Phoenix

Astronomical Society of Victoria Inc.
(A.I.N. A0002118S)

Issue 2 – August 2009

The Newsletter of the Great Melbourne Telescope Project

Latest Developments

In this second issue I am delighted to report that dismantling of the polar-declination axes assembly has begun and is proceeding well. The ASV's committee have been attending on Wednesdays at the Museum Victoria (MV) store. This work, on the largest piece to come from Mt Stromlo, will help us to establish whether reconstruction of the GMT is feasible within the constraints of heritage legislation; so far, no major technical or engineering problems have arisen. The major article in this issue gives merciless details of how we dismantled the Hour Angle drive.

We are concerned that the fire-exposed metal of some parts of the axis assembly may not be as strong as it used to be. One of our volunteers, a materials scientist, will soon be able to make a professional inspection of the quality of the metal. ASV is still exploring with MV how more volunteers can be included effectively in the work sessions.

Drawing and description of the original parts has begun. It takes more than a day to examine and describe each part … you can't just write "It's a rusty old bracket". A future article will show this process in more detail, especially as we envisage that volunteers could help, once our methodology has settled down. We estimate that it will take at least one year to describe the parts, following which a Conservation Management Plan can be developed for the instrument. This pace accords with the timescales perceived by the three parties involved - ASV, MV, and RBG; and it is not a slow pace, because there is so much work to be done. Heritage Victoria will be consulted on the project at the proper time.

MV have been busy with setting up and running their excellent Pompeii exhibition (this is really stunning - you should go and see it, and if possible, not in the school holidays), but have also found some time to progress work on the web site. The Web domain has been reserved, but the site is not quite ready to go up yet. The logo for the project has been agreed in principle - see the article on the last page of this issue.

Most of this and the next issues of *Phoenix* will be taken up with details of dismantling some of the hardware, but that is really because some cute pictures can be included. An even greater effort is being expended on the paperwork and back-room tasks such as describing, measuring and drawing the components, and these tasks will continue long after all dismantling has been done. Steve Bentley has drafted some technical Fact Sheets - so far there are nine - the idea is to have an informative A4 sheet for each interesting aspect of the telescope. Articles in future *Phoenices* will present a more detailed description of these tasks.

Steve Roberts, editor

OUR WORK ENVIRONMENT

Members of the ASV sub-committee have established a regular method of working at the Museum's premises. We attend on Wednesdays, and do all our work in one of the loading bays of the storage building, which has a 10-ton overhead gantry crane. One or more MV staff are always present and actively work with us. Neville Quick, MV's Manager of Collection and Research Facilities, is also a qualified crane dogger; we have found the gantry crane to be indispensable for positioning and turning over the workpiece, and for holding and removing the heavy parts as we detach them.

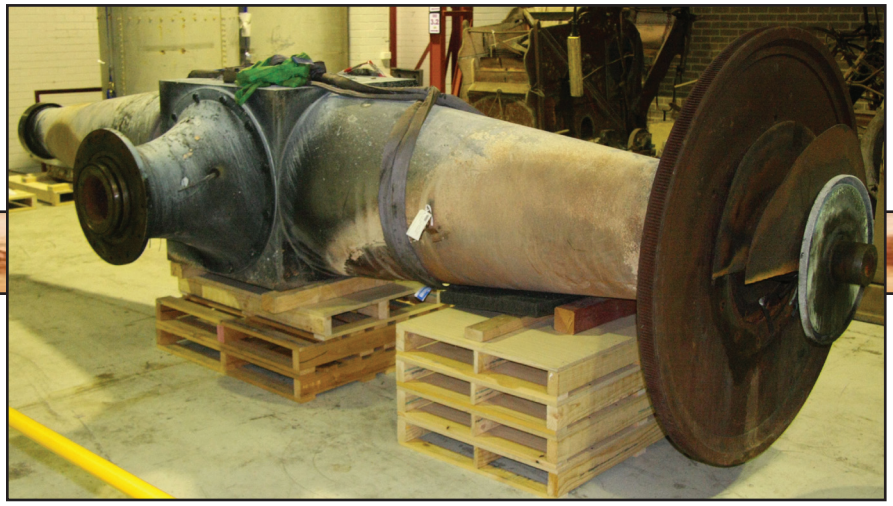
So far, the loading bay's real estate has not been needed for any other purposes, so our work has stayed undisturbed between workshops. But the down-side is that this particular part of the building cannot be heated! We walk to it through a nice climate-controlled area; but when we pass through the mighty security/fire doors into our area, the cold air hits us like a brick wall. It'll probably be too hot in the summer.

MV has provided adequate mechanical and measuring tools, a camera, lights, and a photography station; but we also bring our own tools and cameras, supplementing those already provided. We've had to make a couple of trips to the hardware store, and one of the MV staff has, on occasion, nipped out to fetch his own tools from home. Thus, we've had no problems with tools or the working environment … apart from the temperature!

One tedious thing, to be expected with all machinery, is that just to touch the workpiece tends to leave dirt, rust, and/or a sticky black grease on one's hands. Washing grubby paws has become an enduring feature of our work. Even then, our tools, cameras, papers and computer keyboards are starting to acquire unwelcome marks of grime.

REMOVAL OF HOUR ANGLE DRIVE GEAR FROM NORTHERN CONE

This mighty effort was our first job - I won't call it a baptism of fire, as the GMT has already had one - and is best described as four tasks. I am pleased to report that, as you will read below, we have succeeded and we are now ready to remove the northern and southern cones themselves.



Here's the assembled two-cone polar axis assembly, with the declination axis running through the cube. The right-hand cone is termed the "Northern Cone" because it pointed at the North Celestial Pole (down through the Earth) when the telescope was in its working location. Prominent at its end is a 60-inch (1500 mm) solid iron worm wheel with 480 teeth around its circumference - about 5 teeth every 2 inches. For operation at Mt Stromlo, this disk was driven by a worm gear to turn the entire assembly, with telescope attached, about the polar axis - that is, altering its Hour Angle (so as to keep the telescope pointing at a given Right Ascension). In the original instrument, the moving parts weighed over 8 tons.

Task 1 - Removal of Cable Reel from Cone End

Picture 1 shows more detail of the HA drive gear and a smaller, corroded brass or bronze toothed wheel nearer the end of the shaft. In between them is half of a reel with electrical cables (the other half having been sawn off and discarded at Mt Stromlo). This reel had to be cut further with a sabre saw to allow its removal before anything else could be freed. **Picture 2** shows the cable reel now detached, with some of the badly-burnt copper cables trailing out of it.

Picture 1

Picture 2

Task 2 - Removal of Toothed Wheel from Northern Cone Hub

This small toothed wheel was probably added at Mt Stromlo, for sensing the telescope's position in Hour Angle. It appeared to be attached to the shaft by a retaining ring fixed to the hub by six socket-headed screws, one of which was found broken. The remaining screws were removed, with difficulty, but this did not release the toothed wheel or its ribbed protective housing. We then realised that the wheel was an interference fit onto the hub, and there was no way to get purchase to pull it off, short of building a 20-inch cog puller or hiring the only one known to be available, which was hours away in Mornington.

Picture 3

However, we were able to get a hydraulic (bottle type) car jack between the hub of the 60-inch HA drive gear and the wheel. The jack was nearly horizontal, which led to problems with its internal oil pump needing to be primed. By pressing on the housing with the jack, we were able to distort it to press against the toothed wheel, but the wheel distorted instead of moving. MV then provided three 8-tonne truck jacks, and by pressing at two or three points (**picture 3**) we were soon able to crack a gap. Repetition of the technique at points all around it eventually moved the wheel and its cover off the shaft completely.

Task 3 - Separation of HA Drive Gear from Northern Polar Axis Hub

We suspended this 60-inch gear on its own sling under the gantry crane, to take its weight on detachment, and then removed the bolts that held it and the hub to the northern cone. These bolts had previously been loosened - **picture 1** on page 3 showed Neville expending the effort that we now know is typical for loosening any GMT nut or bolt. Here's a picture of one of the bolts (**picture 4**); the exposed threads are wet with WD-40, but it has not penetrated to the threads that were initially inside the nut. Of relevance, therefore, is that most of the threads are generally undamaged and not significantly rusted.

Picture 4

This is a 1950s Stromlo nut and bolt; but we later found that earlier Imperial threads were in similar good condition, which raised our hopes that all the bolts might come out easily, once started, even when the bolts, nuts and surrounding metal were rusty. All bolts had been done up very tightly, and of course that was under *sliding* friction until the rotation stopped; to undo them meant overcoming *static* friction, which is greater. We grew to relish the sound of the "crack" as a nut or bolt suddenly began to rotate under our ministrations. That, and the smell of WD-40 in the morning ...

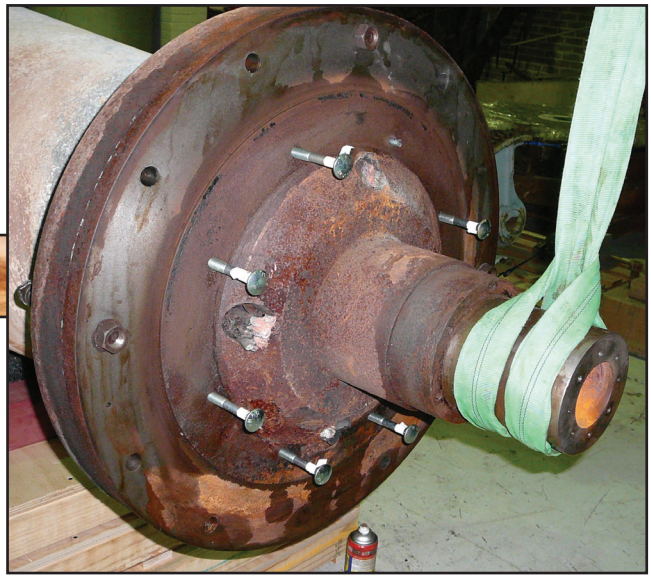
Now, to remove the drive gear, we reasoned that because it was so large, it would give plenty of leverage at the hub; and we possessed some drawings of the modifications made at Mt Stromlo, which showed a relatively small area of contact between the gear and the hub. The entire axis assembly was lying East-West on its pallets, so Neville simply sent the gantry crane about a metre to the East, which pulled the gear off the hub and left it hanging majestically in space, as if in an exploded diagram. **Picture 5** shows the three Barries availing themselves of this photo-opportunity. It only remained to lay the disk down on a new pallet (everything in the MV store lives either on a pallet, or inside a numbered grey box) and, of course, to *strap it to the pallet* and *label it.*

Picture 5

Task 4 - Removal of Polar Axis Hub from Northern Cone

The northern cone is not an original part, but was added by Mt Stromlo engineers in the 1950s to allow the telescope to continue observing an object for longer after its meridian passage. A careful study of their engineering drawings revealed that the cone's function was to fit into a circular recess on the face of the cube and present an identical recess at the cone's other end for the original northern hub of the polar axis to fit into. The recess presents a face about 35 mm deep around a 570 mm circle, in which the hub for the Hour Angle gear fits. We feared that the mating surfaces may have been rusted together, but they turned out to be in good condition, with only a slight colouring of rust; only friction and accurate Stromloidal engineering were holding them together.

However, the hub would not budge off the end of the cone, despite some judicious tapping and levering. The solution came to one of us while lying half-awake at 4:30 one morning: the hub had a circular array of eight threaded holes about halfway out from its centre. These had not been used for a long time, and would have been part of Grubb's original 1868 configuration. Long enough bolts screwed into these holes should pass right through and press on the inner surface - the end of the cone - thus pushing the hub away from it.



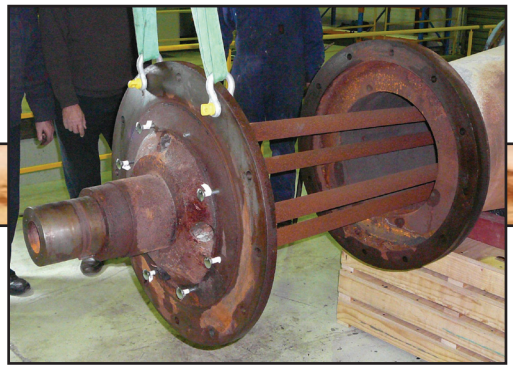
Picture 6

We determined that these holes had been tapped with a 1/2" Whitworth thread, so someone was sent to a nearby hardware store to buy eight long bolts with 1/2" threads. The only stocked bolts long enough were coach bolts, but they would do. Meanwhile, we had carefully cleaned up the threads in the holes, and on screwing in the oiled coach bolts, at the right depth we felt them press against the inner surface. **Picture 6** shows the situation at that stage; note the three capturing bolts in the outer circle, and the taut crane sling, each able to take the weight if a sudden separation occurred. We then continued to turn the coach bolts by half-turns, using about 100 Nm of force on each of them in a staggered order, using a long-handled socket driver. Imagine our elation as a small gap appeared and the hub began to slide out of the end face of the cone. However, we were not able to lever it out - we had to push it all the way using the coach bolts.

With the hub completely detached but retained by the three outer bolts **(picture 7)** and stable, we attached crane slings to holes in its upper part, removed the three bolts and began to pull it out by sending the gantry crane East **(picture 8)**.

The hub had four steel pipes which served as conduits for electrical cables, running inside the northern cone along its full length; these once fitted, with a rubber lining, into the back of the hub and into the face of the cube, but now they were firmly stuck to the hub by burnt rubber. The pipes therefore pulled out from the cube instead of the hub, but the cables stayed attached to the cube and, with their burnt insulation, they exerted a significant friction as the pipes slid along them. Anyway, with the hub and pipes gone, for the first time we could see clearly into the cone; **picture 9** shows the inside of the "cube end" of the cone, with four bunches of burnt cables coming out of it. Note especially the 12 rusty bolt heads around the edge of this end face. These attach the cone to the cube; and undoing them will be a story for *Phoenix* issue #3.

Picture 7



Picture 8

Picture 9

GMT PROJECT IDENTITY AND LOGO

Museum Victoria's professional design staff were supplied with details about the Great Melbourne Telescope and our proposal to restore it, plus some photographs of galaxies that were made by the GMT in the 19th century. (You can see such photographs at the free "Shared Sky" exhibition at the NGV in Federation Square.)

The requirement is not only for a logo(*), but also for the design and layout of Web pages, letterheads, business cards, compliments slips, e-mails, and the formatting of posters and the Fact Sheets … and of *Phoenix*.

The MV team came up with three alternative themes. The first one was based on a photograph, taken by the original GMT, of a curious 14th-magnitude ring galaxy (probably AM0644-741 in Volans at R.A. 6h43m, Dec -74º14'; a spectacular Hubble picture of this gravitationally disrupted galaxy is at http://apod.nasa.gov/apod/ap051022.html), with stars of various sizes scattered across the picture. This photo went well with a sparse, clean format using blue and gold colours for sky and earth, and it made a good ring-and-dot abstract logo, but we felt it was too remote from the nature of the telescope itself, and would not easily be connected with it in the public's mind.

The second alternative was based on the same photo but now made entirely abstract, with strongly coloured blotchy circles on a starry background. This looked a bit like a plate of decomposing fried eggs, in my humble opinion, and generally it did not appeal to the others either, although the ideas would be suitable for a more abstract project (especially one involving fried eggs).

The third design used two basic elements - the profile of the original telescope with its northern pier, and a tapering cylinder of the lattice structure of the GMT's tube. We liked this very much, as the lattice tube will be a prominent feature and is practically unique to the GMT, in both its original and restored forms; and in the designs, the reader's eye is drawn to look through the tube to see the stars. The incomplete silhouette of the GMT looks too much like a gun, but that will be fixed. It may be feasible to hint at the lattice structure, in the silhouette.

This third design has now been agreed upon by the three parties MV/ASV/RBG, in its approximate form. MV will refine it from there, and I hope to be able to use it for *Phoenix* and indeed, all future printed GMT materials will have this common design.

THE LONGER TERM VIEW

The dismantling work is a pilot phase, of necessity limited to the limited numbers of ASV people (all inducted as Research Associates) that MV can practically handle. At this stage we are still exploring feasibility and looking for reconstruction barriers that could or would block the project; but we are also gaining experience and developing methods of working that can be adapted to provide work allocation, safety and supervision of additional individuals from the volunteer list. Not least of what has been achieved so far is a demonstration that the ASV can be relied upon to work safely, competently and harmoniously with the full-time MV staff.

The sub-committee members and team leaders all have relevant professional qualifications and skills including engineering, physics, chemistry, electronics, computing, history, communications, management and administration, as well as their interests in amateur astronomy. However, we are aware that our volunteer force also possesses significant skills - some of which we do not have - and we fully intend to make use of these, when working conditions allow.

Even now, after a few workshops at MV's store, the mechanical and drawing work we have done so far still represents much less time and effort than that spent by the ASV sub-committee on the paperwork, research, management and liaison aspects of the project. An enormous amount of work is still to be started! Thus, there will be an expanding scope for other ASV volunteers to contribute as the project gains momentum through steady progress. Despite this initial work being done, we are still in the feasibility stage now; then, beyond the reconstruction phase, we hope there will be re-installation, commissioning, operation, and management, in all of which the volunteer opportunities should be even more extensive.

(*) Which, being an ex-Pom trained in classical Greek, I correctly pronounce "loggo"; everybody else seems to say "low-go".

***Phoenix* issue 2** - August 2009
Author/Editor: Steve Roberts,
for the ASV GMT sub-committee
steve@steveroberts.com.au

Layout: Richard Saunders