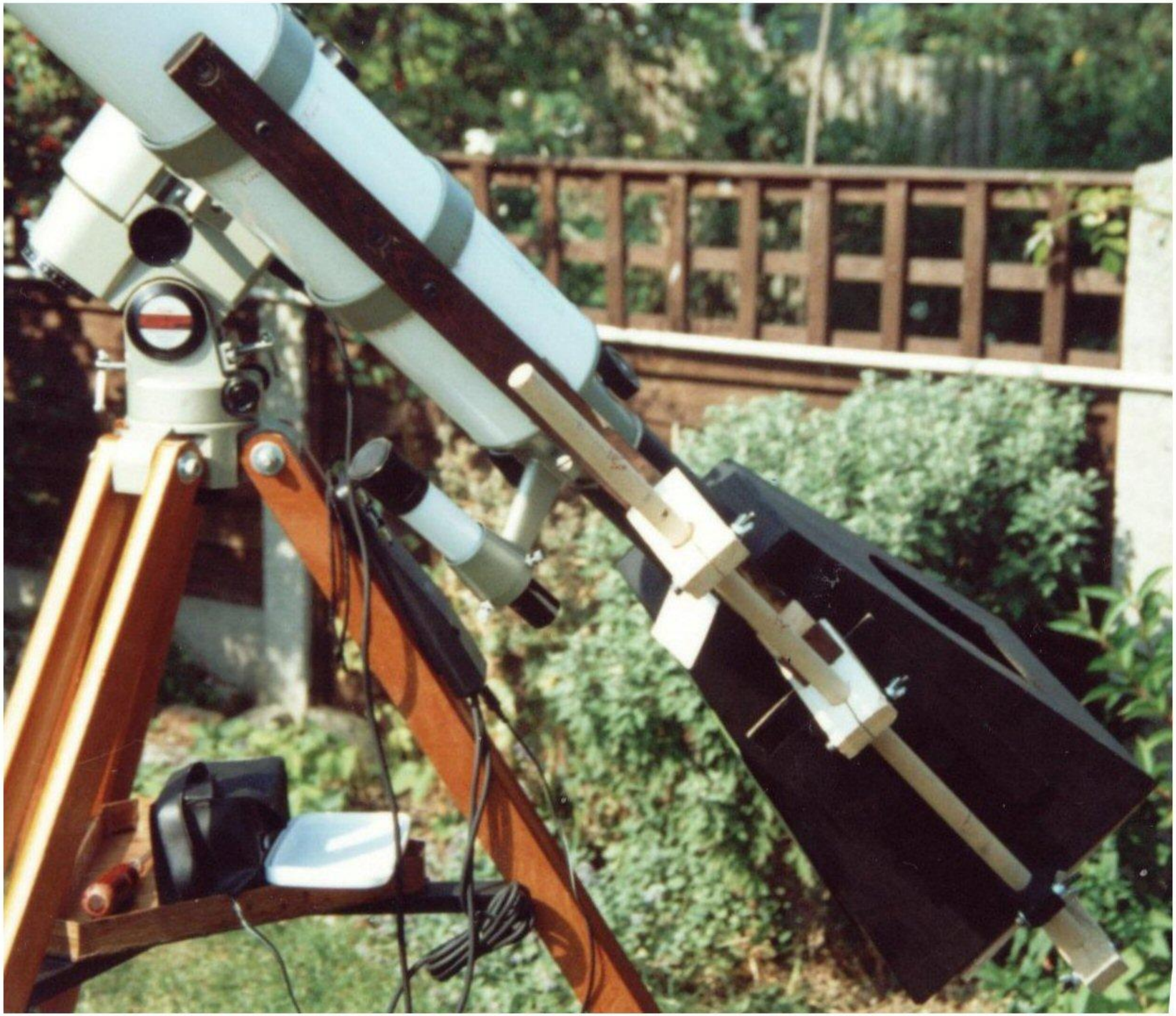


Fig. 5a. Closeup showing observing apertures
and rotating screen holder

Screen
slotted
in holder

Rotating screen holder

Fig. 5b. Detail showing rotating screen holder, with screen

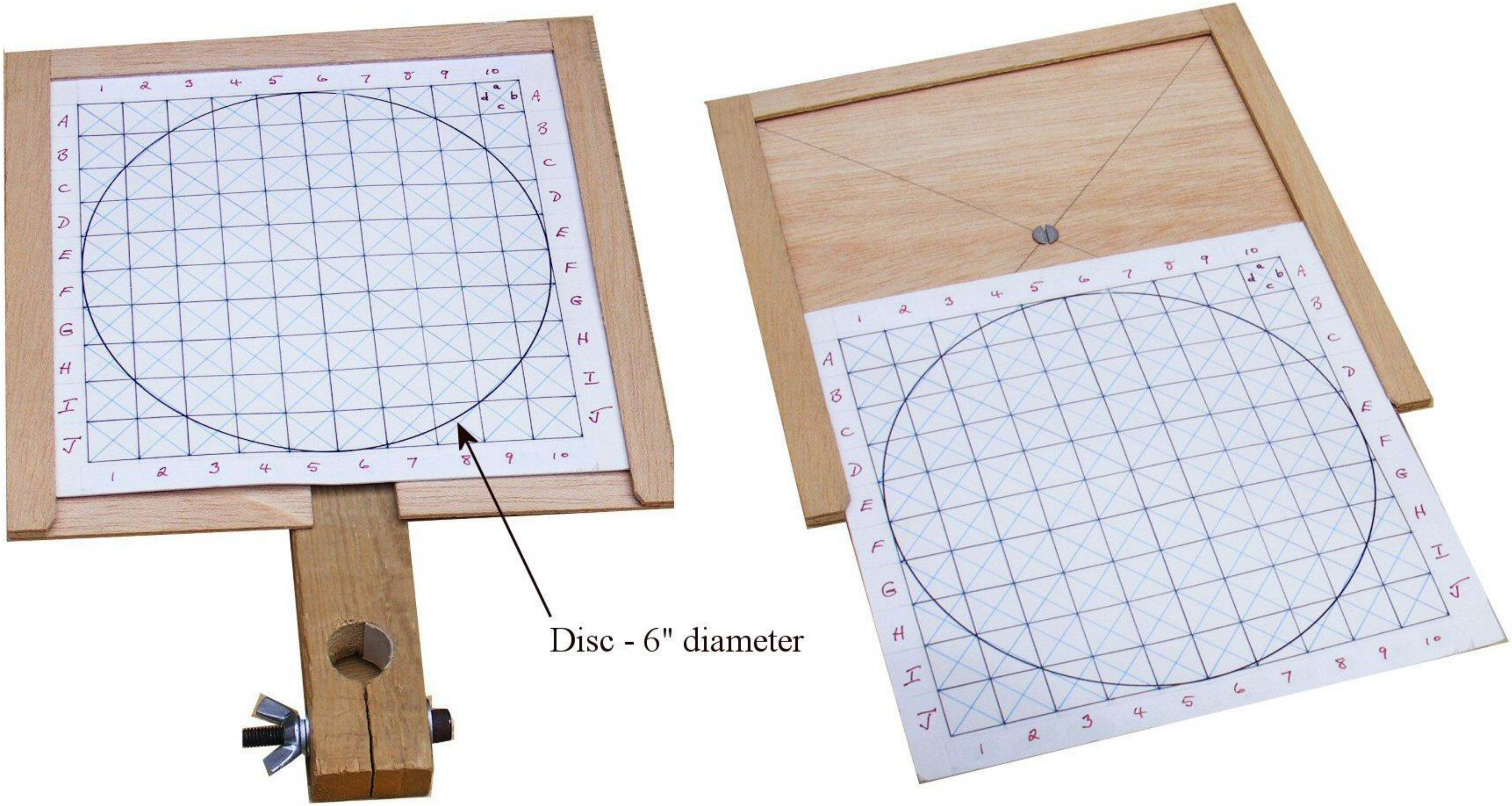


Figure 6. Closeup of underside of solar projection box, showing closed observing apertures

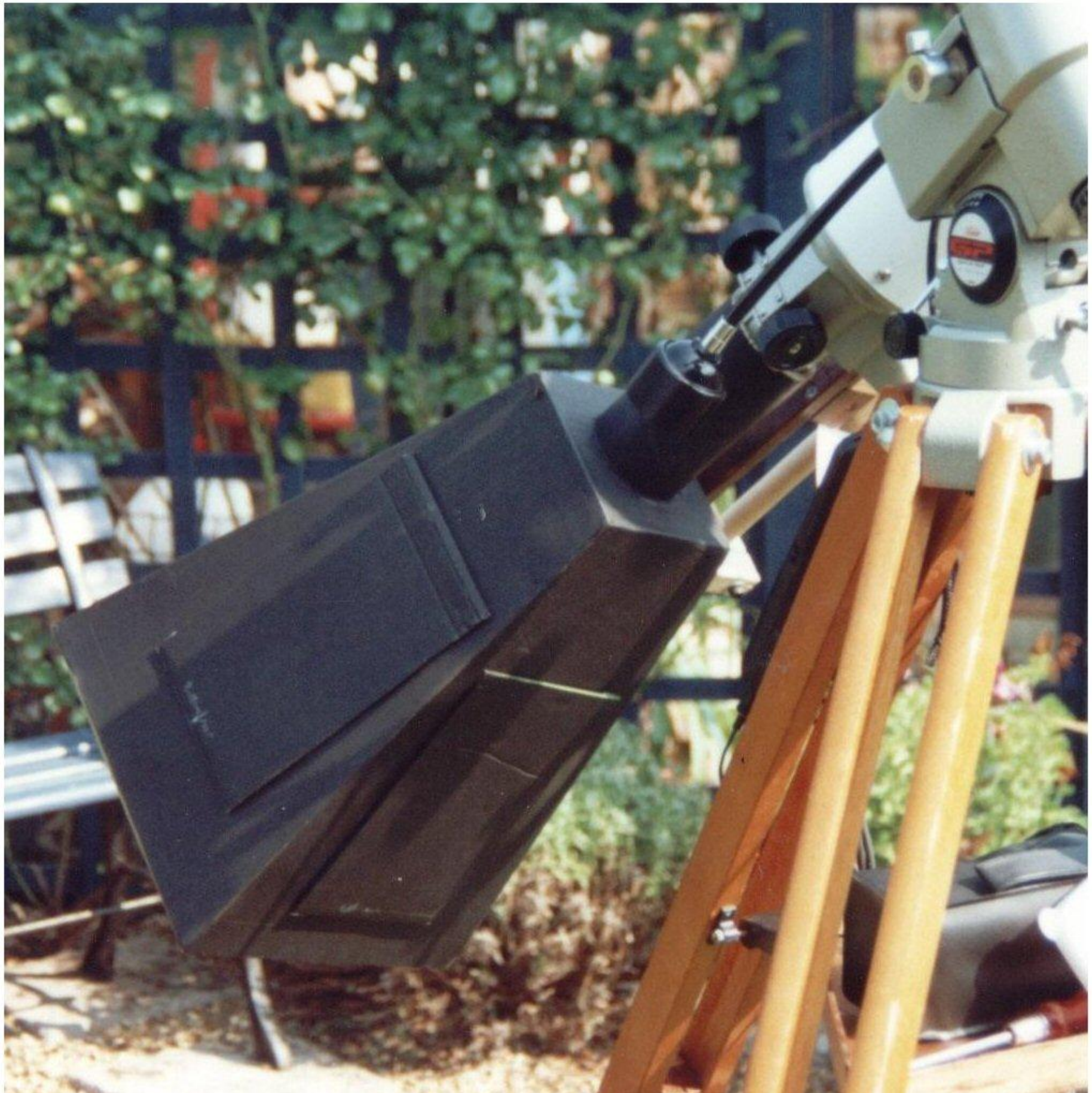


Figure 7. Closeup showing image of Sun through observing aperture

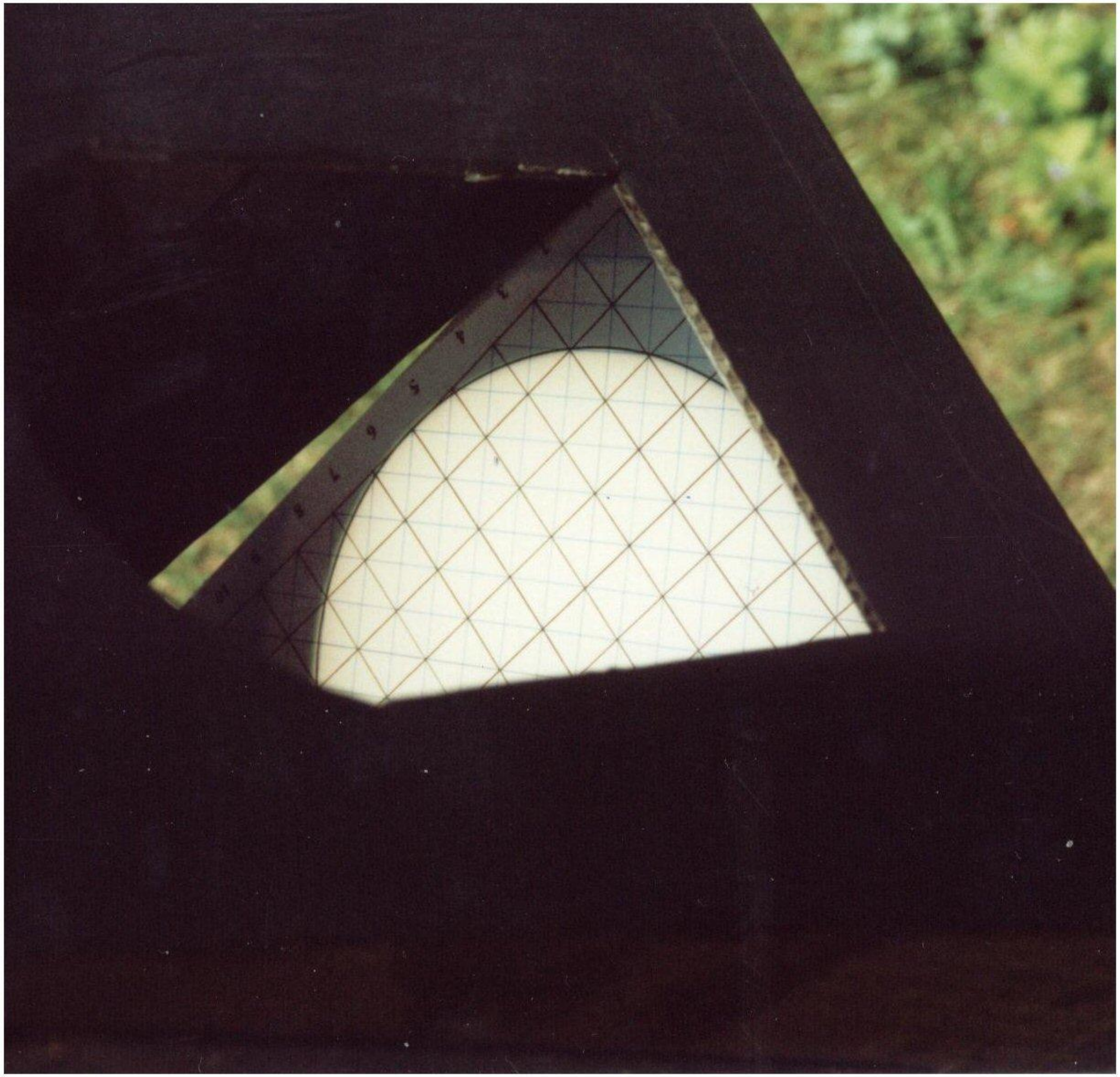


Figure 8. Closeup showing observing apertures and rotating screen holder

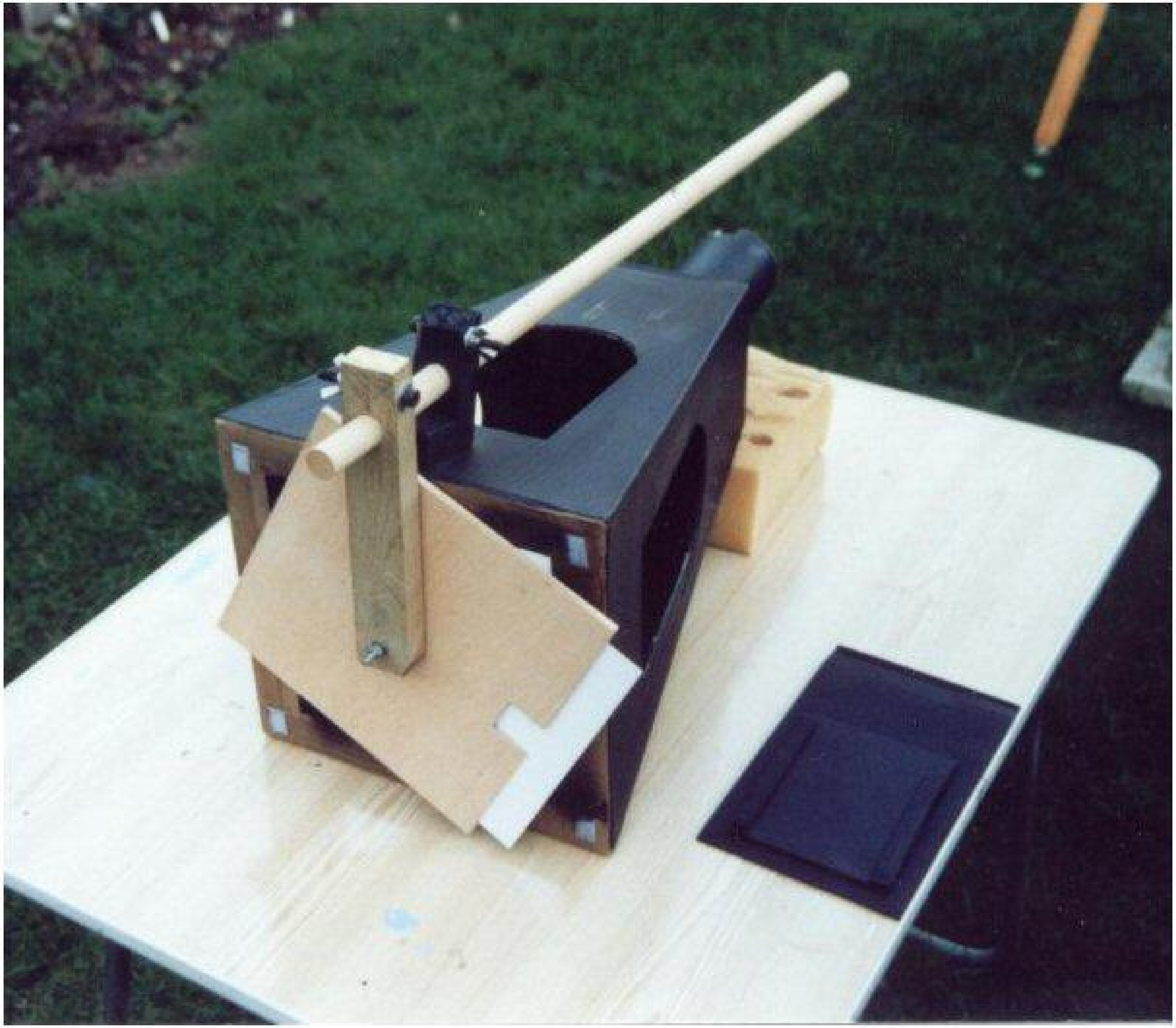


Figure 9. Closeup, showing projection box clamps.

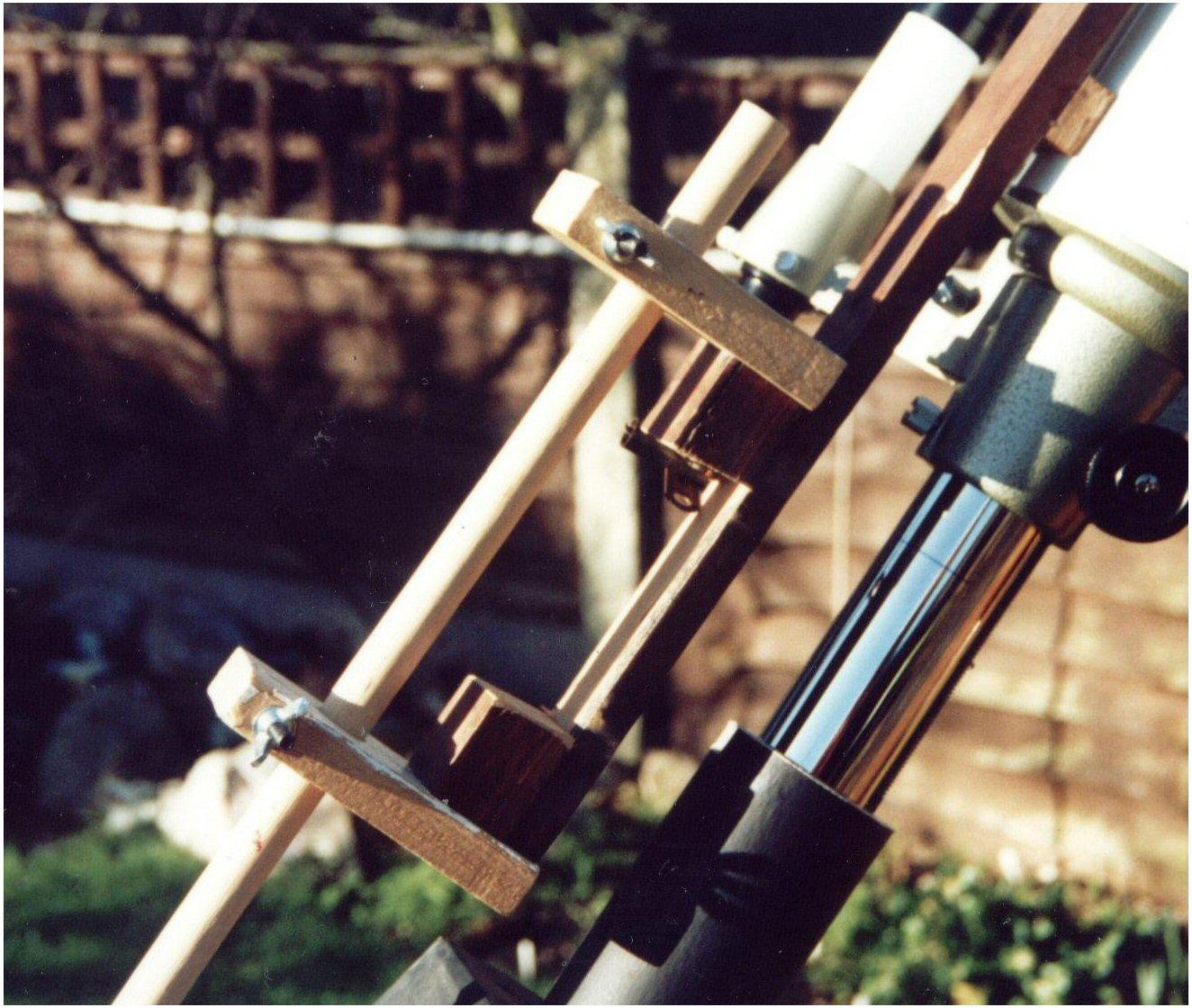


Figure 10. Closeup, showing projection box construction.

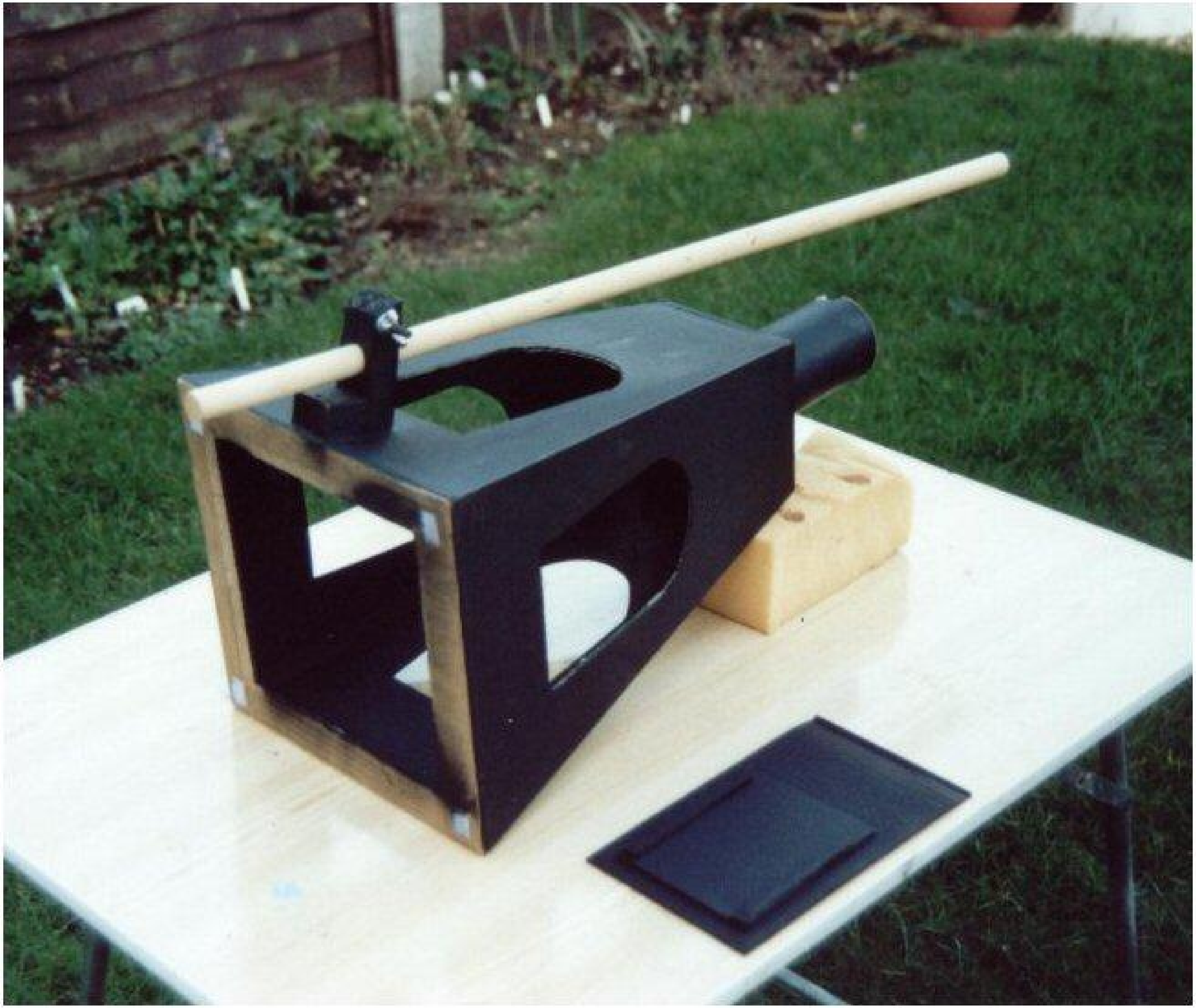
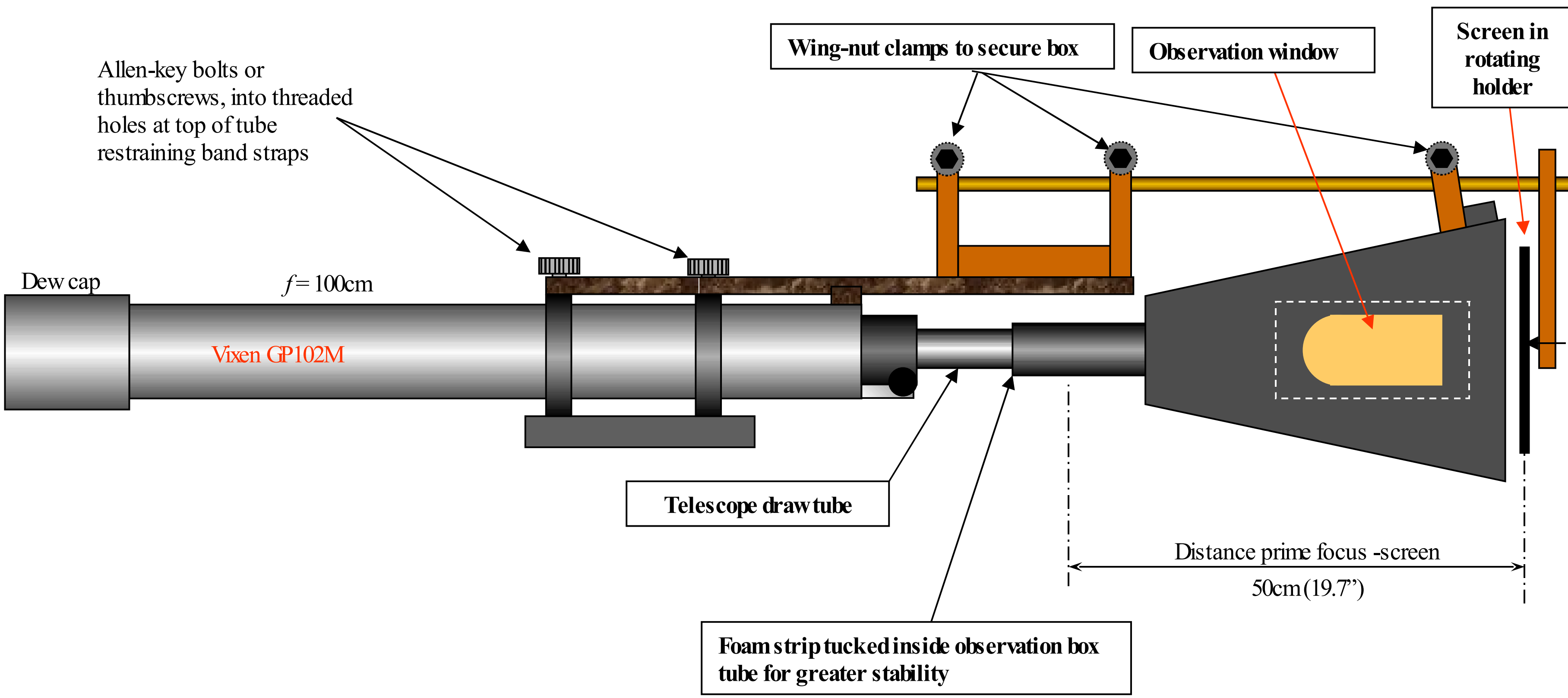


Figure 11. Solar Observation Box. General arrangement



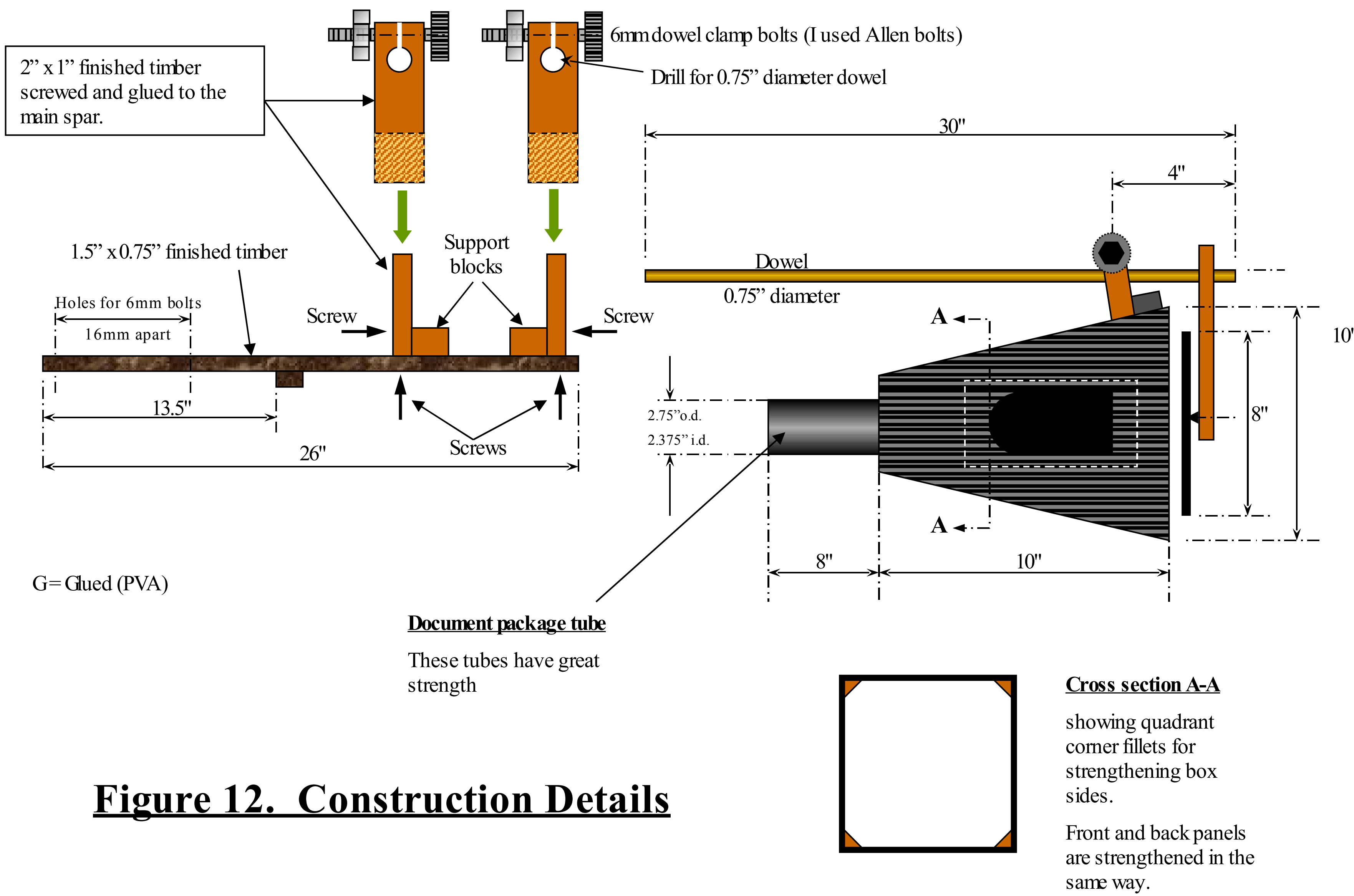


Figure 12. Construction Details

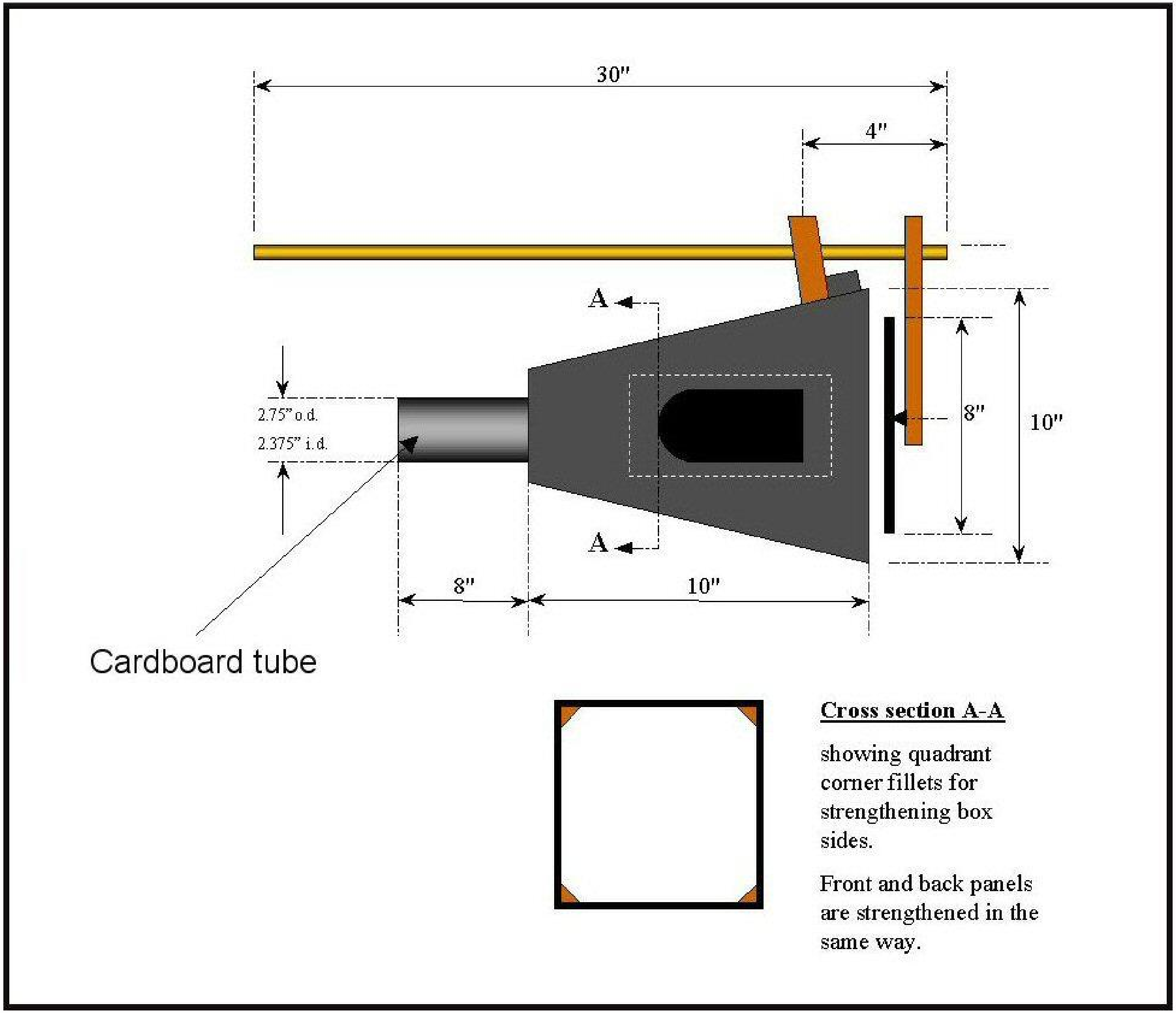
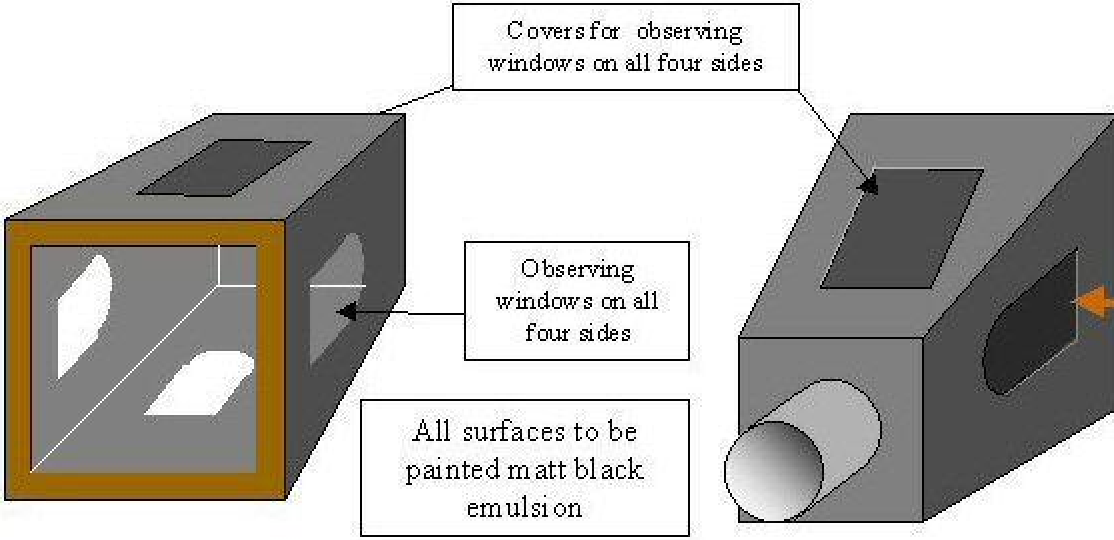
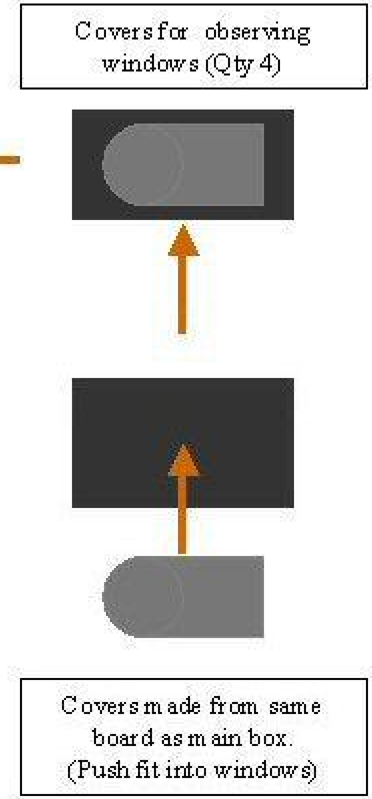


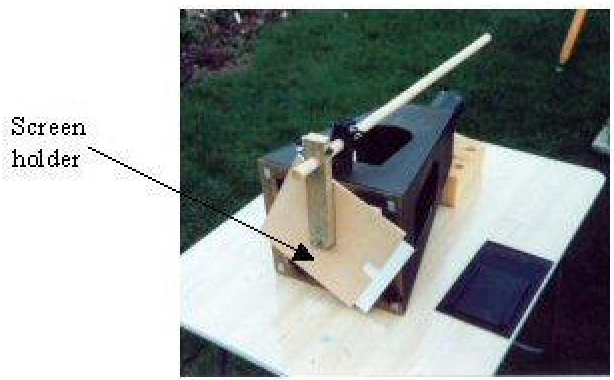
Figure 13. Construction box details





View showing viewing ports. Note Velcro buttons at each corner of back to provide for a translucent screen for public viewing.

Note port cover for blanking off ports (one only shown).

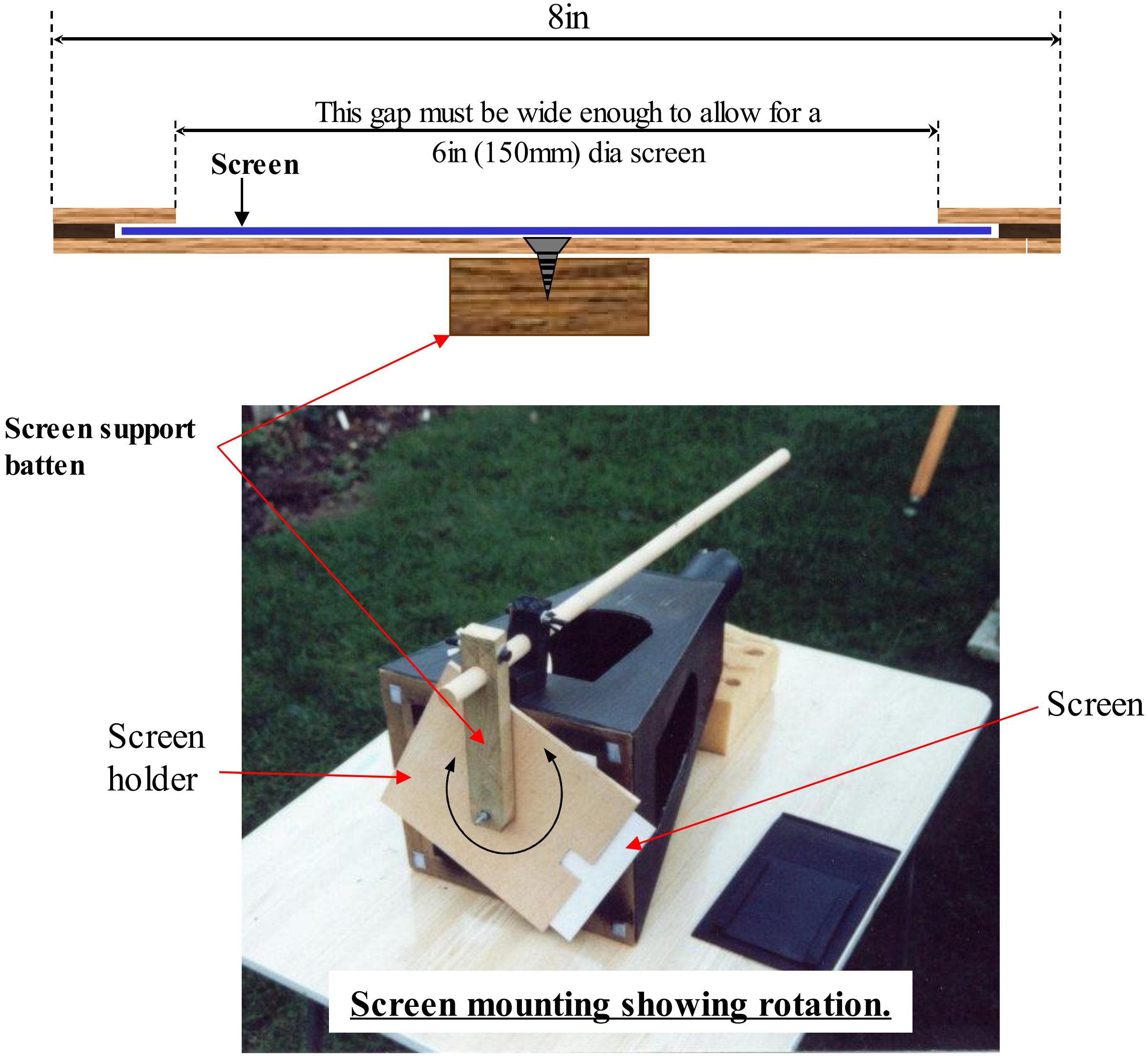


Screen mounting showing rotation details. See also Figure 5.

Fig. 14. Box construction

Fig 15. Projection Screen Holder

Cross section of projection screen holder



Screen mounting showing rotation.

Notes:

The construction at this end of the box is optional, depending on the preferences of individuals. A non-rotating screen will simplify construction.

A screen that rotates will allow the alignment of the screen's grid with the diurnal motion of the Sun, which simplifies recording. The multiple windows are also essential, to allow for the various angles that the telescope adopts during observations.

A WORD OF CAUTION - EYES & EYEPIECES

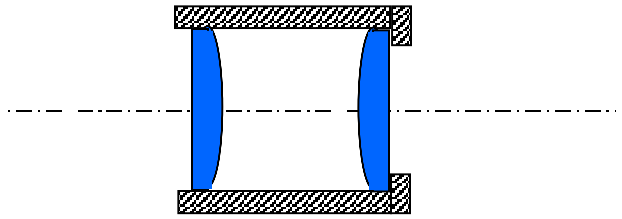
Eyes

The Sun is a dangerous object to view and, for the inexperienced, I'll repeat the obvious perils of "naked eye" viewing. If you look at the Sun with unprotected eyes, then blindness or serious eye damage will occur. A number of solar filters and materials are available that reduce the levels of light to acceptable levels at all wavelengths. A projection box, however, is the safest way to observe.

Eyepieces

So much for your eyes, but what about eyepieces? Most eyepieces that we use today are of compound design, using cemented elements, the most popular being the Plossl design. With projection, all the rays will come to a focus inside or very close to the eyepiece, with possible damage to the eyepiece elements due to the heat. The solution to this is to obtain, if you can, a Ramsden eyepiece, which employs two uncemented elements as shown in Figure 16. I was unable to find a source for these and so I bought two lenses of 1 inch focal length from Ian Poyser, who was then located in Rochester in Kent, and a friend kindly turned up a 1.25 inch barrel and constructed a Ramsden eyepiece for me, with a focal length of 1 inch, 25.4mm. This is a simple and robust eyepiece, with no cement, whose limitations make it unsuitable for conventional astronomical viewing, but for solar projection, it is perfect.

Figure 16. The Ramsden Eyepiece



Solar Observing Record

Date:

Robert Oseman, 15 Whitehill Lane, Gravesend, Kent, DA12 5LT, ENGLAND. Tel: 01474-362834

Time started: *(local time)* *(UT)* ***Time ended*** *(local time)* *(UT)*

Telescope: *Vixen GP102M; f=1000mm* ***Eyepieces:*** *26mm Plossl [ ]* *7.5mm Plossl [ ]*

Star diagonal [ ]

Image : ***Position angle P:*** ____________________

Heliographic latitude of centre of Sun's disc B_o __________

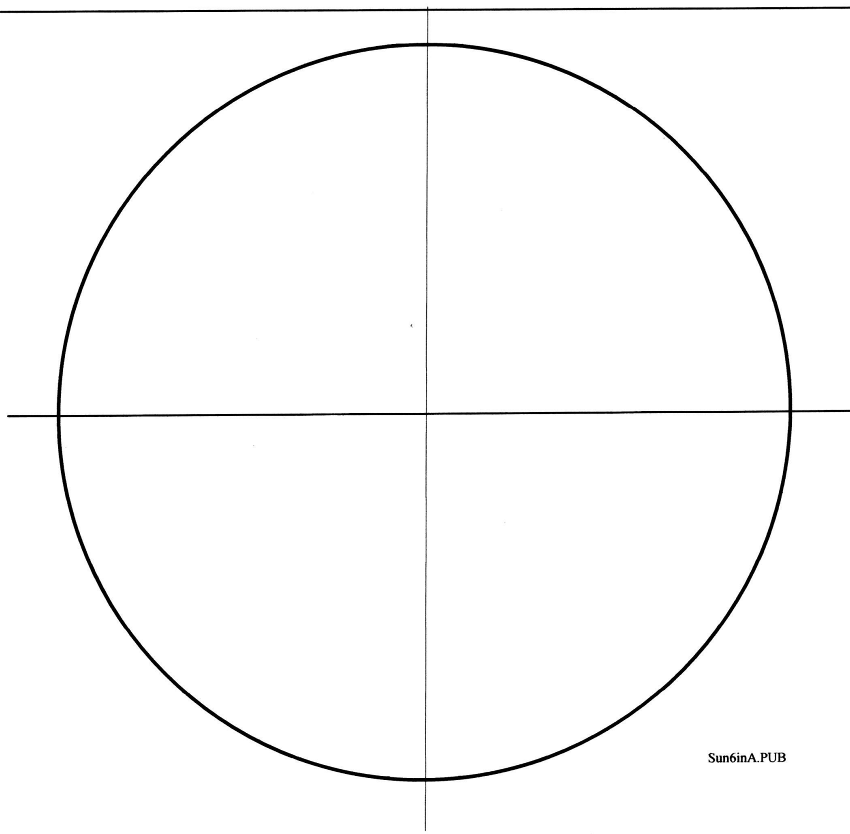
Heliographic longitude of the centre of the disc, L_o ____________________

Carrington Rotation No.: ________________

Weather: ____

Seeing: ____________

Notes:



Sun6inA.PUB

Figure 17.

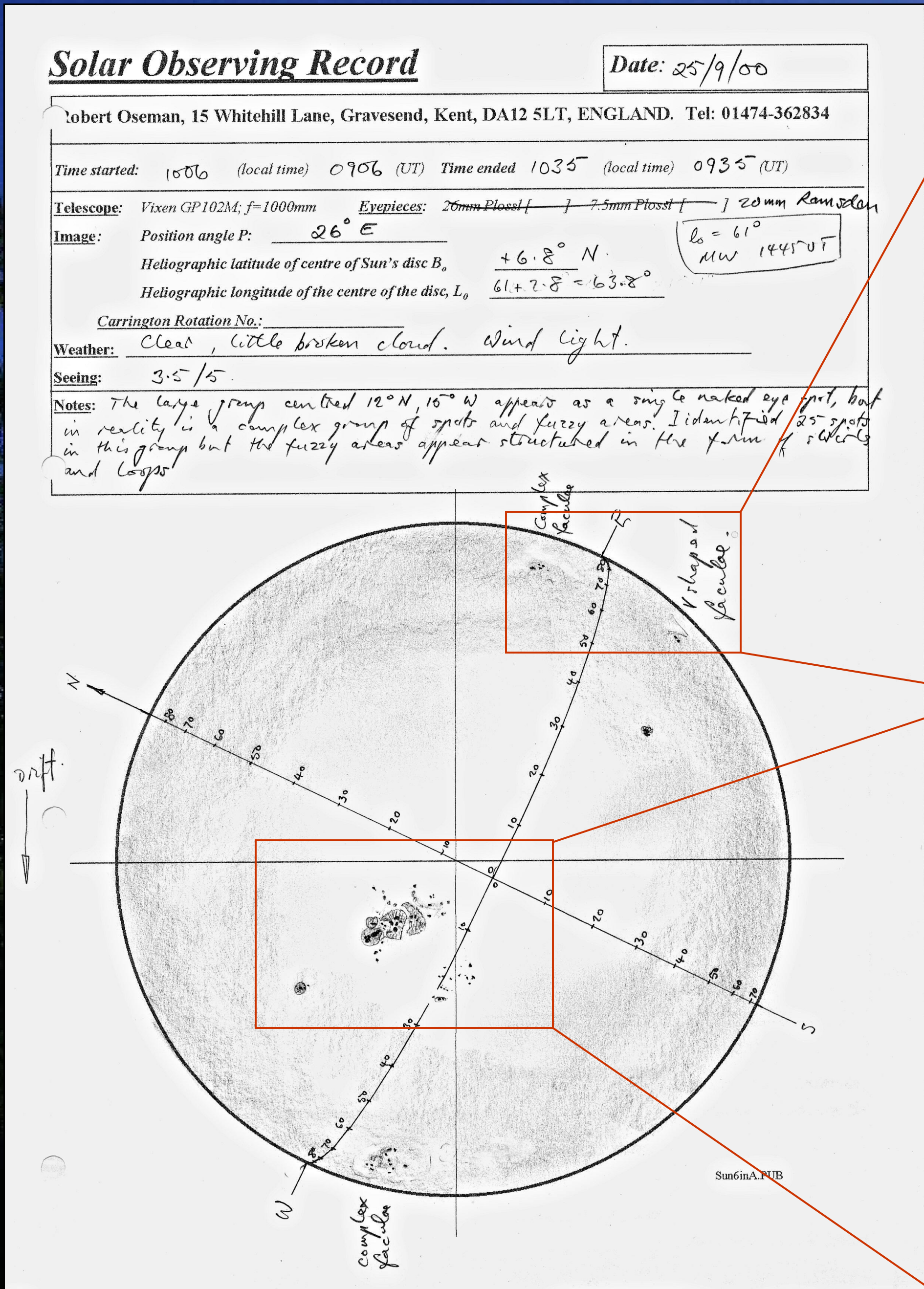
A drawing blank - size A4

A NOTE ON MEDIA

I preferred to produce my drawings on what is known as "bank" paper, or typist's copy paper or "flimsies", which I bought in W H Smith. This is a thin white paper, thinner than tracing paper, yet strong enough to go through a printer. It is sufficiently translucent, so that when laid over a grid identical to the screen in the projection box, you can locate and draw sunspots and any faculae you might be able to perceive with reasonable accuracy. There's no "best way" to draw. Provided the data are as accurate as you can make them, it's a personal choice.

The solar coordinates on drawings are produced using Stonyhurst discs downloaded from Mt Wilson Solar observatory and printed at the correct size.

I obtain the effect of limb darkening using a soft pencil, dragged gently around the solar limb edgewise and worked (also gently!) with a finger tip until the desired effect is achieved. Do not extend this into the centre of the disc, which must remain bright! It's often best to do the shading before the sunspots are drawn, so as to avoid smudging these. Faculae can be "taken out" using an artist's putty rubber or a normal eraser shaped to a wedge with a sharp knife.



Solar Observing Record

Date: 25/9/00

Robert Oseman, 15 Whitehill Lane, Gravesend, Kent, DA12 5LT, ENGLAND. Tel: 01474-362834

Time started: 1006 *(local time)* 0906 *(UT)* *Time ended* 1035 *(local time)* 0935 *(UT)*

Telescope: *Vixen GP102M; f=1000mm* **Eyepieces:** ~~*26mm Plossl [ ] 7.5mm Plossl [*~~ *]* 20mm Ramsden

Image: *Position angle P:* 26° E

Heliographic latitude of centre of Sun's disc B_o +6.8° N.

Heliographic longitude of the centre of the disc, L_0 61 + 2.8 = 63.8°

l_o = 61° MW 1445 UT

Carrington Rotation No.:

Weather: Clear, little broken cloud. Wind light.

Seeing: 3.5/5.

Notes: The large group centred 12° N, 15° W appears as a single naked eye spot, but in reality is a complex group of spots and fuzzy areas. I identified 25 spots in this group but the fuzzy areas appear structured in the form of swirls and loops

Figure 18.

A drawing done using the projection box.