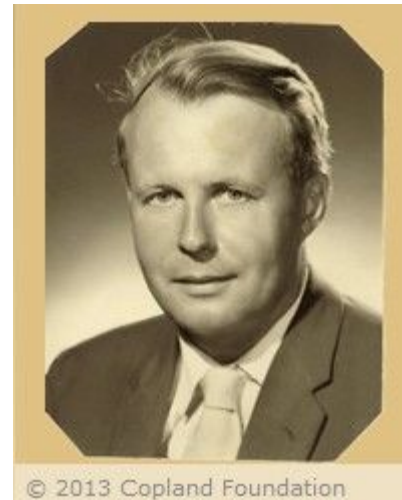


Sponsorships!

We are pleased to report that the Copland Foundation has pledged support of \$70,000 to the Great Melbourne Telescope Restoration project.

The Foundation was established from the estate of the late Alexander Ewart Copland (pronounced “cope-land”), whose family began with furniture manufacture and upholstery and diversified into property investments. After service in WW2 Alex became a renowned Toorak socialite, international traveller and keen collector of fast cars, but his real passion was for preserving old houses and their contents; he was an active Board member of the National Trust. But in later life, he became concerned about the environment; he sold his cars, he turned his back on high society and ran a backpacker hostel on Elizabeth Street, until his death in 2005. His estate gifted many of his collected possessions to art galleries and museums, including Museum Victoria, which received vintage motorcycles and scientific apparatus.



Among other charitable bodies arising from Alex's life and collections, the Copland Foundation makes grants to projects that Alex would have been interested in, including the acquisition or conservation of historic artefacts, especially for public display and education. The GMT restoration project falls within this scope, and after several visits and meetings the **Copland Foundation** was pleased to donate \$70,000 towards the costs of the project, for engineering work in the near future.

A major part of the project to date has been centred on recreating the original engineering drawings and records lost in the two bushfires at Mt Stromlo. We do have some of the more recent engineering drawings showing major changes made to the mounting at Stromlo, and this has helped in recreating the shapes and dimensions of missing parts. Methods have been devised for returning modified parts to their original forms and in many cases this will involve machining by lathes and mills larger than those on hand at the Museum's Scienceworks workshop. At least some of this work will attract commercial charges and other substantial expenses such as the purchase of large rolling bearings to replace those overheated beyond further reliable use in the 2003 fire.

As we have just started on this exciting stage, the Copland donation is very timely indeed.

We also have generous offers of support in kind from engineering companies, including **Marand Precision Engineering, Pizzey Engineering** and **United Service Technologies**.

Continued....

(continued from page 1)

La Trobe University has already contributed some numerically-controlled precision machining of smaller components; and consulting engineers **Beca** are well on the way with a gratis assessment of the rigidity and public safety of the proposed steel frames that will reinforce the basalt-clad concrete pillars for the polar axis.

Without this very public-spirited kind of support, we would soon find ourselves with the project at a standstill. It would also be hard to keep our team of volunteers intact if the workshop sessions degenerated into thumb twiddling and endless discussions about what we might have been able to achieve ... but how would we show that on the project's Gantt chart?



Bureau of Meteorology joins GMT Project!



Recognising the major 19th-century contributions of Melbourne Observatory to meteorological instrumentation, calibration, observations, data transmission, observer networking, analysis and forecasting, the Bureau of Meteorology has joined the GMT project alongside Museum Victoria, the Royal Botanic Gardens and the Astronomical Society of Victoria. **Welcome aboard, folks!**

The Bureau was established as a Commonwealth agency in 1907, uniting the various State meteorological services. Astronomical and meteorological work are closely related, and biographies of some dozens of workers across both fields, including Lt Dawes of the First Fleet, and Matthew Flinders, can be read at www.austehc.unimelb.edu.au/fam/1511.html

Robert Ellery, in the formative days of Melbourne Observatory at Williamstown in 1853, began meteorological as well as astronomical observations, and operated a time-ball as a definitive signal for ships to synchronise their chronometers. He may have instigated the choice of name for the neighbouring town after Altona of Denmark/Germany, the seat of *Astronomische Nachrichten* and the Central Bureau for Astronomical Telegrams.

Within a year or two the Melbourne weather readings were being made by Georg von Neumayer at Flagstaff Hill in West Melbourne. There was a Victorian colonial office of meteorology run by Brough Smyth, and it was actually called “Melbourne Observatory”; Neumayer took it over in 1857 until he left for home in 1863, at which time Ellery took over some of the functions of that observatory including the meteorological work, and moved them to the new Melbourne Observatory site in the Domain, south of the river Yarra.

Ellery set up the Victorian Weather Office and built up the telegraphic observer network steadily, as did Henry Chamberlain Russell at Sydney Observatory. Russell was the first in Australia to have a barometric chart published in a newspaper (circa 1880s) but Ellery followed a couple of years later, and in another year or two Ellery was the first to start issuing daily weather forecasts.

Continued....

(continued from page 2)

When the Bureau of Meteorology was formed, its headquarters was in Melbourne and all of its permanent staff with one exception were transferees from Melbourne Observatory - the exception was the Director, Henry Ambrose Hunt, who was from Sydney Observatory. The state observers' networks were taken over, the NSW contingent being the largest. After the takeover, Pietro Baracchi (who had taken over as Government Astronomer on Ellery's retirement) kept the Melbourne Observatory meteorological instruments working until about 1913; this ensured an exceptionally precise set of jump values to adjust the pre-1907 readings into a continuous set of data for the city. Baracchi was instrumental in influencing PM Alfred Deakin (who was also a Melbourne Observatory board member) to take over meteorology as a federal function.

The BoM celebrated its centenary in 2007-8, and acknowledges its existence as being derived from all of the colonial observatories. Locally, the Victorian Weather Office was based at Melbourne Observatory from 1863 to 1907; thus there is a very strong historical connection.

The modern Bureau is keen to have such pioneering work recognised, as well as to show how its current work adds to our knowledge of the ever-changing environment, in pursuit of which it is supporting the "Science Observatory" concept now being developed. There are many instances that illustrate the rich, joint history and the ongoing close, cordial relationship between astronomers and meteorologists. The interest and participation of the present-day Bureau of Meteorology in the restoration of the Great Melbourne Telescope, and in the general conservation of heritage at Melbourne Observatory, is most warmly welcomed.



FLANGE NEWS

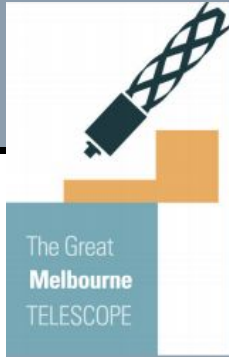
Around the big end of the Declination Axle, the heavy flange shrink-fitted by Stromlo engineers remains in place. OK, I suppose this is not really news, is it?



Substantial work is required at each end of the Axle, and this has now been planned and is ready for signoff. Our proposal, with regard to flanges, is to mount the Axle in a lathe (at an external heavy engineering company) and machine the offending flange down to nothing. Barry Clark has been pushing like mad for this process for some years, but he denies being a flange crazy.

Watch this space for photos and news of this process; fortunately, the sound of it will be transient.





MORE BUSHFIRES!

We at the GMT project express our deepest sympathy for the astronomical community at Siding Spring, where a ferocious bushfire on 13 January 2013 destroyed houses and property, including some of the buildings at the Australian Astronomical Observatory.

Several astronomers lost their homes but no lives were lost. The Anglo-Australian Telescope itself was threatened; its dome was sealed off to exclude dust and embers. Astronomical work resumed on 14 February, with the AAT pronounced undamaged.

This photo, taken by NSW Rural Fire Service, shows a destroyed auxiliary building with the intact dome of the AAT in the background.



Our good friend and supporter **Professor Fred Watson**, Astronomer-in-Charge of the AAO, said that lessons had been learned from the Stromlo fires of 2003 that destroyed the GMT and most of the other

telescopes. Since that particular tragedy, undergrowth has been kept cleared, and screens have been fitted to all windows of buildings, to stop burning embers getting in and starting interior fires.

Siding Spring Observatory

STARFEST

In Australia's Astronomy Capital

2013 StarFest

Science in the Pub - Bigger, Bolder & Better. Presented by Prof Fred Watson
Featuring: Prof Brian Schmidt, Prof Ken Freeman and Prof Matthew Colless

SSO StarParty - Public Three Night Star Party with Guest Astronomers
Telescopes, Sky Tours, Dark Skies, Camping, Cabins & Much More!

Bok Lecture - Presented by Nobel Laureate Prof Brian Schmidt in the Big Dome

Observatory Open Day - Telescope Tours, Astronomy Talks & Scenic Views

4th-7th October 2013 Numbers Limited - Book Now www.starfest.org.au

Australian National University AAO

The All New SSO StarFest is part of the Warrumbungle Shire's Festival of the Stars. Come Join the Good People of Coonabarabran and Help Celebrate Our Dark Skies!

Activity has returned to something like normal, and readers' attention is drawn to the forthcoming **StarFest** at Siding Spring:

www.starfest.org.au

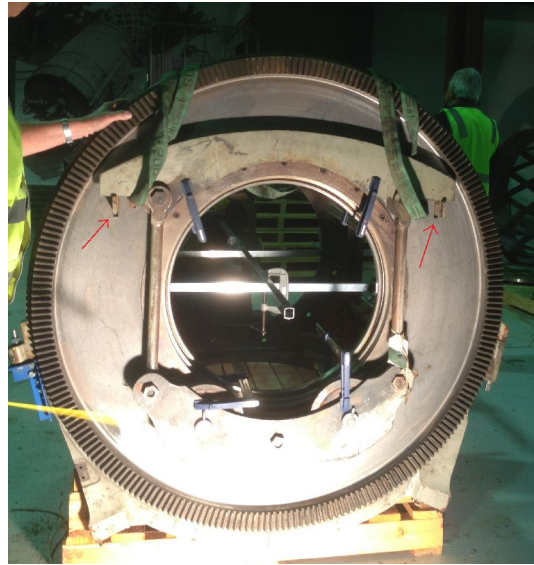
4-7 October 2013 

Picture Gallery - 1



The Cube and its Roller Frames

Trial assembly of components on the Cube has helped our understanding of how they fit, and of the tolerances required and available. Below/left we see the Cube, endowed with temporary aluminium Cartesian axes, with the new Declination Clamp Disk on the left-hand face.



The Declination Axle will pass through the clamp disk (as the x-axis) with its tapered outer end to the right, where it passes through the Lesser Roller Frame. This latter apparatus is visible, hanging from a crossbar between two long arms pivoted on the Cube. The left-hand ends of these arms, arrowed in the picture above/right, protrude through slots in the Clamp Disk and support the Greater Roller Frame, which in turn supports the thick end of the Declination Axle. A nut and thread on the Lesser Frame allows adjustment of the proportion of polar-direction loading carried by the roller frames relative to the loading on the original plain bearings of the Declination Axle.

A ghostly glow from a modern electric light illuminates Barry Adcock and Graeme Bannister. This is not a permanent feature of the Great Melbourne Telescope, not even if we go back to the candles and gas lamps that were in use in 1868!



The Declination Axle and the Cradle



Here Graeme Bannister measures up against the hovering Declination Axle, ready to gain mastery over it, subdue it and lead it willingly to a new location



With bated breath he makes the Axle hover over the Bell Housing, which is mounted in the storeroom's loading bay like a great cosmic plughole.



The Axle fits into the Bell Housing - the Cube should be filling in the gap. Whatever would Sigmund Freud say?



The Cradle is located and bolted on top of it. The telescope tube will sit in the Cradle, but not yet!

OUR NEW TIDY TOOL RACK

Neville, the Museum's store manager, disapproved of us using the telescope parts as a tray for loose tools. What a pity - the 270 kg mirror cell back plate was particularly suitable for this purpose.



So he built us this nice rack for tools, in the hope that we'd actually put the tools away!



Neville is very keen on safety, of course, and would not like to see anyone cleaning the church clock like this

The Mirror Grinding and Polishing Machine

David Linke has now assembled the major parts of this two-ton behemoth. Last issue you saw the bare stillage - well, here it is again, with a fair bit of the MGPM built upon it. Scienceworks staff and volunteers have been particularly helpful in getting parts of the MGPM to sit still, as required while other parts are moving. The last known use of the machine was in the 1950s and we have yet to decide exactly how some of the original parts, that are now missing, looked and functioned.



David sawing the end off a specially made steel strut that holds the two sides of the frame together



Rear view of the MGPM - the backplate (not yet fitted) attaches to the two vertical areas

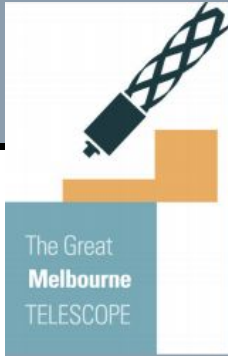


Front view - the circular table upon which the 1300-kg metal mirror sat; it must have been very top-heavy



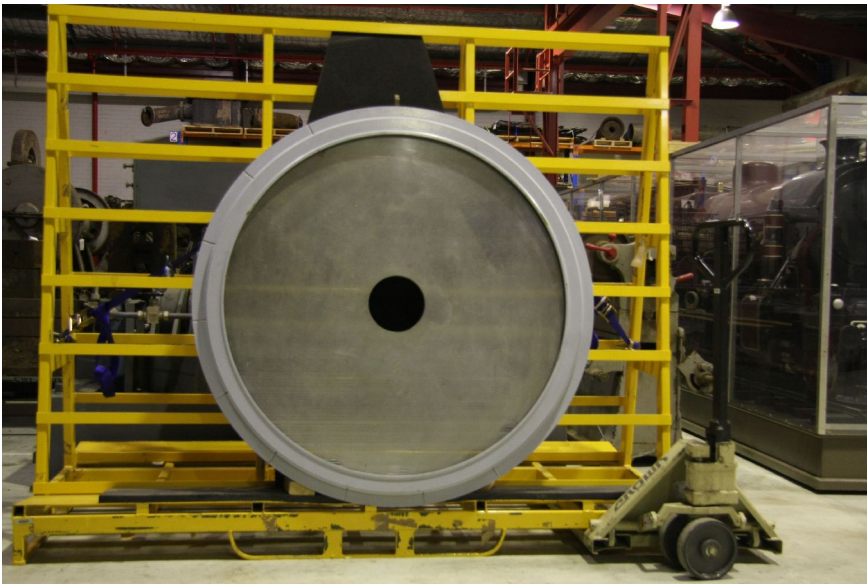
David, apparently imprisoned in a Fiendish Contraption of his own making





GMT OPTICS

Barry Clark's concepts for the optics for the restored GMT are crystallising - a process we hope the actual mirrors will not undergo! Barry has prepared a thousand-line Excel sheet of calculations, leading to the optimal combination of design (classical Cassegrain), field of view, exit pupil (the viewing aperture just outside the eyepiece), and focal length, all the while aiming for simplicity of components and materials. His eventual design is for a 48-inch $f/32$ Cassegrain mirror set; with added lenses, $f/12$ and $f/41$ performance can also be obtained. Having failed to find a second-hand mirror we are now earnestly talking to an American manufacturer to quote for such a mirror, to be solid and 8 inches thick, either of low expansion borosilicate glass, fused silica or glassy ceramic material.



Meanwhile, the historical speculum-metal mirror was cleaned for some sort of media photo shoot. Here it is as it stood in 2009; note the absence of the, er, reflection - normally an essential attribute of a mirror. Or, perhaps, this photograph was taken by a vampire.

Now, after a brisk scrub with the old wire brush and some Brillo pads - well, actually it was cleaned with great care (after reflecting on its significance), here it is. Even now, the reflection could be a lot better (100% of the light is desirable, of course - and the photographer's head would be nice too). But this metal mirror is a priceless historical relic, and cleaning it alters its parabolic shape - a source of much anguish and difficulty in the original GMT.

We look forward (or, more correctly for a mirror: we look backward) to getting a new glass or ceramic mirror.






The Declination Clamp Disk

Behold, part 5000*, the Clamp Disk, to be attached to the Cube; a metal strap is tightened around it, to stop the telescope moving in declination. The original telescope had gearing and two big handwheels, which hefty assistants would turn to slew it in Declination and Right Ascension; these will be restored - the gearing and handwheels, that is - and modern motors will be inconspicuously added, with suitable decouplings for safety, to slew it electronically as an option.



Above right, you see it bolted to the Cube, back in 2009, with our hands-on workers Barry Adcock, Arthur Coombs, Ian Barry, and Lindsay Garrett much in admiration.



Now, the basic problem we have had with part 5000 is that when it was inducted into the Museum's collection in the 1980s, it was logged as items 34, 35, 36, 38, and 39 ... yup, it came in Five Easy Pieces. And, consisting of 132 kg of cast iron, it cannot feasibly be welded back together especially in view of safety factors and of the important load it will take - so we commissioned a replacement part, number 5010. This was cast in SG iron in December 2012, and was machined down to size in January. The new part looks glorious; above right, you see it attached to the Cube. 

* And behold the new part numbering, which settled down with parts having 4-digit numbers in a logical sequence, the numbers being spaced out so that more parts can be inserted in place. The 3-digit drawing numbers remain as they were; this part has, and has always had, drawing #214.

The Story of the N.A.S.A. Mirror Part Two



By Jim Pollock

Part of the refurbishment of the GMT requires the replacement of its optical train. As a result, we were looking for a replacement 48-inch mirror, and about a year ago we heard that a 48-inch f/6.5 mirror was available in California. The mirror – and a complete 40 tonne telescope – had been commissioned in the 1960s at the height of the Cold War, by NASA and Jet Propulsion Laboratory. Its purpose was to try to look at, and hopefully photograph, orbiting Soviet satellites.

The 48-inch mirror was attractive but it had disadvantages. It had no central hole that would allow it to be used in a Cassegrain telescope. The mirror and telescope were in California and would be expensive to ship to Australia. And the mirror's support was an inflatable collar containing *mercury!* - which attacks and eats aluminium, such that you can't even bring a mercury thermometer onto an aeroplane. A photo of the mirror, and the story of our attempts to acquire it, appeared in the previous issue (#7) of Phoenix; here are two more pictures of the telescope -



As described in Phoenix #7, although we investigated bidding for the complete telescope, we were told that the mirror would probably go to the University of Arizona. Also, as we were an Australian entity rather than an American organisation, we were ineligible to have the telescope gifted to us. In the end we abandoned the idea and finally admitted that red tape had beaten us.

After that disappointment, in January 2013 our contacts in the US brought us up to date on what had happened to the mirror. Contrary to what we had been told, the mirror never found its way to the University of Arizona. For whatever reason, NASA/JPL had failed to find anyone who was interested in the telescope, or the mirror, and the complete telescope had been sold by the US-government General Services Administration, to a local company in California. Apparently, the purchasing company had little or no experience with optics or telescopes and, possibly believing that the mounting was constructed from titanium or an exotic alloy, had bought the telescope and mirror hoping to sell it at a profit. It purchased the complete telescope and mirror for US\$150,000.

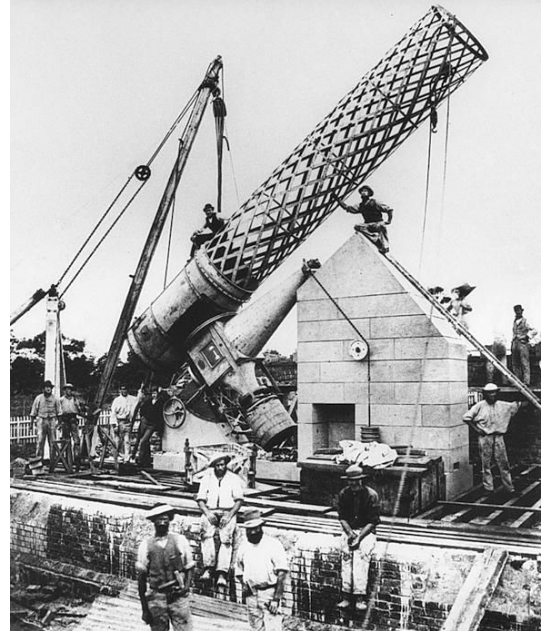
Subsequently, the telescope appeared on eBay under the category of Professional Telescope for the *Buy it Now* price of \$6,000,000 (six million US dollars). Bids were non-existent and the eBay listing has subsequently disappeared. It seems unlikely that the new owners could have found a buyer, considering that NASA/JPL hawked it around the professional (and amateur) astronomical community for many months. So, the ASV is continuing to keep abreast of events, although its acquisition is no longer being seriously considered.



The GMT's Iconic Lattice Tube



The Lattice Tube is the signature element of the Great Melbourne Telescope. This unique and iconic artefact distinguishes the telescope from others of its ilk, of which there are few anyway.



The photo below shows the Lattice Tube in the Museum store. Astute readers will note that it is only about half the length that it used to be! The top half was not required by Mt Stromlo, and is now known to be destroyed and lost. We will have to re-manufacture the missing bit.

We have a free choice of materials, but the finished job must closely resemble the original tube, even if the full length is no longer necessary for the optics we will be using (the tube, after all, is just a way of holding the secondary mirror). The practical choice comes down to steel or aluminium, and we can make just the missing half, or we can re-make the entire tube and archive the unused remnant. The original mild steel tube was obviously very heavy (the surviving part weighs 424 kg) but it counterbalanced the speculum-metal mirror, which was also very heavy (about 1,250 kg). A



modern mirror would be about 400 kg, so a full-length aluminium lattice tube (painted black on the inside and grey on the outside) would be appropriate.

Then we have to worry about flexibility of the tube. Extra internal rings were added to the original tube at Mt Stromlo; it appears that they came from the scrapped upper section of the lattice tube. Back in the 1880s, it was reported that when a 112 lb mass was hung from the end of the tube, it bent by only 1/200 inch; nevertheless, various flex modes are possible, including axially, as described in a journal paper by the feisty Professor Kernot, first professor of engineering at the

University of Melbourne (and a member of the Observatory's Board of Visitors). Prof Kernot has been described as “the first Australian engineer”, and his controversial career makes interesting reading - google on “biography william kernot”.



RBG WORKSHOP - 13 December 2012

The Royal Botanic Gardens hosted a half-day workshop to help determine the vision for changes to Observatory Gate (their project name for opening the Melbourne Observatory reserve to the public, as a part of the Melbourne Gardens). About 20 participants from ASV, BoM, MV and RBG, plus several professional Facilitators, met for a morning at "Domain House" in Dallas Brooks Drive, near the site.

The workshop was charged with thinking about the visitor experience, with especial reference to how the visitors could be exposed to science, and to experiencing the scientific method, concomitant with RBG's mission to present their botanical materials in an effective and educational way. Workshop participants toured the Observatory site in small groups, then re-convened to discuss and write down their ideas. It was established, for example, what sort of people would visit the site now and in the future, what they can expect to see or do during their visit, and how they should feel or want to feel about their experience when they return home, and when they talk to their friends.

The resulting swag of opinions and concepts will be useful for RBG in planning changes to the Observatory Gate area, including the cafe, entrance to the Gardens, and the heritage buildings. On this latter, ASV representatives defined a concern for Melbourne Observatory's world-class astronomical heritage characteristics, and noted that the curtilage of the heritage buildings - the surrounding area supporting the function of the buildings - should remain uncluttered all the way to the site boundaries. This is particularly important in the case of observing rooms such as the East Transit Room, the domed rooms and the GMT House.

Steve's Adventures in Moreland



Ah, another Wednesday, another workshop. But before I attempt these arduous labours I always scoff a decent breakfast at any of the cafes in Sydney Road. Here is one which I discovered in the course of this most scientific research. I have to keep the breakfast in the dark, and creep up behind it carefully, it gets frightened if it sees me. (Well, other people do).



I'm off again for 3 months in Europe - riding a bicycle this time; I am going to buy a bike of unusual design in Holland and ride it to Copenhagen. Daft thing to do, really. Follow my blog to see the carnage ... <http://stevethings.wordpress.com>

PHOENIX, issue 8

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

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