

Restoration Work Surges Forward!

The ASV team is very proud to report that we have come through the “hard yards” of Stage 1 of the GMT Restoration Project (dismantling, drawing and cataloguing), and we are now comfortably progressing into the “sweeter metres” of Stage 2 (design and construction). Gantt charts and milestone diagrams have been drafted, and are being revised weekly as we plan the next 12 months and beyond. The final assembly and site installation will constitute Stage 3, estimated for 2015, the timing being determined by the necessity to integrate the restored GMT into the Royal Botanic Gardens' plans to refurbish and expand their Observatory Gate precinct.

There has been “only” an 8-month gap since I did the last issue of Phoenix - I have an excuse, of course - see www.stevethings.wordpress.com or Google “steve road of bones” and feel lucky - but on returning from this 5-month excursion, I saw that the nature of the GMT work had changed remarkably. Gone are the days of “slow but steady progress” - as well as the transition into design and construction work, Museum Victoria have deployed more staff and resources to the project. We have identified a clear goal of reassembly of the restored Polar and Declination Axes and the Telescope Tube, as much as possible, by the end of 2013. The key structural elements of the telescope will then be in place and we will be well on the way to completing a fully functional astronomical instrument. Motivation and dedication therefore remain high, with the ASV volunteers hanging in there every Wednesday; we are up to workshop #165 and we have instigated monthly planning meetings to coordinate technical work at this level.



With 8 GB of data, 3,000 photographs and 700 drawings now under management, the time has also come to revise the nomenclature of the GMT's component parts. We are working on a new schema which will organise the 700-odd parts into a few key assemblies, each with a number of sub-assemblies, made up in turn of the individual components that fit together. This will enable work on the restoration to be more efficiently planned, prioritised and managed. (For more details, see page 9). We have a clear visualisation of the day when the GMT house's slide-off roof slides off, and assembly A-100 elevates its mighty eight-tonne bulk, historically accurate but at the same time technologically modern, glaring at the sky and embellishing the Melburnian skyline. 

PICTURE GALLERY



Assembly in the Cube - South face, showing the large friction-relief lever



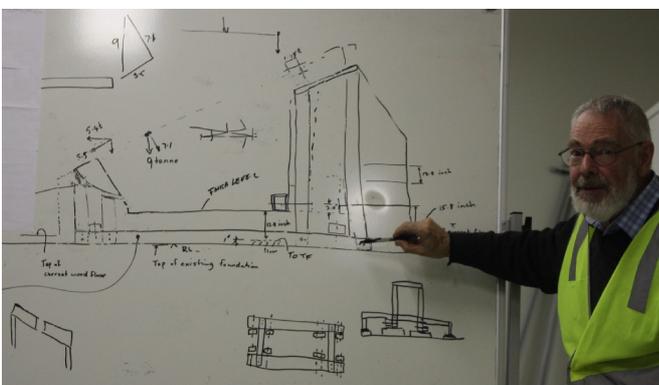
North face, showing the spigot that locates the friction-relief apparatus



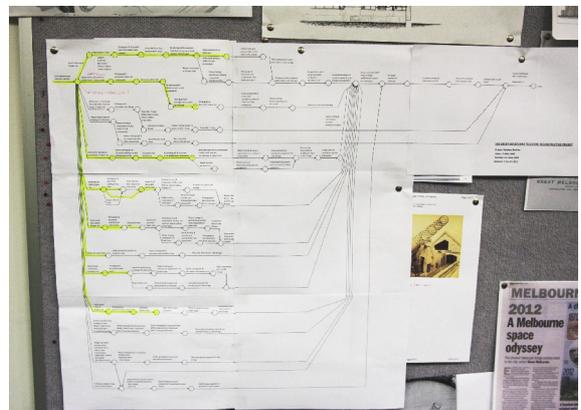
East face, showing Roller Assembly of the friction-relief mechanism



The Declination Axis Clamp Disk, long ago broken into 5 pieces but here re-assembled, pulled tight by the Clamp Ring itself and bolted to a plywood board. For safety and conservation reasons, a new casting is being made and will be machined to faithfully match the original in all details, except that the central hole will be circular instead of octagonal



Barry Clark anguishes about the proposed steel frame that will safely hold the telescope during reconstruction and ultimately reinforce the on-site North & South Piers



Steve Bentley drew up a Milestone Chart, whatever that is. If we ignore it, perhaps it will go away



Arghh! - A Deadline!!

I love deadlines - I like the whooshing sound they make as they fly by ...

Douglas Adams

Melbourne Observatory celebrates its 150th anniversary in October 2013, so we reckon it would be cute to exhibit the GMT “as restored so far” around that time. This implies that we should HAVE at least a partially restored Great Melbourne Telescope to exhibit. We hope to be able to display the reassembled Telescope Tube on the complete Polar Axis, mounted on new steel frames, and a partially completed Declination Axis. We also hope to display a replacement for the missing upper section of the Lattice Tube, thus restoring the Telescope Tube to its original size and length.

It will not be feasible to place the GMT in the GMT House at that time, nor to have it fully commissioned and it won't even rotate on its axis (it will need to be fixed in position, for safety reasons), but as exhibited, it will look as if it *could* rotate. For the first time since restoration began in 2009, visitors will be able to see its sheer size and appreciate the quality of its general appearance, and get the flavour of how it will work mechanically.

As a by-product, we would be pleased if some additional sponsors could become impressed with our work thus far, and thereby become motivated towards helping us complete the restoration process and rendering the telescope optically fit for public use.

NEW MUSEUM VICTORIA STAFF AND ASV VOLUNTEERS

We welcome **Matthew Churchward** - Senior Curator, Engineering & Transport, and **Matilda Vaughan** - Curator, Engineering, with MV Humanities Department, who have taken over curatorial oversight of the GMT Restoration Project, continuing the work previously done by David Crotty. This increased commitment has stimulated the progress of our work!

Also we should mention Graeme Bannister, John Cavedon, Mal Poulton, and Chris Atkins, among the ASV volunteers heretofore unsung who have joined the GMT team. All these people are seen working hard every Wednesday (except for absences*) and we have a lot of fun getting on with the job. Constructing something is very rewarding.

* That disclaimer reminds me that every shop in Russia, where I have just travelled, is obliged to display its opening hours, but in reality the staff need to nip out for smoko or lunch, so the signs typically say “The shop is open from 0900 until 1800, except for when it isn't”.

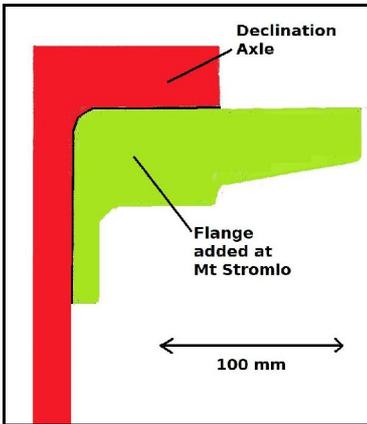
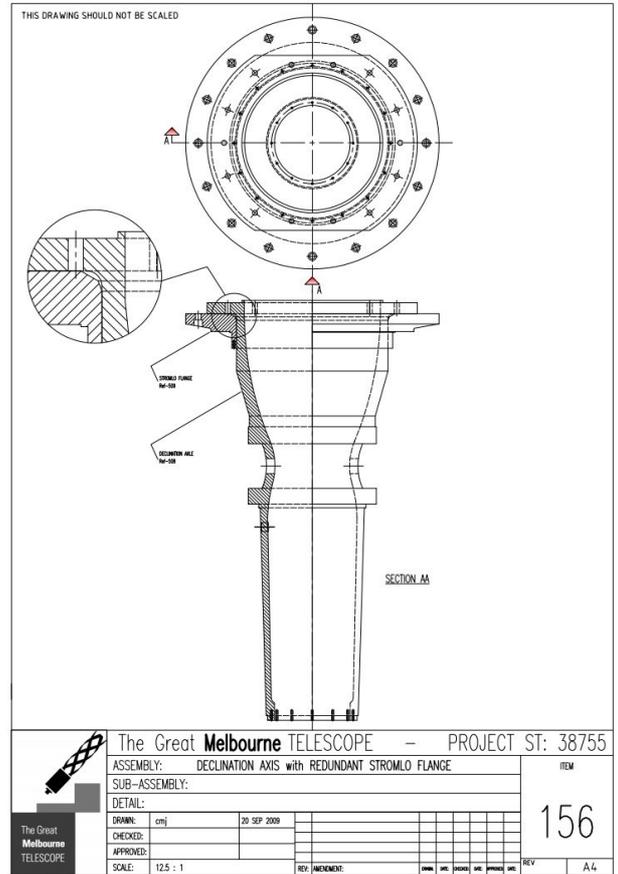
The effect of all this is, that we now have a **mid-term target to aim for**; and when dates are placed into project-management Gantt charts and the like, they spawn sequences of earlier dates by which other things have to be done. And, some of those dates are really quite soon, so we have suddenly acquired a focus for many of our activities.

Therefore, tasks are now being prioritised, resources estimated and deployed, jobs brought forward or put back, meetings held, coffee and lunch breaks ruined, all with the worthy intention of attaining this deadline - which is about 12 months away and which, in truth, is a very important step on the way to completing the restoration of the whole Great Melbourne Telescope. 

The Axle and the Flange



We have a slight problem with the Declination Axle - a key component that allows the telescope to rotate in the equatorial plane. On close examination, this was found to consist of most of the original 1868 Grubb axle, made of cast-iron, with a steel flange added at Mt Stromlo in the 1950s. The flange is radially 200 mm wide and axially up to 75 mm thick, with a thin sleeve extending a further 65 mm along the axle. We need to remove it, so that the axle can fit back into position in the restored telescope; but no amount of pushing, hammering, cursing or praying has been able to shift it.



The diagrams show the top of the Declination Axle and its intimately associated Stromlo Flange in cross-section; the outside diameter is about 1 metre. We have been told that the Mt Stromlo technical staff shrink-fitted this flange - that is, it was heated to make it expand and then placed over the axle, so that as it cooled and contracted it grasped the axle, with a grip of, er, astronomical strength. It is a neat example of fine engineering, beautiful to behold and admire ... it's just that

it is now getting in the way of our historical restoration.

Page 5 of Phoenix #3 described the removal of these two parts - still stuck together - from the Cube, during our workshop #5; and here they are, suspended in space, while we enjoyed an unjustified feeling of victory in those heady days of mid-2009. We are now on workshop #164 - so this has been bothering us for 159 Wednesdays.

Reversing the shrink-fit process, we could simply heat the flange up again to release it, but the heat would rapidly be conducted to the Declination Axle itself, causing that also to expand, resulting in no net flange freedom (apart from the risk of fracturing the historic cast-iron axle). We toyed with other bizarre ideas, such as sawing through most of it and then drilling a line of holes or angle-grinding the metal inaccessible to a saw blade; or packing the hollow axle with bricks of solid carbon dioxide while frantically heating the flange with blowtorches and then belting it with sledgehammers; or putting a heavy plate across the other end of the axle, attaching a few threaded M20 rods and screwing nuts down on those to pull it off slowly; or using a fifty-tonne press to produce the same result; or all of these techniques, together.





Staff from the Scienceworks engineering workshop also discussed trying to push the flange off with large hydraulic jacks. Our greatest concern, which led to this idea also being abandoned, was the fear of cracking the original axle casting, structurally weakening it and rendering it unreparable.

These mechanical wizards generally agreed that it'd be quicker to mount the whole thing on a huge lathe (we have access to one big enough, in Altona), and machine a cut that would detach an annulus of most of the flange, then machine the rest of it down into nothingness. Essentially, the flange would be flensed and then flung, ending its flight as it flops onto the floor.

So, watch this space, as we joyously anticipate further developments and seek a solution, in this Tiresome and Tedious Tale of the Axle and the Flange.



“Flange” was first used as the **collective noun for baboons** when Rowan Atkinson, costumed as a literate gorilla, used it in a very funny 1980 TV sketch (<http://www.youtube.com/watch?v=beCYGm1vMJ0>); it has since entered the English language, and has cropped up in scientific papers in the field of baboon studies.

Collective nouns enjoyed a great popularity around 1900, but they date back to at least 1486 (*a Sentence of Judges, a Fightyng of beggers*, etc). As a schoolboy (which was, um, not long after 1486) I had to learn many of them, and more have since been added - *a pride* of lions, *a murder* of crows, *a parliament* of owls, *an absence* of waiters, *a fraid* of ghosts, *an annoyance* of e-mails, *an attitude* of teenagers, *an unemployment* of graduates, *a school* of whales, *a University* of Wales, etc. Even flanges themselves have one - *a fancy* of flanges - but we are having enough problems with just the one, thank you.

There should be a collective noun for collective nouns, and this has indeed been addressed, suggestions including: *an iteration*, *a collective*, *a shitload*, etc. Sorry, but three years of flange-mania has taken its toll of my sanity.

New Stillage for the Mirror Grinding and Polishing Machine



One of our volunteers, David Linke, is almost single-handedly reconstructing the Mirror Grinding and Polishing Machine (the name given to it in the original Grubb paper of 1868; I'll use MGPM for short). The MGPM was associated with the GMT from the time of its very first design, since a speculum-metal mirror requires regular polishing to maintain its reflectivity, and is a unique historical artefact in its own right. Restoration now being somewhat advanced, a partial reassembly is in order, so David

asked Museum Victoria to build a *stillage* on which the MGPM could be assembled and transported. A generous private donation funded its fabrication.

“Stillage” is a word familiar to museum collection managers, but I had to look it up - “Stillage - a frame or stand for keeping things off the ground, such as casks in a brewery”. An obvious line of necessary and useful research immediately sprang to my fevered mind ... and during the highly relevant and essential field work entailed, one could also compare it with “ullage”, the propensity of stored whisky to become reduced in volume by unseen means. Here's a typical stillage, set up to expedite the smooth progress of Warwick University's Student Beer Festival.



As the MGPM will weigh over 2 tonnes when assembled, it clearly ought to be standing on its own stable and firm base, which should very preferably have fittings to fix it in place, as well as fittings to assist in lifting, transporting, storing and exhibiting the fully assembled machine safely. That is, a stillage; the staff at Scienceworks' Engineering Workshop promptly knocked one up, and at the following week's workshop the finished item appeared:



Now all we have to do is reassemble the MGPM (including the manufacture of a few missing parts, and replacement of the bearings) and put it on top of that - and as you can see, by the time I brought the camera in, the trial fittings for assembly on the stillage had already begun. The finished machine will be mechanically in working order but, despite its name, it will not actually be used for grinding and polishing any mirrors.

However it is intended for public display, probably alongside its former victim - the GMT's original 1400-kg speculum-metal mirror. And here indeed is that historical mirror, gazing balefully over the assembly of the very machine that so often ground it down. Rather poor taste to assemble it here, really.



The Quest for a Mirror for the Great Melbourne Telescope



By Jim Pollock

The restoration of the Great Melbourne Telescope has now been in progress for more than three years. One of our key challenges is to re-equip the telescope with a new primary mirror. Originally, the GMT had a 48-inch diameter mirror with a focal length of around 30 ft, working at about $f/7.6$. The GMT was the first large Cassegrain telescope ever built and mounted equatorially, and its two primary mirrors are of equally immense historical importance as being among the last large speculum-metal mirrors ever cast and polished. Our sole surviving GMT speculum is simply too historically valuable to use in the refurbished telescope; and in any case its metal surface has a tendency to tarnish, and needs to be refigured every time it is re-polished.

Therefore we need to find a replacement mirror, and for many months now the ASV has been searching for a suitable candidate. In October 2011, the ASV GMT restoration group was visited by Trudy Bell, an American science journalist who was very impressed with the work that we were undertaking. Trudy is a member of the US-based Antique Telescope Society, was a former editor for *Scientific American* and is on the editorial staff of *Sky & Telescope* magazine. Being amazed that so much of the GMT was available for restoration, she immediately set about publicising the demolition of two of the great myths that have surrounded the telescope. Firstly, as Barry Clark's research discovered, it was *not* a gigantic failure, as claimed by George Ritchey of Mount Wilson Observatory fame*. Secondly, it had *not* been totally destroyed in the 2003 bush fires. Trudy also publicised the fact that the GMT restoration project needed a replacement 48-inch mirror.

Within weeks, we received news that a surplus, very high-quality 48-inch mirror had been located in California. It was owned by a US-government agency and was, would you believe, "Free to a Good Home." Further enquiries revealed that, not only was this mirror available, but its associated observatory-quality, alt-azimuth mounted telescope was also available at no cost. The hitch was that the new owner would have to pay for its shipping from California - all 35 tonnes of it!

The ASV restoration group immediately moved into top gear. From our contacts in California, it appeared that anyone who put in a bid for the *entire telescope* would be the front runner and would probably be given the telescope, its optical train and all its accessories at no cost. However, if a bid were submitted only for the optical train, the University of Arizona had already lodged a competing bid, and they were known to be the preferred recipient.

* George Willis Ritchey was the optician responsible for the 60-inch reflector of 1906, and went on to commission the 100-inch reflector, both at Mount Wilson in California. In 1904, Ritchey wrote "I consider the failure of the Melbourne Instrument to have been one of the greatest calamities in the history of instrumental astronomy; for by destroying confidence in the usefulness of great reflecting telescopes, it has hindered the development of this type of instrument, so wonderfully efficient in photographic and spectroscopic work, for nearly a third of a century". But the accuracy of Ritchey's pronouncements should perhaps be treated with caution. In 1908, when the 100-inch mirror blank was examined before work began on grinding and polishing, Ritchey rejected it on the grounds that two layers of fine bubbles in the blank rendered it useless. His opposition to the use of the blank continued for almost the next decade and it was not until the mirror was completed and the telescope's initial teething troubles were overcome that Ritchey accepted that his earlier criticisms were unfounded.



The 48-inch surplus telescope mirror sitting in its cell in California. The mirror and its telescope were “free to a good home”, but American red tape defeated us.

Sadly, from then on, problems began to arise. First of all, did the ASV want a complete 35-tonne 48-inch telescope? What would we do with it? Where would we put it? What would be the cost, not only of getting it here, but installing it in an appropriate building? Would we have the manpower available, given that we are already heavily committed to the GMT restoration project? Most importantly, would this be a good use of ASV members’ funds?

If the ASV wanted to trump the Arizona bid, we would have had to bid for the entire telescope. Cost estimates for shipping the telescope, from Long Beach near Los Angeles to Melbourne, came in at around \$60,000. Even to airfreight just the mirror in its cell would have cost \$10,000. A further problem was that the mirror cell used a flexible collar to support the edge of the mirror, and this contained about 5 kg of mercury. Mention “mercury”, and freight forwarders and shipping companies run for cover; airlines have a screaming fit, even over a single thermometer, because mercury attacks aluminium. (Americans attack it too, calling it “aluminum”)

A potentially fatal problem then emerged. As the mirror and telescope were owned by an Agency of the US Government, they could be passed on (gifted or sold for a nominal sum) only to another US-based entity. So, we investigated the possibility of asking another US-based group to acquire it first (perhaps a museum or amateur astronomical group) and to pass it on to the ASV, but each line of investigation came up with even more problems.

Thus, the ASV’s plans to acquire either the complete telescope, or just the mirror for the GMT were thwarted by US governmental red tape and finally came to nothing. On the other hand, our circle of astronomical contacts, particularly in the US, has expanded greatly. The fact that the GMT project is actively seeking a 48-inch mirror is better known and we now have a network of people who, enthused by our restoration efforts, are now looking out for something that might suit our purpose. 

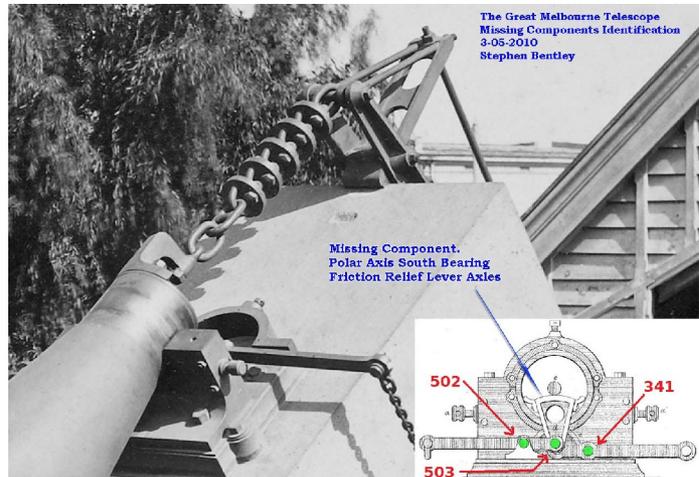
Revision of Nomenclature of Parts and Assemblies



Now that we reckon that we understand the location and purpose of most of the 700 parts that make up the GMT, we have begun the task of reorganising the nomenclature system for identifying each part and its associated drawings and paperwork, so that components can be more conveniently grouped together into assemblies and sub-assemblies of related parts, and sorted into a logical order. In the new schema separate numbers (or letters) will be assigned to each assembly, sub-assembly and part, with gaps in the sequence to allow the addition of new sub-assemblies and parts as they are invented or required. At the same time, all the drawings and part folders will be edited and relabelled to introduce more consistent part names.

For example, part 341 is currently called “Right Ascension Axis South Bearing, Eastern Friction Relief System Lever Pivot Axle”. Now if assembly D were the RA axis, D-3xx its south bearing and D-370 the lateral friction relief mechanism, then it would become part D-370-0341 and would need only “Lever pivot axle” to specify it:

- D Right Ascension axis -
- D-3xx - its Southern bearing
- D-37x - Eastern side of that
- D-370 - Friction relief system
- D-370-0341 - Lever pivot axle



This part, which is missing anyway, is shown coloured green in Steve Bentley's edited picture. With all this order where chaos once reigned, I can't resist having a go at it in German, as it'd be a single word: *das Rektaszensionsachsesüdkursöstlichreibungserleichterungssystemdrehachse*.

Similarly, if assembly F were the declination axis, F-5 its counterpoise lever system, and F-510 the west roller assembly thereof (visible, as it happens, at top right on page 2, through a side window of the Cube) then F-510-0373 could be “central plate bolts” instead of “Declination Axis Counterpoise System West Roller Assembly centre plate fixing bolts” and of course in German - *die Deklinationsachsegegengewichtssystemwestlichwalzermontagezentralstückbefestigungsschrauben* (in the plural, because there are three of them!)



For safety reasons we will be replacing all critical GMT bolts with new ones; so imagine us fronting up in the hardware shop and asking “Guten Tag, drei Deklinationsachsegegengewichtssystemwestlichwalzermontagezentralstückbefestigungsschrauben, bitte” ... and very possibly getting the reply “Ach, heute haben wir keine Deklinationsachse....” - look, you get the idea. (The idea is, that I get paid by the column-inch). 



Steve's Adventures in Moreland

At this latter end of my life, and after a 35-year break from motorcycling, I bought myself a secondhand BMW motorbike; when I spoke of it I called its colour “red” but it was strictly called “maroon” - a dark, subtle sort of colour. And of course I began riding it to the GMT workshops,

parking it around the back of the premises where it would be generally out of sight - we BMW riders do like to keep a low profile, you know. It was also almost silent when running - not like those yobbo Hardly-Ablesons that make a noise like a cow crapping as they splatter down the street. Anyway at one workshop soon after I bought this bike, there was this cute little Vespa scooter prominent in the car park. As the ASV volunteers came in one by one, each one said “Hey Steve, is that your red motorbike outside?”; no it is not mine - I would not be seen dead on that thing. Morning Steve, is that your ... No It Is Not!! ... and so on, for the whole morning.



Then just before lunch, Neville came in to see how we were going along, and we could all feel the tension in the air, knowing what was going to happen; and sure enough when he saw me, he began with “Is that your ...” **NO IT IS NOT!!** Mine is bigger. And I don't think a red Vespa would carry me for the 28,000 km I just did on a (another, new) BMW across half the planet.

I had motorbikes in my student days, in London, and these were British: Triumph 650 and the like, having nuts and bolts with Whitworth imperial threads, as found on the Great Melbourne Telescope. They leaked oil all the time. Now, the other day I was looking at the route from my house to Moreland, on Google Earth (which sometimes joins up the pictures badly), and I was surprised and delighted to see this road sign. Perhaps there are British motorbikes somewhere around here.



DONATION FOR BUYING WORKSHOP TOOLS

As we moved towards making the missing parts of the GMT earlier in 2012, we identified a need to have some basic workshop equipment and tools - lathe, saw, bench, vice, spanners, milling machine, machine tools, etc.

We are now pleased to report that the GMT project has received a donation from a budding hobbyist of **sufficient funding to buy such tools**, which will be loaned for the duration of the project, reverting to the donor when the project finishes. MV is working on the provision of proper workshop space, power sources, marked areas and lanes etc to accommodate these tools when they arrive, complying with Operational Health and Safety requirements. Now we are looking forward to actually getting our hands dirty, and making things!

PHOENIX Issue 7

© Astronomical Society of Victoria, 2012

Written/edited/layout by Steve Roberts,
for the GMT Restoration Project

Distribute freely! Download this & back issues, as PDF files, from:
www.asv.org.au/greatmelbournetelescope.php
www.greatmelbournetelescope.org.au/newsletter