

Chapter Six - Astronomy

Dobson's class

The beckoning universe

After a year of digging deep out in the visible night sky, I was ready to dig deeper yet. My homemade 6-inch box telescope was no slouch — possibly as clear as most any 'scope with a decent 6-inch primary mirror would be, and proved to be a fantastic, totable workhorse. I saw the main seasonal celestial highlights with this solid construction to my continuous delight... Leading to craving a larger telescope, knowing that twice as much real estate of mirror size is what it takes for the deep sky objects to show with more satisfactory definition. In the mountains, the 6-inch works relatively great! Back home, galaxies were only defined as fuzzy ovals; exciting to find, but never showed divisions or dust lanes. Nebulas have decent definition, and several of the wide field open star clusters. Globular clusters could be sharper though, and there are many low magnitude objects that require higher power and light gathering ability.

This doesn't mean that the 6-inch box telescope would be supplanted — far from! This is perfect for urban use — planets and the Moon look extraordinary in even the bright light polluted areas, and I started to bring it out in front of our local natural foods store; the Good Earth in Fairfax, to share views of the waxing Moon with the public. I was just beginning to warm up to doing sidewalk Astronomy, shy about it at first not saying much, but the reactions were so positive - this was fun! And the Good Earth became a favorite place to set up for years ahead, (when I was more well versed and accustomed) with a steady flow of locals swinging by to shop, happy to become tripped out by the cosmos on their way. This telescope was mostly the one brought out, being perfect for urban viewing and easy to carry in the vw bus.

The maestro

I found out that John Dobson, legendary sidewalk Astronomer and developer of the famously effective Dobsonian telescope mount, was indeed still teaching his telescope building class in San Francisco! In the autumn only and not at the CAS, but at the lesser known Randall Museum up on Corona Heights. Alisa totally encouraged me to enroll and did so for me as a birthday present!

Dobson was gaining notoriety that year of 2005 with a large 90th birthday celebration for him held on a sunny day at the Randall — and was the celebrated subject of the documentary film ***A Sidewalk Astronomer***. John's birthday celebration was held in late August (his actual birthday is September 14th), so Alisa and I attended, finding out about this event after signing up for his class that starts in late September.

Dobson's 90th birthday party at the Randall Museum

A beautiful day up at the grounds of the Randall Museum; a modestly sized yet impressively equipped natural science center, tucked away along the edge of Corona Heights hill in San Francisco, with a great view east, furnished with an intimate auditorium, a dozen or so classrooms/meeting rooms, woodworking shop, various shop and nature based courses, and a wildlife sanctuary, among more.

This event initiated me into new connections that became long lasting and life changing. First off, arriving there and seen on display were a few large handmade telescopes on display on the grass (safely away from sunlight in tree shade.) I spoke to one of its owners who has an impressive truss tube telescope — I think with a 14" mirror? He is a long time student and friend of Dobson's, who I befriended in classes later — John Muhilly. An owner of a blue sonotube 'scope (with a 10" mirror?) is Peter Schumacher, another future colleague of the cosmos — though I didn't know yet.

Wandering around the festivities including solar viewing through both a handmade sun 'scope and a professional factory made filtered solar' scope. A mirror grinding demonstration, where anyone can try it out, scraping one disk of glass against another, slowly digging a concave dip with different grades of wet carborundum grit — sand, essentially. The demonstrator is a friendly, socially inviting fellow who also became a familiar face and friend, Ken Frank.

John Dobson, man of the day, is busy talking to dozens of people who are probably a mix of old and young students and friends. I eventually got in a word by wishing happy birthday, and that years after looking through his telescope on streetcorners I am finally taking his telescope building class in a few weeks away! He didn't have much time to chat because of the dozens of people coming up to greet him, but briefly replied with a simple "*thank you.*"

Soon there are speeches outside in a central pavilion circle. Friends and colleagues take their turns relaying anecdotes about incredible times with John over the decades. Soon to be familiar faces are there — Margaret the Randall Museum administrator, John Dillon, naturalist educator/speaker, and of course, Carol Strauss, and Loretta Botta, who know JD from a ways back who also later became good friends ... To name just a few.

A city hall representative presented an official declaration from the mayor that today is officially **John Dobson day** — which is very San Francisco. Dobson appeared amusingly embarrassed by the attention. Then it was his turn to speak, with razor sharp wit and good storytelling. Applause by the 70 or so attending, followed by a big telescope cake, enough for everybody to have a small piece. A lovely event, and I think there may have been a presentation with a slide show in the auditorium, showing Dobson's huge telescopes over the years in national parks. What a life, and still going strong at nearly 90!

This event was significant for exposing me to my future community of Astronomy lovers, and I think that it was here when I first learned about the **San Francisco Amateur Astronomers (SFAA)** who meet there regularly and have monthly lectures by professional and amateur Astronomers alike. *Hmmm, sounds interesting.*

I seem to recall it being one of those late August evenings when wind and fog rolled over any chance of clear telescope skies. Different from October/November, when the telescope making class is held in San Francisco for weather reasons.

Telescope making class begins

After a most satisfying September in England, Wales and Scotland, I started Dobson's class eager and refreshed. Meeting at the Randall, John arrived with two class helpers; Ken and Peter, who I met informally at the celebration a month earlier. JD is a witty and sometimes cranky speaker as he gives us the rundown on what to expect. There are around 20 students, making it a full class. Our first step is to decide what size mirror we want to grind, based part by what porthole glass pieces are available. Rather than hauling his inventory to the classroom, the plan is to decide before going to Dobson's apartment to pay and fetch the piece. I decided on grinding a 12" mirror. I originally wanted to go with a 16", but wisely knew that it would be a step in too unmanageable a final telescope size.

I call him to designate a pickup one afternoon that week. He has some 12.5" portholes for around \$30 apiece. I get to 4135 Judah Street where he lives on the ground floor apartment, with a ***Sidewalk Astronomers*** graphic posted on the front door of this old house near the ocean. He answers and invites me in, down a musty hallway to a bright rear apartment on the backyard filled with wildflowers. He has a small stack of porthole glass pieces and pulled out a 12.5 inch piece.

Step one!

Followed by the second class, with grinding materials doled out by Ken and Peter. Demonstration by John, showing us how to hold the tool, apply grit with water, pushing the glass with arm pressure turning rotating every few strokes. Rinse and repeated. And to really make everyone remember, to *not* let your fingertips get between the glass pieces, he'd yell out the warning with seismic volume! Alarming — and wisely so. He knows how to teach!

Cosmology

Around this time I found out that he also teaches a cosmology class there, and I enrolled a week late, missing the first class. It was great for being challenged by often difficult puzzles about physics, and to be exposed to his unique takes on the cosmos. Largely a lecture course, yet he would keep us on our toes by putting us on the spot. A few of the same students as the telescope making were also enrolled, plus a few more. John Muhilly was always there, who gave Dobson a ride there and back.

I'm going to jump this parallel chronology to a future chapter on Dobson's cosmology classes. I will mention that it was a good opportunity to take both classes in tandem; telescope making got us pushing and pulling glass — cosmology class pushed and pulled our brains!

Captain Ken

is my nickname for Ken Frank -- which has a nice ring for someone so actively involved, and into boating. He was the one who introduced me to the SFAA, around the time when he was the active president, and who really helped with Dobson's telescope making class. Not only with the SFAA, but worked at Scope City (the telescope store in North Beach also specializing in parts, where I shopped for a few times), swims across the bay, later working for

the Astronomy Society of the Pacific (ASP), organizing and attending star parties all over California... When I say Ken is actively involved, I mean *actively involved!*

More including the ever inclusive, socially affable Ken in the following chapter.

For now I want to add that I had mentioned to him in class that I had already made a box shaped telescope with a pre-made 6" mirror, and he encouraged me to bring it to class! So I did for maybe the fourth class — but Dobson totally snubbed it, as if it were a distraction. The rest of class were interested, and we had it out front later, viewing the Moon looking magnificently. Dobson oddly ignored it, but Ken thought it was great. A few of stayed out later, trying out its balanced movements, appreciating the design and good optics. Ken called passersby in front of the Randall to get a look... It's sidewalk astronomy!

For the sake of context now back to telescope building.

We get to buy a smaller piece of glass as the grinding tool, and suitable amounts of the rough grade carborundum grit to start digging the pit into a focal length.

Caveman's work

is what Dobson called the procedure, and this was taught in class, then we are sent off to do the glass grinding at home, or in whatever environment we can find that serves as a mirror grinding space. This includes a water and grit drainage, outdoors preferred. I had our back patio! I constructed a special temporary grinding bench, as one of the options that were instructed. Allowing the glass to be held in place on the tilted bench with furring nails on one end, while I sit on the other end slightly raised to allow rinsing the grit away (using the garden hose) off to the ground while not backing up to me. It's all physics, making sense — sense that Dobson had developed over years of dedicated trial and error, with excellent and thrifty results!

Grinding glass

This is not meant to be an instruction manual, so I try to summarize the long procedure here. Basically, the first grinding goal is to establish a pit that allows for a workable focal length — not too deep making too short of a focal length ; and not too shallow giving too long of a focal length. Test this by reflecting sunlight on the wet primary glass, focusing the reflection against a wall while measuring its distance from the glass to the wall and that is your approximate focal length. I was aiming for something in the 72" range, but my overzealous grinding dug it a bit too deep. It's much harder to reverse to a shallower concave dip from a deep one, and sometimes the depth that you dig is the focal length you're stuck with. I forgot what length it was during this first stage, but I called Dobson who told me I could reverse that but to not go very much or the glass would get too thin! I evened the edges by a margin more satisfactory, and it did make the glass thinner but fortunately by not too much. [*Whew*]

Tube length, and more supplies

After figuring the approximate focal length by the next class, bringing our in-progress work, the telescope tube length can be determined. My focal length was around 69" — a good length for a 12.5" mirror! I was relieved after grinding that glass so diligently. If at worst, I could simply buy another porthole and start over, but discouraged by Dobson since he had limited inventory.

One of the items sold in class was the small secondary mirror to be installed on a custom made three partite spider vane, Dobson style - made of cedar roofing shingles cut to be held in place by tension inside the walls of the tube. Cedar because it doesn't expand or shrink ; by tension to allow easy removal and adjusting. More genius innovation discoveries by Dobson!

When I was handed the secondary mirror by JD, I had an unfortunate accident of butter fingers and I dropped it on the floor. "*you should not have done that*" scolds our sometimes curmudgeonly teacher. I pick it up and only it's underside is chipped! He then said I was lucky and it's okay!

More good fortune on my way to deeper skies.

I was just one of a few of the students who were on schedule with this stage. The next steps are to continue grinding with finer grades of grit to shape its curvature to closer refinement, while gathering the materials for the 'scope and base.

Driving to a concrete suppliers shop in the industrial section of San Rafael to buy a lengthy sonotube, made to be concrete foundation forms, and they happen to also be perfect for telescope tubes! Customizable, relatively lightweight, sturdy enough to last a long time after being painted, and structurally there's not much better to be found anywhere.

Plywood sheets are bought at the lumberyard for the base and rocker box. Owning a '71 VW bus is *perfect* for these errands. I couldn't wait to get the finished telescope loaded in ready for dark sky trips!

Onwards...

Pitch

Once the curvature of the glass nears its best stage of using fine carborundum grit, we bring our glass — both the primary and the grinding tool (both conforms to each other in shape) for a class operation of making pitch laps. Used for polishing the glass; the final stages of forming the glass. More students have caught up, and I've been ready first. JD wastes no time with readying the pitch, that he has melting in a coffee can on a portable electric coil stove he had plugged in for awhile. The pitch hardens fast when cooling, so he

does the work of pouring the proper amount on the curved side of the glass tool >presses a dowel into it to make crisscrossing grooves > places it face down on the center of the mirror face — all in under half minute for each mirror glass. *He really knows his stuff!* The pitch is then supposed to sit this way undisturbed overnight to conform to the curved glass before beginning the final stage of polishing the surface. The purpose of the pitch is to be able to polish the glass smooth, with the help of adding doses of cerium oxide, without pushing the glass too much, as the pitch has less resistance as a material, and the waffle cavities give it somewhere to slowly ooze to from the pressure.

I work at polishing as instructed, while getting the telescope pieces assembled [I had the lumberyard in Fairfax cut each plywood piece to specs] It helped that I already made a telescope before, knowing what every parts function in advance. In this case the telescope has to be built before finishing touches to the mirror are made. Assembly is still requiring trial and error by me. Even though Dobson claims that a telescope can be assembled in a day. I might be pickier about some aspects, and plainly far less experienced.

Customizable

The things I did that swayed from his instructions was to adhere the secondary mirror with my leftover supply of silicone glue that I had for my first 'scope. He uses a leather strip with wood glue. Who knows what will last longer.

Being able to call him to ask questions on most afternoons was great — and he always knew exactly what was asked about, in a flash. I may ask about do I need to polish the cloudy edges away?

He'd say *"that doesn't make no never mind."*

He's a master at this... And using cheap materials! Some of the touches had cereal box cardboard fit underneath the primary mirror, a disposable cardboard spool from within a roll of tape with a short piece of plumbing pipe as the eyepiece holder, and, as the bottom

bearing to spin smoothly on the Teflon pads — an LP record! As a true record collector it seemed cannibalistic to sacrifice even the poorest lp from my big collection — but I stopped into Yesterdayland, the thrift store in downtown San Anselmo, to find a battered copy of *The Sound of Music* (without a cover) for only 25 cents, and used that to good effect.

After tooling and retooling details — like redoing the base with 1.5" plywood for the sides, because 1" thick was too flimsy and would bend outwards under the weight of the 'scope. Plus I had to move the eyepiece hole by a few inches due to miscalculation of the focal length from the primary mirror to approximately where the eyepiece lens sits. (forgetting the distance between that and the angled secondary mirror.) I patched the mistake hole with the help of some Bondo used for rusty damage spots on the old VW bus. Whatever it takes!

A few more custom choices were to use circular plywood cutouts (that I had) as the side bearings with smooth formica tabletop edge laminate applied around (my idea) and again to give the tube some extra length. And I added wood rims to the top and bottom edges of the tube. I saw the cardboard rims as vulnerable edges to become potentially dented in transit, plus the rims supply a bit more structural definition.

[see my original telescope building notes at the end of this chapter.]

Star test

Between the structure and polishing the glass, everything is ready to bring to class for the star test! I was the first in class to be this far along, making mine an exemplar for the rest of the class. We set up my brand new 'scope, all parts intact yet still in testing mode, out in the dark on the side of the Randall, with the mirrors set in place (of course the primary was not finished, un-aluminized and a piece of glass that dimly reflects starlight)

Dobson taking charge, using my work to give examples of collimating the mirrors by sighting them, then focusing the eyepiece on a single star (I used my 20mm Plossl from my first 'scope). Bringing it in and out of focus turning it both ways to see if the mirror has astigmatism. JD said that it does, and to correct it I need to polish the glass for a half hour more but with the tool under and the mirror on top.

I was amazed by how lightning fast he deduced this solution! After such a quick look.

The class took turns doing this focus test. Turning the eyepiece out of focus results in skewed oval shape that otherwise should be more circular.

Final polishing and test

Following his instructions I got the final polishing done, with tool on the bottom, hoping this will fix the problem.

I loaded the mirrors into the 'scope for a quick late night checking of my own in the back patio. Working good by my inexperienced standards, and what was unforgettable was pointing it at the waning Moon. Ghostly beautiful using the unaluminumized glass! Dim yet large and clear — reflected by just polished concave glass! I have a good feeling about this.

To test it again, John has me bring the 'scope to his house in the Outer Sunset District in the city near the ocean... Midafternoon (?!) I find more genius Dobson ingenuity. He has me set up telescope in the shade in front of the house, pointing it at a lamppost towering above Judah Street a couple of blocks east. Using not the lamp light itself (not lit in daylight) but to focus on a tiny glint of sunlight reflected off of the metal fixture! Clever substitute for a star.

The verdict of his focus test is a go! Not perfect, but this mirror is now ready to be aluminumized.

Haha! I was stoked, and immediately scheduled a visit to Bob Fies, who operates a telescope mirror aluminumizing setup in his garage in San Bruno.

A shiny mirror is born

The class was supposed to get our mirrors aluminumized in groups, but I cut to the chase and booked my visit immediately! I could not wait to try this fresh, bigger telescope out in the backyard!

Bob Fies is available in the afternoon, so I drove my freshly finished porthole glass to find his ranch style suburban house in San Bruno, just south of San Francisco. A mellow and patient older gent (probably 20 years younger than Dobson) who built a truly fascinating aluminumizing tank and vacuum setup in his garage! He used to be an engineer for airplanes, then became involved with aluminumizing telescope mirrors — something rare to find, doing so for Dobson's students and for worldwide amateur telescope makers. When I arrived he was getting his mail delivered which had packages from Europe with mirrors to be aluminumized. An impressive service!

The process took a few hours. Soaking my glass in a toxic solution while priming the vacuum. Hanging the mirror in the purifying vacuum tank, then aluminumizing within the tank. An amazing setup and unsuspecting behind the facade of the old suburban house. I listened to his stories about JD from over the years. Then it takes time for the aluminum coat to be travel ready. Lifted from the tank all shiny new — imagine the Silver Surfer climbing out with it! Bob wraps the fresh mirror carefully in paper towels, then aluminum foil. I thank and pay him (a modest sum for the extraordinary task) and off I go!

“the transitive nightfall of diamonds ”

Eagerly anticipating the views through this brand new labor of love, I carefully unwrap this clean, fresh primary mirror. Only about a half inch around its perimeter is unclear from a common effect from polishing mirrors by hand, essentially making it a 12". (like JD said about the edges "it doesn't make no never mind." as his turn of phrase.) Plus, furring nails are there, keeping the mirror from falling forward — loosely to allow the expansion and contraction of glass in changing temperatures. Oh my, this is going to be great!

The double cluster in Perseus was one of the main highlights of the first visions — using a new 40mm eyepiece for wide field view — crystal clear and closer looking! The **WOW** factor as thrilled as ever back there in the patio space outside of the lower room/painting studio, accompanied by celestial sounds of the Grateful Dead, **Dark Star** Fillmore West 1969 versions heard low through the open doors. *In my element!* A late night of perusing the sky, easier height compared to my first 'scope. This is twice as big, making an improved difference for seeing deep sky visions — the Orion nebula is a **fantastic** highlight! And galaxies looked more like galaxies! Andromeda was easily found. I stayed out there until the waning Moon was in spectacular sight — I was in heaven! Or rather, I was *in* the heavens!

Telescope launch!

I couldn't wait to show this off to class, just an evening away. The vw bus loaded — lucky to have chosen this sized telescope, I could lift the heavy base by more of the same drawer handles as my other 'scope, now with one on either side. Any larger might give me a hernia. I could lift this with both arms, with the front panel braced against my torso for leverage. The tube was awkward to manoeuvre at first; lighter but long. It has one handle on top of the rocker box, the other hand can grip along the bottom end where the mirror weight lies. (naturally easier with two people, and Alisa came along.)

We hauled the finished (except for the unpainted base, though I did paint the tube with the same dark blue - purple as my first 'scope) telescope into the classroom first. The only finished telescope of class so far. My dedicated zeal was apparent. Everyone enjoyed checking it out, and when class was ready we took it out for all to test drive!

I forgot to mention what may be obvious — that I didn't install a finder. This is also Dobson's preference, as he demo'd how to effectively sight a target by knowing what you're looking for while sighting along the edge of the rocker box, nudging the bearings until you've found it. I have a headstart with this method!

John seemed pleased, calling this a brand new baby telescope. Everyone had a chance to look through it, moving it around on its smooth bearings. Focusing on stars. It was a good example. Dobson had a few suggestions for improvements, never for high praise, but told me to get this 'scope out to 9th & Irving, you focus on Venus while I'm at the Moon. I thought that was high praise by itself! He said give a call in a couple of days when skies should be clear and we have a waxing Moon. Will do! Out in the parking lot loading my brand new baby telescope, John pointed out about my VW bus. *“now that's a good vehicle for a telescope!”*

Sidewalk Astronomy with JD

On a clear autumn evening, we planned to set up at sundown at the busy intersection of 9th & Irving in San Francisco. A sort of crossroads to great restaurants, cafés and bars, and near the museums in Golden Gate Park, making for a steady flow of foot traffic, often including a generous amount of curious people up for looking into telescope's pointed at the Moon or planets.

Alisa helped by driving, knowing how difficult parking can be around there. Unloading the 'scope on the corner where I set it all up, Dobson arrives, pulling his amazing telescope named ***Tumbleweed*** in a kids red wagon, stored in a friends garage nearby.

As soon as I have my 'scope setup, there's a short line forming, eager to check it out!

It took some minutes to find Venus — a sharp little white crescent up in the encroaching twilight, while John has Tumbleweed on the waxing crescent Moon - which I loved to dash over to for a look! Between the crowds we tended to. Such fun to hear "WOW" exclaimed so naturally from so many different types of people! Seeing the planets from the street corner ignites sense of wonder for those who are passing by, not expecting it, and are open minded about it.

JD has this to say about the planet Venus, "*Venus is covered with dense clouds of hot battery acid. So DON'T GO TO VENUS!*"

This was a busy night of sidewalk Astronomy — fellow Dobson student Jennifer and her daughter bring their beautiful telescope made in a previous class — named Albirio painted in gold along the tube length (8" mirror?) A few of the other students stopped by, who were still finishing their telescopes, and a good flow of the general public, ... appreciatively.

Out there for almost 3 hours when Venus and the Moon set. This would continue ahead for more occasional clear evenings.

It was such an honor to be doing sidewalk Astronomy with the man who turned the world on to it — who turned me on to it years ago on these San Francisco streets. I knew that I should be involved, and here I am!

Others have been also involved, becoming increasingly addicted to this activity... and will probably — hopefully — continue far into the future, with sense of wonder and awe fully intact.

~ Dean Gustafson, April 2021

TELESCOPE CONSTRUCTION NOTES

12.5" Dobsonian telescope dimensions (from the '05 class/homemade scope by Dean Gustafson) originally modified from various plans...

ROCKER BOX

Sideboards:

20"(h) x 17 3/4" (w)

---Must be 1" plywood or larger, or the sides will bend outward under the weight of the scope.
(all of the rest is 3/4"plywood)

Bottom:

20" x 17 3/4"

--two pieces glued and screwed together for thickness.

Front:

17 3/4" (h) x 20" (w)

Cradle Boards:

16" (h) x 14 1/2" (w)

TUBE BOX

Two of each : 16" (sides) x 14 1/2" (front and back)

BASE or GROUND BOARD

Approximately 25" diameter plywood circles (but they don't have to be circular)

--two pieces glued and screwed together for thickness.

SONOTUBE

14 1/2" diameter.

TAILGATE

12 1/2"

FEET

I used four 2 1/2" pieces, but it could be a bit better. Use your judgement.

SIDE BEARINGS

8" diameter plywood circles (size & material can vary), with formica or similar laminate applied to the sides.

LP RECORD:

Do NOT use a Beatles album! no matter the condition, it could be highly collectible and still sound great.