Current Notes

View of the Godlee Observatory from Whitworth Street.

The Journal of the Manchester Astronomical Society
August 2012

Contents

Opening Remarks. Page 2
Editor – Barry Henshall F.R.A.S.

Honorary Membership Page 3
Barry Henshall F.R.A.S.

Beginning astronomy: a voyage of discovery Page 5
Barbara Isalski

NWGAS Astro-imaging Workshop Page 8
Barry Henshall F.R.A.S.

Annual Photographic Competition Page 9
Barry Henshall F.R.A.S.

Stargazing in the City Page 12
Nicola Frost, Science Communication Officer at MOSI.

Godlee Telescope Drive Update Page 14
Michael Gilligan

Godlee Astrograph Page 18
Michael Gilligan

Refurbishing and upgrading the Godlee telescopes Page 22
Kevin Kilburn F.R.A.S.

Officers and Council, 2012—2013

Minutes of the Annual General Meeting April 2012

Cover Photograph; View on 1 Sept 2011 from Whitworth Street.
Mike Oates

Opening Remarks

The internet has had both a positive and negative impact on astronomy. On the positive side is the wealth of information available, such as solar, planetary and deep sky images, which are freely available and, together with television programmes and presenters like Brian Cox, must create an interest perhaps not seen since the 1960s and the space race.

But such freely available information also has a negative impact. Why should the general public spend their time outside on cold winter nights with expensive equipment to produce images far inferior to those from, say, the Hubble telescope? Surely it is much more comfortable to sit back in front of a computer screen or TV and be fed the information: or so it is argued.

That may be so for a large majority of the general public but for those who actually look through a telescope and see with their own eyes the rings of Saturn, the Jovian moons, the elusive planet Mercury it must bring a certain thrill not felt when viewing a TV screen. We can extend outwards, beyond our solar system, to objects within our galaxy and then even further to galaxies hundreds and thousands of light years away.

But observational work is just one aspect of astronomy. Interests extend into astrophysics, cosmology, astrochemistry, astrobiology, star and galactic formation, the history of astronomy and astronomers; the list goes on and on.

Our Society is one that is vibrant with our Thursday evening events well attended as are our public lectures held at the Manchester Metropolitan University during the winter months. With so much interest shown by members I must ask the following question. Why so few submission of articles to Current Notes? It is not a learned journal but one that reflects the Society and its member's interests. Each and every one of you has a story to tell. For instance, why the interest in astronomy, your main interests and why, your choice of equipment and its subsequent use, imaging and processing, success and failure, visits to observatories - the list seems endless.

So, why so few articles from members? The success of the Journal is in your hands. As I said at the Annual General Meeting this year Current Notes reflects the development and history of our Society.

Our move back to the Godlee was relatively painless and I feel sure that members are now happy to be back home. There are a number of projects in hand to improve the functioning of our 8" refractor and 12" reflector. I hope that when the work has been completed more of our members will take advantage of the improvements.

Since the last issue we have had a number of new members join our ranks and I am sure I speak for all in welcoming them to the our Society

Barry Henshall F.R.A.S.

Honorary Membership

At our public meeting held on the 17th November 2011 at the John Dalton Building, Manchester Metropolitan University (MMU), Guy Duckworth, the Vice President, awarded Honorary Life Membership to Conway Mothobi for his long standing support of the Society. Conway was also presented with a Galilean thermometer.

Our public meetings have been held at the MMU for a number of years and Conway has always been on hand to organise the excellent facilities offered by the University. On a number of occasions Conway has also invited us to attend Public Outreach events. Our participation at these events has given us the opportunity to promote our Society and show to the general public some of our members work. On behalf of the Society I would like to thank Conway his enthusiasm and continued support.

As you are all aware we were away from the Godlee for just over 12 months and during that time there were many discussions between ourselves and the University about the planning and scale of renovation for the Godlee. Foremost in those discussions was our own Tony Cross. I can safely say that without his commitment we would not be enjoying the benefits of such a high standard of work and facilities that we see around us today.
At our Annual General Meeting held on the 19th April this year I had the pleasure of awarding Honorary Life Membership to our Publicity Officer Tony Cross. In addition Tony was awarded a gift of a Galilean thermometer for his excellent promotion of the Society and especially for his inspirational coordination with university project managers and contractors, before, during and after the renovation of the Godlee Observatory, 2011.

Barry Henshall F.R.A.S.

Beginning astronomy: a voyage of discovery.

I have, at last, started! This is the sixth month of indulging in a hobby I have wanted to pursue for many years. I start with minimal knowledge, but lots of enthusiasm for learning!

Knowing how difficult it is to juggle time priorities, I thought that committing to a long-distance learning course would both provide a framework for study and of course, having paid up front for the modules also helps one keep to new resolutions. After a little internet research I was attracted to the John Moores Liverpool University programme, as it sounded the right balance of theoretical science and practical work and included the history of astronomy. How fascinating to think how past astronomers – from as early as 1200 BC or maybe earlier - tackled and achieved so much with little or no optical instruments. Each civilization contributed so much: Babylonians, Egyptians, Greeks, Indians, Chinese, Islamic, and others. But the start of modern astronomy seems to begin in the Renaissance era, associated with Nicolaus Copernicus and the "scientific revolution" of a heliocentric universe.
I have a special affinity for Copernicus for several reasons, so I am prompted to write a little about him. Also, I have just spent the weekend trying to spot the crater on the moon named after him - one day, I will succeed in photographing it! Meanwhile I am grateful to Kevin Kilburn for providing this excellent photograph.

Copernicus crater on the moon. Photograph by Kevin Kilburn

Nicolaus Copernicus was born on 19th Feb 1473, the youngest of four children. He must have been amazingly clever – holding high status in the fields of astronomy, canon law, medicine, mathematics and economics and versed in 5 languages. His father, also Nicolaus, had been a prosperous merchant, and his mother, Barbara Watzenrode, the daughter of a leading merchant family in Torun. His father died when he was just 10 years old and a maternal uncle (subsequently a bishop) became their protector. He was enrolled at the University of Cracow in 1491, a centre renowned for its learning particularly in mathematics and astronomy. Five years later he went to University of Bologna to study canon law, where he lived with an astronomy professor Domenico Maria Novara and made his first astronomical observations. Whilst at Bologna he acquired a good reading knowledge of Greek, which was fundamental for his studies in astronomy, given that major works by previous Greek astronomers (including Ptolemy) had not yet been translated into Latin, the language of universities at the time. These were the beginnings of his scientific enquiry that led to challenging Ptolemy's geocentric model of the universe, a concept which ruled at the time.

Copernicus moved to Frombork (Northern Poland) in 1501 and then went on to study medicine at the University of Padua. Interesting to note that at the time the study of medicine included astrology, as it was held that the stars and birth signs influenced human development and influenced medical treatments. He was unable to complete the 3-year studies as he had only been given a 2-year leave of absence by his chapter, but despite this, he became a physician that was consulted by notables in East and West Prussia. He then matriculated from the University of Ferrara, from which he obtained a doctorate in canon law and became immersed in church matters and politics. He took up residence in his chapter at Frombork and stayed there the rest of his life.

Being responsible for the administration of a number of holdings and keeping accounts and records, he assessed the problem he found with the local currency, and drafted an essay on coinage in which he deplored the debasement of the currency and made recommendations for reform. His manuscripts were consulted by the leaders of both Prussia and Poland in their attempts to stabilize the currency.


NICOLAI
COPERNICI TO
RINENSIS DE REVOLVTIONI-
bus orbium cœleſtium,
Libri VI.
IN QVIBVS STELLARVM ET PL-
BASILEAE, EX OFFICINA

Copernicus: Conversation with God, by Matejko

Around 1510-14 he wrote an essay that has come to be known as the Commentariolus in which he introduced the heliocentric universe, and although he sent copies of this to various astronomers, he never published it. He also wrote a letter criticising Johann Werner's work, claiming he had mis-calculated time in "Letter concerning the Motion of the Eighth Sphere". But it took a young mathematician named Georg Joachim Rheticus to encourage Copernicus to publish On the Revolutions (de revolutionibus orbium coelestium), and remarkably a manuscript of this six-volume work, written in his own hand, has survived , now in the Jagiellonian University of Krakow.
Rheticus oversaw most of the printing of the book, but had to pass this to Andreas Osiander, a Lutheran theologian when, on account of his Copernican views, he had to resign from his chair in Wittenbert and go to Leipzig. Religion was trying to maintain control: Osiander then introduced the word "Hypothesis" on the title page and replaced Copernicus' preface with another, warning the reader not to expect anything certain from astronomy, nor to accept its hypothesis as true, but merely a mathematical way of computing the motions of the celestial bodies with greater precision. Copernicus probably suffered a stroke and was not well enough to realise the changes that Osiander had introduced into the treatise. It was on 24 May 1543 that Copernicus, at this stage on his deathbed, at last held a copy of the finished work.

So what other steps did I take in starting off on this path of scientific discovery?

1 – Armed myself with essential equipment: warm, lined shoes or boots and thermal underwear! This is an ideal opportunity to use those Christmas presents of woolly hats and scarves that are too embarrassing to wear in the day.

2 – Considered carefully what telescope to buy; sought advice. (Cheekily, I bought the husband a telescope for his “big birthday”!)

3 – Joined the best astronomical society around – MAS – a very welcoming and helpful organisation; the many benefits include access to magazines and a library and a fountain of experience and knowledge in its established membership. It was also fascinating to hear Professor Chandra Wickramasinghe talk about the possibility and evidence for microbial existence in extraterrestrial locations – I wonder what my microbiology colleagues would think of that?

4 – Used light pollution in Manchester as a good excuse to plan holidays and weekends away, based on an astronomical calendar, of course. There are several journals around that are excellent in providing such information. (Roll on Portugal!) One of the best museums I have visited in the past was in Florence, which had historic working models of the universe, and we were escorted around by a local student from the University of Pisa dressed up in Renaissance attire, explaining how they demonstrated the concepts of the universe in the 15th and 16th centuries. And there was Galileo’s original telescope and, in a jar, one of his fingers!

5- Started learning how a camera really works and dropped big hints on what I wanted for my birthday (thanks Marek, that’s a great book, really enjoying it).

6- Resolved to protect some time for myself (encouraged husband to continue his judo on Thursdays).

A visit to the Science Museum in Florence (approx. 2006)

Other sources of information.
There are many, many websites packed with astronomy information. The Natural History Museum in London also has an exhibition – which made a very pleasant break from a business conference. I had never realised there were so many serious, amateur astronomers, doing amazing work.

Natural History museum, London, Feb 2012. See also its website http://www.nhm.ac.uk/nature-online/space/index.html

The NASA website, is packed with information http://www.nasa.gov/ . I was introduced to Stellarium software (downloadable easily, and for free, from the internet) by MAS and it is a brilliant package. Check out also the University of Nebraska-Lincoln website on http://astro.unl.edu/naap for some super animations that help explain the celestial sphere. Finally, typing something like "astronomy apps for mobile devices" in a search engine will provide an impressive number and variety of packages that are available (thank you Barry Henshall for introducing me to these). I've no excuse now for not being able to see the stars!

Barbara Isalska

NWGAS Astro-imaging Workshop

On the 21st April 2012 the Manchester Astronomical Society hosted the 3rd North West Group of Astronomical Societies (NWGAS) Astro-imaging Workshop at the Godlee Observatory.

The speakers for the day were

1. Tom Hudson (Macclesfield AS) – Solar imaging in Hydrogen alpha. The talk was restricted to image capture (exposure/problems etc) and subsequent image processing. It was not felt appropriate to spend time on specific scopes such as the PST and their operation.

2. David Ratledge (Bolton AS) The use of IRIS software for image capture and processing with worked examples.

3. Kevin Kilburn (Manchester AS) Colour enhanced lunar photography, a new BAA Lunar Section project. Approach to imaging and subsequent processing.

4. Peter Franklin (Blackpool AS) Multi-alignment points in Registax 6. Enhancing your lunar and solar images.

5. Steve Warbis (Macclesfield AS) DSLR deep sky imaging of Messier Objects.

We had about 30 delegates from Macclesfield AS, Bolton AS, Liverpool AS and Blackpool& District AS. Those attending considered the day a resounding success and I feel sure that next year will see a 4th imaging workshop hosted by one of the other North West Group Societies.

Barry Henshall F.R.A.S.

Photographic Competition 2011/2012

The Manchester Astronomical Society Photographic Competition was held on Thursday April 5th 2012 and was open to all members. This year there were two categories

1) Astronomy
2) Atmospheric phenomena

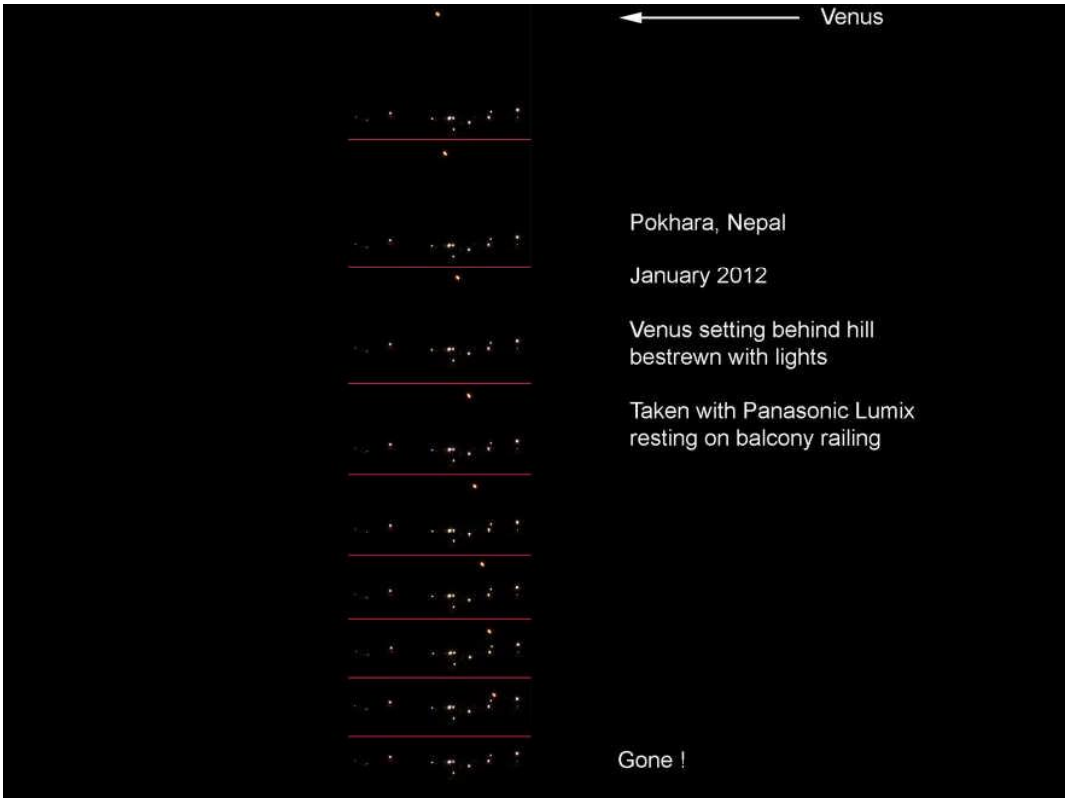
and each category was split between beginners and previous winners of the competition (advanced). This year we were very pleased to welcome a former member of our Society, Ray Grover, who judged the entries.

Those entering the competition were
Mike Oates, Anthony Jennings and Kevin Kilburn in the Advanced section with Barry Henshall, Tony Cross, Janet Maresh, Guy Duckworth, Michael Gilligan and Barbara Isalski in the Beginners section.

The winner in the Advanced astronomy section was Anthony Jennings for his image of Messier object M1

whilst the Earth Atmospheric section was won by Mike Oates with his image of noctiluscent clounds.

The winner of the Beginners astronomical section was Janet Maresh with her image of Venus setting in Nepal. This was a composite of a number of individual shots.



whilst the Earth Atmospheric section was won by Tony Cross with his image of a circumzenithal arc.

Overall the evening was a great success and a big thank you to all those members who entered the competition this year. I am sure that with clear skies, warm clothing and enthusiasm next year's competition will be an even greater success.

Barry Henshall F.R.A.S.

Stargazing in the City

On the 22nd May the Museum of Science & Industry (MOSI) joined forces with Manchester Astronomical Society (MAS) to host 'Stargazing in the City' – an event that introduced 30 local teenagers to the wonders of the night sky in a fun, quirky and participatory way. Highlights included a new planetarium show, a guide to virtual stargazing, a quiz show, and some real gazing with the experts. The event received great feedback and more collaborations are hoped for in the future, particularly during the stargazing season when evenings get darker much earlier!

Stargazing grants

Earlier this year the UK Association for Science and Discovery Centres (ASDC), in partnership with the Science and Technology Facilities Council (STFC) offered small grants to science and discovery centres to facilitate stargazing events and activities across the UK between March and June 2012.

MOSI wanted to create something for teenagers, an age group that had not really been catered for at previous astronomy events. We approached Tony Cross about collaborating on an event that would allow MAS members to promote astronomy to a new audience, gain some public engagement experience and raise awareness of the Society.

By combining MOSI's venue and public engagement skills with the astronomy expertise of MAS the idea for "Stargazing in the City" was born. We submitted our grant proposal to ASDC and were successful!

An evening's entertainment

Solar telescope

As it was a beautiful sunny evening, MAS started off by setting up a solar telescope outside MOSI for people to safely observe the sun, identify and learn about solar spots and meet the MAS members. This was a great ice-breaker that got people talking and set the tone for an informal, fun evening.

Planetarium Show

Two of MOSI's presenters, Shea Taylor and Jamie Eagleton, wrote and performed a new planetarium show to a full house. The audience learnt about the Manchester night sky, why urban light pollution affects
stargazing, examples of different constellations that can be seen and how astronomy allows a look back into the past. Supported by a contemporary soundtrack, cultural references and a specially produced video and talk that gave you "everything you need to know about our solar system in two minutes" the show went down really well.

Celebrity Beetlejuice Quiz

Inspired by the star Betelgeuse, which was introduced in the Planetarium show, the MOSI presenters delivered a TV-style quiz show called ‘Celebrity Beetlejuice’ in the MOSI cafe. Volunteers formed two teams who competed in rounds such as ‘Play your stars right’ (where teams had to guess whether a named star was “nearer” or “closer” to Earth than the previous one), ‘Seeing Stars’ (where contestants spun a wheel to select a challenge activity) and a quick fire question round. Conferring was positively encouraged with MAS members contributing their opinions too! The winning team was awarded prizes of mini telescopes and books.

Virtual Stargazing

After everyone had enjoyed some refreshments Tony Cross from MAS gave a short introduction to the Society, spoke enthusiastically about how easy it is to get involved with astronomy in Manchester and showed some examples of amazing astronomical photographs captured by MAS members. Then it was Barry Henshall’s turn to encourage everyone to get their smartphones out as he demonstrated how to stargaze virtually using internet applications such as Stellarium.

Talk & Telescopes

MAS brought along some of their own telescopes which they set up outside MOSI. Before heading off people had the chance to take a closer look and chat informally to the MAS members. There was a lot of interest in the equipment and many people asked whether they could visit the Godlee Observatory in the future.

We received some great feedback from the teenagers who attended the event. Comments included:
“I liked that we got to see a load of cool stars and the difference between the city and the country side”
“Nothing to improve on! I can keep the knowledge with me for my physics exam next week! Thanks for a great evening!”
“I enjoyed the planetarium. It was awesome. I would definitely come again.”

MOSI benefited greatly from the expert knowledge and enthusiasm brought by MAS which was an integral part of the event and we hope to collaborate again in the future!

Nicola Frost, Science Communication Officer at MOSI.

Godlee Telescope Drive Update

As most readers will be aware; I am currently working on an upgrade to the Polar Axis [Right Ascension] Drive of the Godlee Telescope, in which a Stepper Motor will replace the present Mains Synchronous Motor. Progress is “slow, but steady” ... which is, of course, exactly what we need for Sidereal Tracking. [Ouch!] .

Requirements:

Grubb’s Twin Equatorial Mount is superbly engineered, and will last several lifetimes; but we need to treat it with appropriate respect. The RA gearing was never designed for rapid slewing, and we must resist the temptation to incorporate any such thing. We will therefore retain the present operating protocol; whereby the Drive is disengaged; [at the Polar Axis Bearing] whilst the Telescope is being rough-positioned, and [at the manual over-ride gearing] whilst the Sector is being wound-back.

Note: this may be reconsidered, on the basis that motor-drive is actually more gentle in action than manual cranking.

The Stepper Motor drive will serve only two purposes:
Tracking in RA, for visual observation and for photography.
Fine-positioning the Telescope in RA, for Target Acquisition.
Note: this could possibly be expanded, to include [3] Rewind of the Sector.

Sidereal Time:

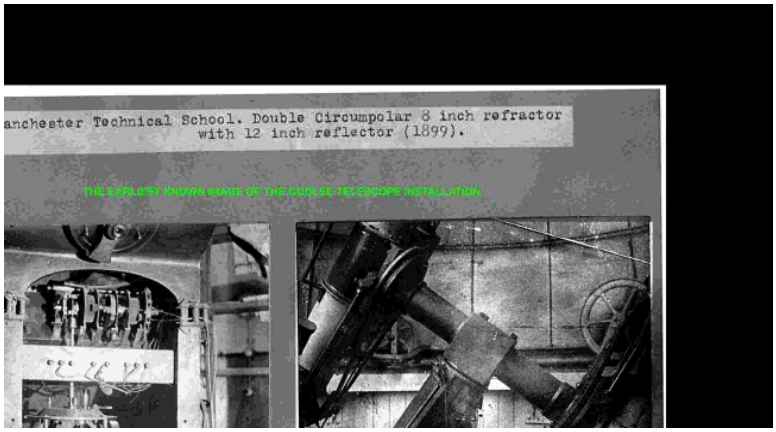
The duration of a Mean Sidereal Day is about 23 hours, 56 minutes, 4.1 seconds [Measured in S.I. units]. However, to the umpteenth decimal place, the rate varies, and conversion is not a simple multiple of Civil Time. There is also a small difference between Sidereal Time and Stellar Time.
For a detailed discussion, see: http://en.wikipedia.org/wiki.Sidereal_time

Relative to the Stars, the Sun appears to move around the Earth once per year, and therefore there is one fewer Solar Day per year than there are Sidereal Days.
Taking the Tropical [Solar] year as 365.242190402 days and using this relationship; the Sidereal Day has a duration of 86,400 x (365.242190402 / 366.242190402) = 86,164.09053 seconds … giving a ratio of 1 / 1.002737909350795
This is typically truncated at the 11th decimal place [for, beyond that lies madness!]
See: http://tycho.usno.navy.mil/sidereal.html
But, for practical purposes, we can realistically accept one part in a million, and therefore a ratio of 1 / 1.002738 or 0.997269

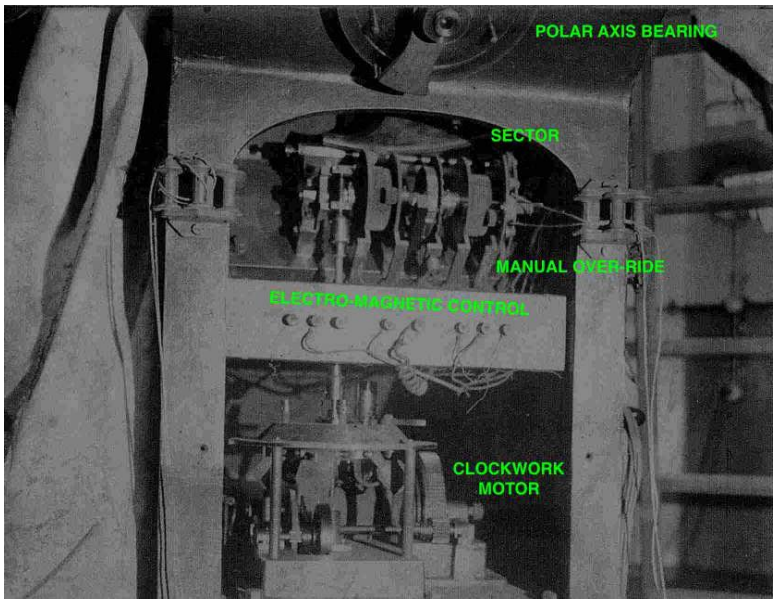
Stability Requirements:

Given the Light Pollution in Central Manchester, the performance of Digital Imagers, and the convenience of Image Stacking Techniques; we are unlikely to need individual exposure times longer than ten minutes. With the Earth rotating 360 degrees in 24 hours, (15 degrees per hour), ten minutes of time equates to 9,000 seconds of arc.
Assuming an imaging “Plate Scale” of one second of arc per pixel; tracking stability of one part in 10,000 should image a point source to +/- one pixel.
Is this achievable? … Probably yes.

History:



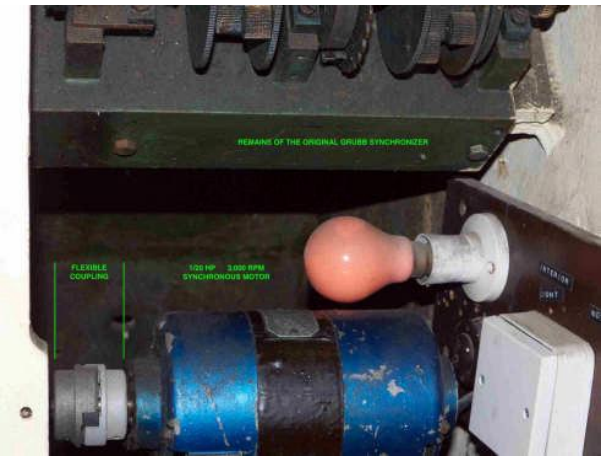
The Godlee Telescope was originally fitted with Grubb’s electro-mechanical drive.
In brief summary: The Telescope was driven by a “Clockwork Motor”, which was synchronised to a Master Clock. There was also the facility to manually speed or slow the drive, (a) to aid target acquisition, and (b) to correct the tracking.



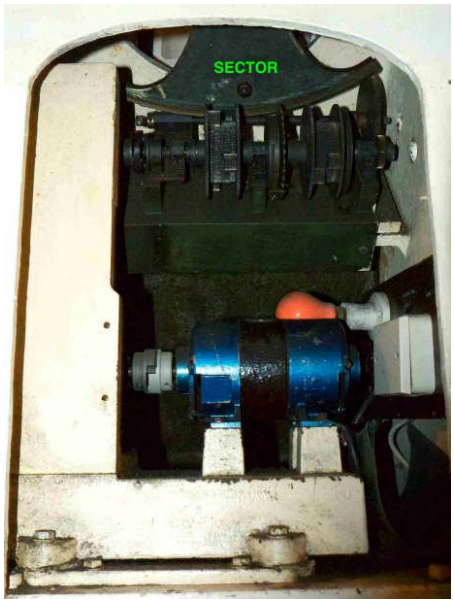
In this exceptionally clever system; the Master Clock [now lost] was a precision Regulator, beating Sidereal Seconds and making electrical contact through a small globule of Mercury. Note: These days we would typically use an Opto-Switch instead. The electrical pulses synchronised the heavy Clockwork Motor that physically drove the Telescope, by electromagnetically selecting between two sets of epicyclic gearing to speed or slow the drive as appropriate.

Note: I have not checked the gear-ratio in the Godlee Telescope, but Grubb typically used 40:41 and 41:40 ... Thus the system could drive at, 40:41, 1:1, or 41:40.

The Manual over-ride control acted on a duplicate system of gears, and the whole system would have been very smooth in operation. This was a masterpiece of electromechanical control, but would undoubtedly require regular Expert Maintenance.



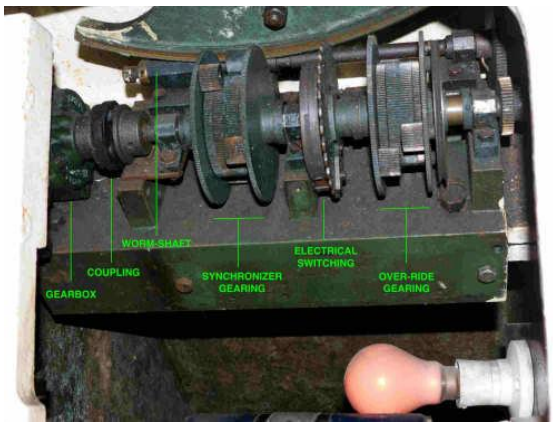
Sometime in the 1950s, the original "Clockwork" drive was replaced by a Mains Synchronous Motor. This motor runs at 3,000 rpm and is geared-down through two Worm Gearboxes in series. The output from the second gearbox drives Grubb's [now redundant] epicyclic gear-shaft. Although the intention was, presumably, to modernise and improve the drive; this system discarded the manual over-ride, which was a valuable feature of Grubb's original system.



My proposed system will both restore that feature [electronically] and improve the stability of the tracking.

<u>Reverse Engineering:</u>

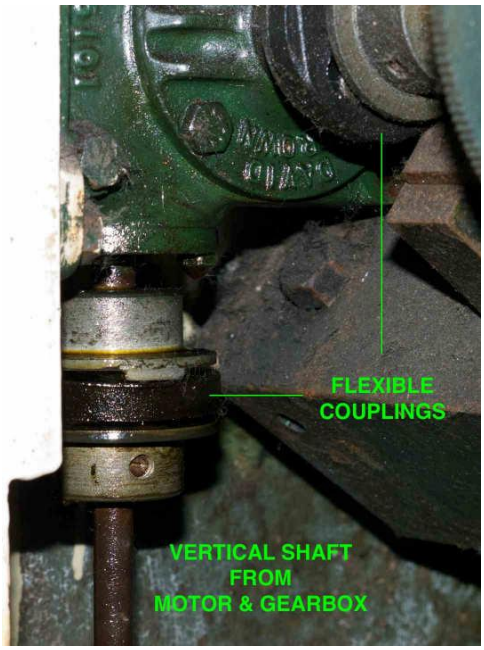
There is no documentation available regarding the 1950s installation. The Synchronous Motor is hard-wired into the electricity supply, and therefore cannot be removed without the assistance of a qualified electrician working for the University. [NewsFlash: Thanks to Tony Cross, the Electrician has recently wired the Synchronous Motor to a 13A plug.] This means that, to minimise downtime, the new system must be designed and built as a module, to be quickly substituted. In turn, that means that we need to understand what is there; so I resorted to some reverse engineering.



The final drive to the Polar Axis of the Telescope is a Worm and Sector [being in effect part of a large worm-wheel] with a reduction of 960:1. The worm-shaft is accessible through a hole in the side of the telescope mount, and has a 5/16" square end to accept the Key/Handle used for rewinding the sector.

The worm-shaft is driven by a spur gear, which is driven by a smaller one on the epicyclic gear-shaft, with a reduction of 3:1. The original epicyclic gears currently

serve no purpose [except to disengage the drive for winding-back the Sector].
The epicyclic gear-shaft is driven by a worm gearbox, which probably has a reduction ratio of 44:1. [see later]
That gearbox is driven by another, with a reduction ratio of 34:1
The Motor runs at 3,000 rpm
All the shafts in the 1950s installation have Oldham Couplings.



3,000 rpm is 4,320,000 revolutions per day.
We know that the Sector divides by 960, and the spur gears divide by 3
4,320,000 / 960 = 4,500
4,500 / 3 = 1,500
So 1,500:1 reduction should be shared between the two worm gearboxes
one is known [by counting turns] to divide by 34
so the other "should" divide by 1,500 / 34 = 44.117647 …
This is an unlikely number; so let's assume that the ratio is actually 44:1
4,320,000 / 960 / 3 / 44 / 34 = 1.002674
Which is a fair approximation to the Sidereal conversion of 1.002738

What Next?

There is no need for the Stepper Motor to run at 3,000 rpm; it has 200 Poles, and will be run in Micro-Stepping mode. It therefore runs much more smoothly than the 2 Pole Synchronous Motor.
There is no need to select the gear reduction to fix the Sidereal conversion. The Stepper Motor will be driven by an electronic pulse generator, whose rate is variable by very small increments.
The Stepper Motor can be much smaller than the present Synchronous Motor, which [at 1/20 HP] is considerably overpowered.

I am in the process of selecting a suitable motor and driver, and designing the controller.
Because of the downtime constraint, mentioned above; I will first build this as a module that plugs onto the square end of the worm-shaft. This is not an acceptable long-term solution, but will provide Proof of Concept before we dismantle the existing drive train.
The final version will sit in place of the Synchronous Motor and its first gearbox.
The drive train will therefore be: Stepper Motor / 44 / 3 / 960
To result in one revolution per Sidereal Day, the speed of the Motor needs to be:
1 x 960 x 3 x 44 = 126,720 revolutions per Sidereal Day
… This is approximately 88 rpm
More precisely … Taking the Sidereal Day as 86,164.09053 S.I. seconds, the speed of the Motor would be 126720 / 86,164.09053 = 1.47068 revolutions per S.I. second.

The Motor has 200 Poles and will probably be Micro-Stepped at 4x, making it equivalent to an 800 Pole Motor. The pulse rate, therefore, needs to be about 1176.5458 per Second.
The pulse generator will be a Quartz Crystal Oscillator, followed by a “Divide by n” counter with sufficient resolution to set the required rate.

By switching the Micro-Stepping level from 4x to 2x or 8x we can double, or halve the rotational speed of the motor … thus regaining the manual override facility.

PostScript:
Whilst I am confident in the design process, and in my ability to construct this drive system: I would welcome input from any member of the Society who either has expertise in this field, or simply wishes to discuss ideas.

Michael Gilligan

Godlee Astrograph

Introduction:

In the Godlee Observatory, Grubb’s Twin Equatorial Mount carries two telescopes [one Refractor and one Reflector], which move together in Right Ascension, but independently in Declination. It also carries an Astrograph Camera, which is the large wooden box attached to the Refractor. This Astrograph is essentially a Plate Camera with a long focus photographic lens and, by telescope standards, has a very wide field.
The Astrograph has probably not been used in the last forty years, and is currently in a poor state of repair. … I have Council’s blessing to investigate and document what we have, and [if appropriate] bring it into use for digital imaging.

Preliminary Inspection:

The objective lens is multi-element, but its detailed optical design is unknown.
The front element is approximately 6 inches [150 mm] diameter. The lens is dirty.
The box-body is approximately 8 inches [200 mm] square, externally.
There is a focusing back and a plate holder, both in semi-derelict condition.

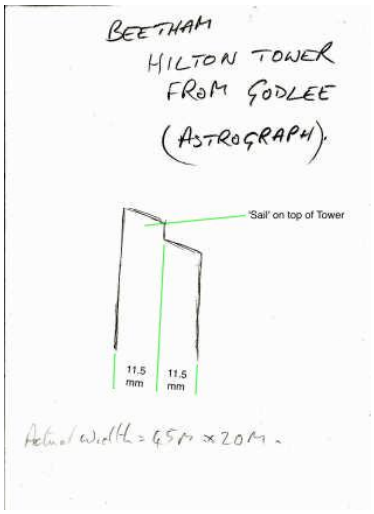
Further Investigation:

The focusing back has been heavily modified at some time: The bellows have been replaced and the Rack & Pinion focusing has been discarded in favour of jackscrews.
The back assembly is bolted to the box-body, but this arrangement probably dates to the time when the back was modified.
Although the plate holder appears to be “Half Plate” size [6 ½ x 4 ¼ inches], there is a reducer inside, indicating that smaller plates were used.

There is an aperture mask 5 inches [127 mm] square at the end of the box body.

Preliminary Testing:

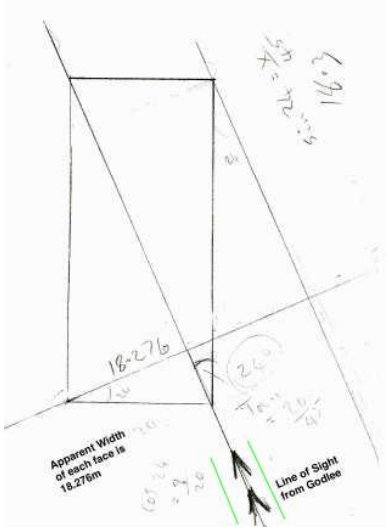
On Thursday 22-March-2012: With the assistance of Mr Tony Richards [a local professional photographer with a special interest in using old, large-format photographic equipment and processes], I roughly measured the focal length of the objective using the Beetham Tower as a test object.



A scrap of ground glass [focusing screen] was held in the focal plane, with its rough side outward, and the Astrograph focused on the top section of the Beetham Tower …
The outline of the image of the top section was drawn onto the ground glass with a pencil, and this was then traced onto paper. [Sketch_1]
Noting the lack of precision inherent in this process …
The image measures 23mm wide and the "Sail" on the top of the Tower appears 11.5mm wide. This means that [by sheer good fortune] the line of sight from the Godlee follows the diagonal axis of the Tower's roof. [Note that any rectangle, whatever its proportions, viewed on its diagonal will appear symmetrical.]

Working in "MapProjector" on the iPad [which uses Google Earth images]; I estimated the distance from the Godlee to the nearest corner to be 1010m, and the Tower Roof to be 45m x 20m in plan view.

The line of sight makes the apparent width of top section of the tower 2 x 18.276m [Sketch_2]



Note: The level of precision in this analysis is, of course, fictitious; but it is useful to leave the rounding 'til the end of the calculation.

The image magnification is therefore 11.5/18,276 = 0.62923258178056

We know from simple lens theory that:
Magnification = Image Distance / Object Distance
Image Distance is therefore Magnification x Object Distance
0.62923258178056 x 1,010,000 = 635.5329393703

Inserting these values into the "Lens Formula" 1/u + 1/v = 1/f
indicates a Focal Length of 635mm, or 25inches
… This is considerably shorter than the literature suggests.
The lens is generally described as 6" f6, which would be 36" Focal Length
But: What we appear to have is a 6" lens of 25" Focal Length [i.e. almost f4]
... a very fast lens indeed, and probably significant in the History of Photography.

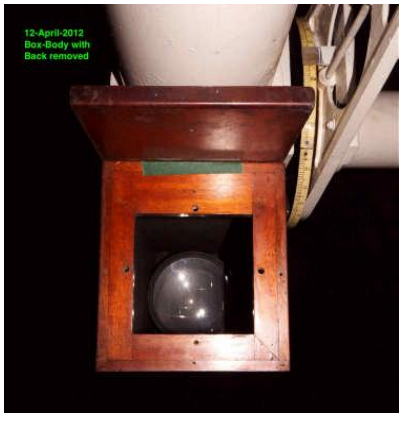
Next Steps:

I think it essential that we investigate further. I have therefore removed the focusing back, and I am making a simple adapter to replace it temporarily; so that we can repeat the "Beetham Tower" test with a digital camera.
The first prototype carried a “tracing paper” screen on a simple focuser … unfortunately; this has confirmed my suspicion that the focuser will need to be recessed into the box-body before we can achieve focus on a DSLR.
After completing that test, I propose to remove the lens for inspection and cleaning: I will first dismantle the lens and measure all of the elements and spacers, then clean it and reassemble prior to further testing. My home location has a clear view across the valley, to a row of street-lights approximately 1,200m away; I can accurately measure the distance between the posts and can therefore calibrate the photographic test result.

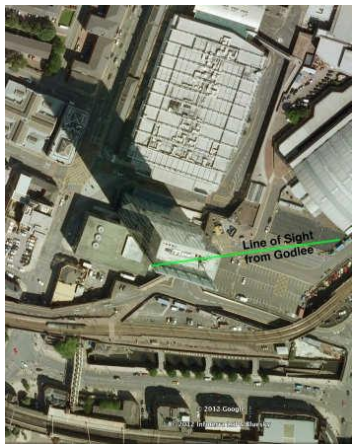
Proposed Future Use:

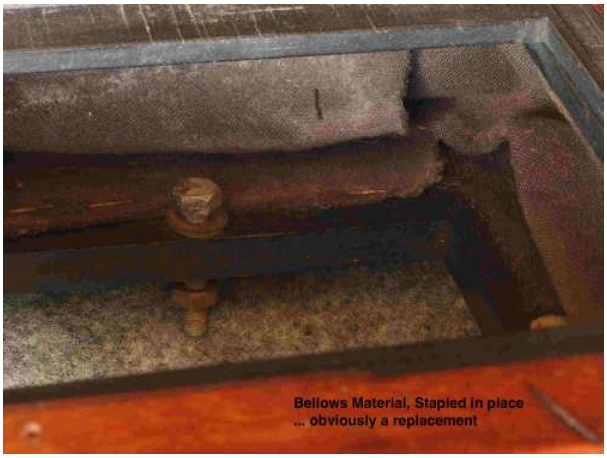
Depending upon the results of cleaning and testing, the Astrograph may simply be conserved as an historic artefact; but might prove to be very useful.
A focal length of 25” and an aperture of f4 would be ideal for photographing Nebulae on a “full frame” or smaller DSLR … but we may do better than that.
It should be possible [albeit tricky] to make an “indexing” adapter, to place a camera in multiple positions within the large-format Image Circle. Stitching together a block of four images would provide a high-resolution wide field view!

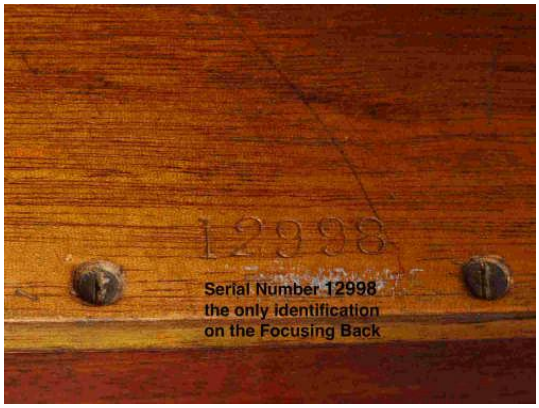
Michael Gilligan



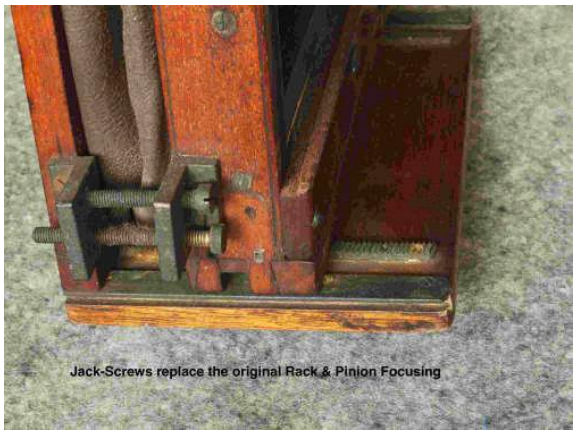

14-July-2012
Focusing Back
Touch-modified

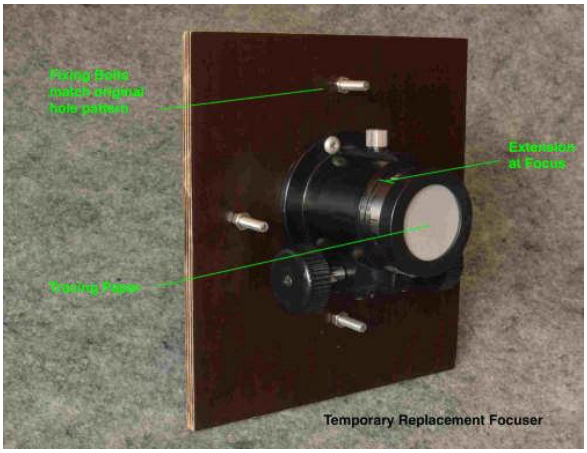

Line of Sight
from Godlee


Bellows Material, Stapled in place
... obviously a replacement


12998
Serial Number 12998
the only identification
on the Focusing Back


Maker's Plate [probably Ivory], and
witness-marks from missing items


Jack-Screws replace the original Rack & Pinion Focusing


Fixing Bolts
match original
hole pattern
Extension
at Focus
Temporary Replacement Focuser


Assembly reference-marks

Refurbishing and upgrading the Godlee telescopes.

Manchester Astronomical Society is fortunate in not only being one of the oldest provincial astronomical societies in the UK but from its beginnings in Victorian Manchester in the last decade of the 19th C, has enjoyed access to one of the few university observatories founded in Britain in the early part of the 20th century [i] [ii].

The Godlee instruments, comprising an 8-inch refractor counterbalanced by a 12-inch Newtonian reflector were the last of only four, so-called 'twin equatorials', constructed by Grubb, at their Rathmines telescope works in Dublin [iii] [iv] [v]. Earlier twin equatorials had been constructed for the London- based pioneering astronomical spectroscopist, Sir William Huggins, c1870 [vi]; for the former president of Liverpool Astronomical Society, Isaac Roberts, c 1885 [vii]; and as a demonstration instrument for the Manchester Exhibition 1887. [viii] The instruments at the Godlee observatory were the last to be built and remain the only Grubb twin equatorial in continuous use, now for well over a century[ix].

The Godlee observatory was a gift to the City of Manchester from philanthropist and textile magnate, Francis Godlee. With advice from the Northwestern Branch of the British Astronomical Association (in 1903 becoming MAS) and Sir Howard Grubb, who personally supervised the installation and commissioning, the instruments were intended to maximise the use of an astronomical teaching facility within the physics department of the Technical School. From about 1903, the observatory was managed by William C. Jenkins, employed by the Technical School as curator of the observatory who, as part of his duties, collected weather data for the Manchester meteorological office. Following his death in the 1930s, the observatory fell into disuse except for fire wardens manning the building during the Manchester blitz of 1941. 1941 is also the only year during which our society was held in abeyance since1892.

In 1946, Manchester Astronomical Society was invited to act as curators of the Godlee observatory. Since then, as a non profit making organisation we have looked after the telescopes at our own expense for our members to use and as a teaching aid in our public outreach. Since 1946, MAS has met weekly at the Godlee observatory, itself unusual compared with the vast majority of UK astronomical societies who only meet once a month. In so doing we have arguably accrued more man hours pursuing our hobby than any other provincial astronomical society. We

are also fortunate in having the facility to house a permanent library that with recent collaboration with the North West Group of Astronomical Societies, the Society for the History of Astronomy and the late Peter Hingley, librarian of the Royal Astronomical Society, is available to other local astronomical societies as an reference source of astronomical journals in the north west of England spanning most of the 20th C.

In 1902 the observatory and its instruments cost Francis Godlee £10,000 out of his own pocket, about £500,000 in today's money. In 2011 nearly half this amount was spent by the University of Manchester in renovating the observatory building (but not the telescopes therein) as part of a multi-million pound refurbishment of the Sackville Building during which time we were obliged to vacate the observatory. After a gap of over a year, MAS returned in December 2011 and immediately set about refurbishment of the library and meeting rooms.

We then turned to upgrading the telescopes to offer a more comprehensive facility for our members and visitors. Public outreach in support of astronomy and science in general has long been our goal and at the Godlee observatory we have a facility that few cities, let alone astronomical societies, can boast [x] . But to make full and better use of the instruments, it has been necessary to spend time and some money in upgrading them, from just visual use, to include more options for digital imaging which allows us to show to members and the public what is available to see in the night sky. Even the growing problem of light pollution in the city doesn't affect digital imaging to the same extent that it did traditional photography.

The 8-inch refractor is eminently suited for visual observation of the moon, sun and planets, its main use on Thursday evenings throughout the year. We are limited to having a maximum of 8 people in the observatory itself at any one time to use the telescope directly but our first purchase was a Crayford focuser (£115) that offers high precision focusing via a backlash-free 1:10 micro-fine adjustment which accepts standard 1 ¼" and 2" diameter eyepieces to improve the quality of visual observation. We have a 2" diameter, 38mm focal length, wide-field eyepiece that gives superb low power views (x75) of astronomical objects, especially of the moon. The new Crayford fits one of several bronze bayonet flanges that were made in the1950s by the late Kenneth Brierley to facilitate the quick addition and removal of tail-end accessories. At about that time, the telescope draw tube was shortened by about 3". In 2010, the brass draw tube was re-machined and polished by Mike Oates to improve its roundness and its simple, telescoping, push-pull sliding adjustment. Together with the new Crayford, this has significantly improved the smoothness and accuracy of focussing.

8-inch refractor rotating tail piece showing sliding focus tube and the Crayford 1:10 focuser. Image Tony Cross.

In the past 15yrs, digital imaging has revolutionised astronomical photography so it was decided to maximise the use of the telescope as a photographic instrument by providing facilities to allow cameras to be quickly fitted to the telescope to take digital images that can be shown during our presentations to a bigger audience in the lower Octagon Room. The Crayford will accept a 2" diameter adapter for securely attaching DSLR and other cameras, provided that members are willing to purchase suitable adapters for their own varied brand of cameras. We have T-adapters for Canon and Nikon DSLRs. We also have two Philips ToUcam Pro II digital webcams for high resolution planetary photography. Our president, Barry Henshall, has donated a dedicated computer that will run the software necessary for DSLR and webcam image capture at the telescope that can also 'pipe' live images down to the Octagon Room. This has been set up by David Shakeshaft, assisted by Anthony Jennings and Geoff Pilkington. Initial results have been very encouraging.
The refractor is also eminently suited for solar observation either directly, through a full-aperture solar filter, or by projection to give a 12-inch diameter projected image of the sun for multiple viewing. We can make visual or photographic 'white light' observations now but we have also been given a very expensive DayStar, T-Scanner back-loaded, etalon filter that will potentially allow superb views of chromospheric surface and prominence detail in sub-Angstrom , hydrogen-alpha light. But it would necessitate the purchase of a relatively expensive (c500 Euro) energy rejection pre-filter if we are to progress this line of specialised solar observation. Its purchase would depend on the support of our members. However, if the cost can be justified, it would equip the MAS and the Godlee observatory with one of the most powerful solar telescopes in any UK amateur astronomical society.

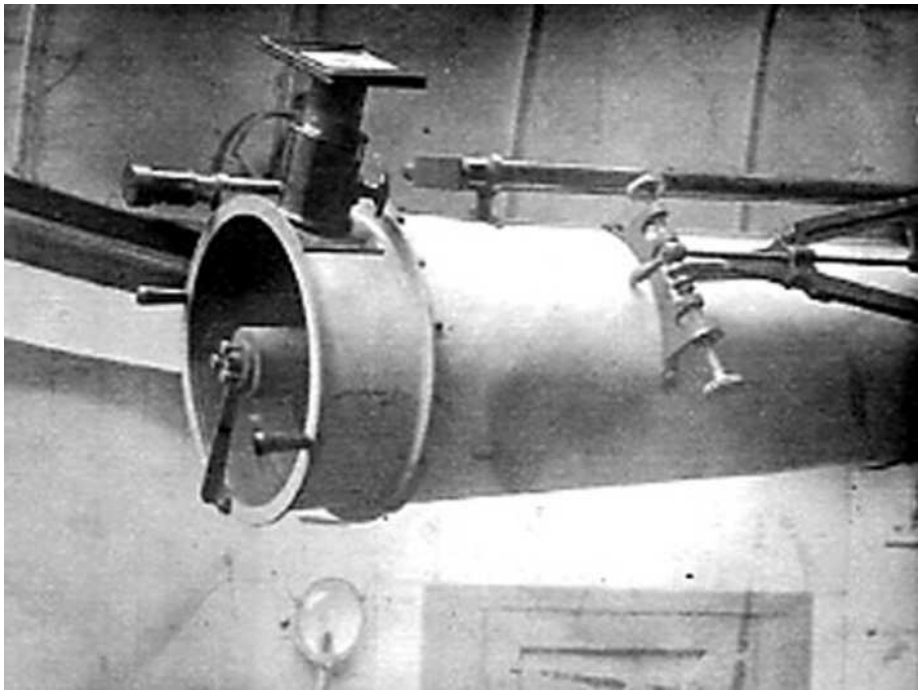
The Godlee refractor carries an under-slung plate camera. Originally thought to be 6-inch aperture f6, antique photography expert, Michael Gilligan, now thinks that it could be as fast as f4.5. He is re-building the back plate to accept a digital camera for future experiments in wide field imaging.

The 12-inch Newtonian is a big telescope on a big equatorial mounting and safety issues have prevented its use for visual

Underview of the Godlee instruments. Image Chris Lord.

observations for many years. The recent purchase of a tall, Class -1, industrial stepladder (£100) now facilitates easier and safer access to the Newtonian focus. Tony Cross has stripped, cleaned and re-assembled the rotating head so that access to the focus is now better. The mirrors were last aluminized in 1997 and we have again had them re-coated at Orion Optics (c£180).The telescope has been re-collimated but will of course need ongoing adjustment as befits a Newtonian. Its large aperture and fast f ratio, f7, make it a very powerful instrument for deep sky photography. We have therefore purchased a low profile Crayford focuser (£105) modified by Colin Harrison to accept a 2" adapter to carry digital cameras at prime focus or an eyepiece. It is our intention to use a Digital Single Lens Reflex camera (DSLR) to capture multiple images for image-stacking and deep sky penetration down to perhaps 15th magnitude. The inevitable light pollution of the city centre can now be largely removed by image processing software. As with the refractor, the Newtonian can also carry a webcam for high resolution imaging of the moon and

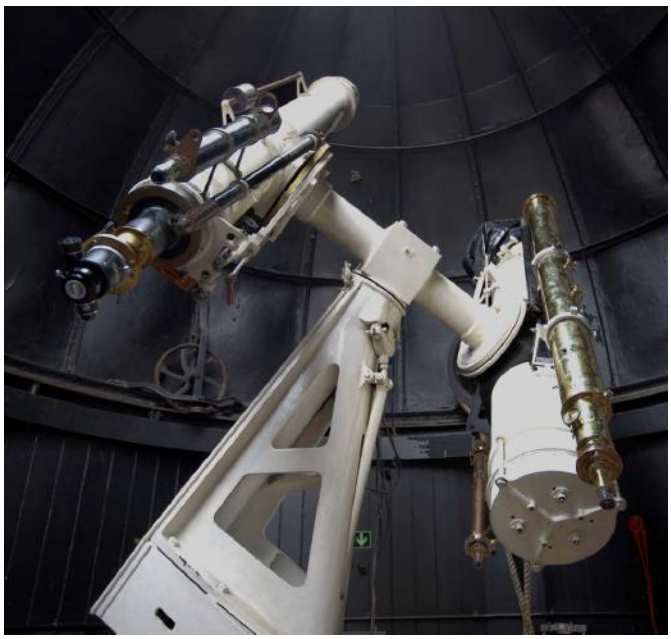
planets. Cameras will be operated remotely for image stacking, controlled by the dedicated computer, or in live-view mode to pipe what the telescope is seeing down to the Octagon Room, without having to climb the ladder except for initial image acquisition,.



12-inch Newtonian, c1902, plate camera attached. Declination slo-mo to its right. Grubb Collection; Tyne & Wear Archives.

12-inch Newt. showing the Crayford focuser and the 5-inch Wray acquisition scope. Image K J Kilburn

The Newtonian is an unwieldy telescope and it is difficult to find astronomical targets, even the moon or brighter planets. To facilitate this, an auxiliary instrument, a 5-inch Wray refractor, donated many years ago by the widow of our late member, Eric Hartas, has been restored by Tony Cross and installed piggy-back on the Newtonian [xi]. This fine antique refractor, c 1890, has half the light grasp of the 8-inch Godlee refractor but is nevertheless a powerful instrument. It offers its own excellent views of astronomical objects and when properly aligned with the reflector should make image acquisition in the latter easier to achieve. Fine adjustment in declination currently has to be done from the eyepiece of the Newtonian using the declination slow-motion attached close to the eyepiece. This can be 8-feet above the observatory floor. Michael Gilligan has donated a set of universal joints that Colin Harrison has assembled into an extension for the declination slo-mo that will allow declination adjustment from floor-level; initial pointing being done with the Wray refractor. Nonetheless, pointing the Newtonian will still be a two man effort. There is more work to do in the alignment and collimation of these two instruments but when completed both will have been brought back into use.



Refurbished telescopes showing the 5-inch Hartas image acquisition telescope on the reflector and the Crayford focuser on the 8-inch refractor. Image Chris Lord.

Refurbishment and upgrading the telescopes has necessitated the purchase and installation of retro-fitted equipment and modifications to the existing instruments to a total cost of about £500. Compared with modern Go-To telescopes, the more than century-old Godlee instruments are relatively simple, bigger and clunky but much more powerful, robust and adaptable. They and their upgrades need to be operated by MAS members and Wardens that are not only trained and familiar in their use but who can diagnose and fix ongoing problems. We are the curators of the Godlee observatory. It is up to us to manage the instruments safely and productively. These are working instruments, not museum pieces. We need expertise, not only to operate the telescopes but to operate and maintain the computer links to the cameras and within the system. All eligible MAS members are invited to become Wardens of the observatory.

Ongoing: The university electrician has refurbished the power switches and installed an isolator to the existing synchronous Right Ascension drive motor but Michael Gilligan is investigating an upgrade to the R.A. drive system to replace the synchronous motor with a stepper motor that will give more accurate electronic drive control and fast-slow adjustment in RA for image acquisition. If anyone with expertise can share this task, it would be appreciated. We also need web-savvy members to help restore the MAS website to full working order so we can publish on-line the results of our upgrade to the Godlee telescopes and our member's work.
On behalf of the President, Dr Barry Henshall and the MAS Council, I thank all those members who have given freely of their time, effort and some out of pocket expenses in upgrading the Godlee telescopes.
What would I now like to accomplish? I would like us to image Pluto from central Manchester. We now have the equipment to do it. It's probably too late for the summer of 2012 owing to bad weather; but it is now achievable.

Kevin J Kilburn FRAS

---

[i] Hutchins, R. 2008. British University Observatories 1772-1939. Ashgate.

[ii] Manchester Astronomical Society, nee' Northwestern Branch of the British Astronomical Association, is perhaps the only surviving Victorian amateur (for the love of it) scientific society in the city.

[iii] Glass, I. S. 1997. Victorian Telescope Makers: The Lives and Letters of Thomas and Howard Grubb. IoP.

[iv] Kilburn, K.J. 1999. Review. Victorian Telescope Makers. ISIS, Journal of the History of Science Society, 1999; 90. University of Chicago Press.

[v] Kilburn, K.J. 2002. The Godlee Observatory in Manchester, England. Journal of the Antique Telescope Society Issue 23-2002. Contact: Antique Telescope Society, Walter H. Breyer, Secretary,1878 Robinson Road, Dahlonega, GA 30533 USA

[vi] After his death Huggins's telescopes were moved to Cambridge and subsequently dismantled. The 15-inch OG of the refractor is now in storage at Cambridge. The fate of the speculum metal optics of the counterbalancing 18-inch Cassegrain reflector is unknown.

[vii] Roberts's 7-inch Cooke refractor counterbalancing a 20-inch Grubb Newtonian. Maghull ca 1885. Moved to Crowborough 1885. Moved to Norwich 1930. This twin is now mounted on the roof of the Science Museum, London. In 1889 the 20-inch reflector was the first photographic instrument to show the spiral structure of the great nebula in Andromeda, Messier 31 that we now know to be one of our closest galactic neighbours, the Andromeda galaxy, 2.5M light years away.

[viii] The 17-inch reflector / 8-inch refractor. Possibly made up only for the exhibition. Subsequently split up for sale separately.

[ix] Constructed in 1899, installed 1902.

[x] Free of charge public outreach lectures have been provided by Manchester Astronomical Society since shortly after WW1.

[xi] The piggyback mounting of the 5" Wray on the 12" Newtonian was devised and built by KJ Kilburn. It is not, as originally intended, bolted directly and firmly to the Newtonian cradle but is attached via a less rigid secondary clamping device to minimise any invasive modification to the main instrument and its mounting. This incurs some inevitable but minimal vibration.

Manchester Astronomical Society
Officers and Council, 2012—2013

President
John Barry Henshall BSc , PhD, FRAS
Email: maspresident@btinternet.com

Immediate Past President
Graham Hodson
Email:

Vice President
Guy D. Duckworth BSc (Hons), FRAS

Secretary
David Shakeshaft,
Email: secretary@manastro.co.uk

For General enquiries contact:
Godlee Observatory
Floor G, Sackville Street Building
The University of Manchester
Manchester, M60 1QD
Answerphone (24 hrs): 0161 306 4977

Treasurer
Anthony Jennings

Publicity Officer
Tony Cross
Email ; publicity@manastro.co.uk.
Answerphone (24 hrs): 0161 306 4977

Other Council Members
Kevin J Kilburn FRAS
Marion Mills
Michael Gilligan
Michael Oates

Non-elected Posts

Editor of Current Note – Vacant
IT – Vacant
Librarian – Marion Mills
Public Lecture Organiser – Kevin Kilburn
Safety Officer - Michael Oates

Contributions to Current Notes

MANY THANKS to all the members that have contributed to this issue of Current Notes. Contributions are welcomed from all members of the Society, and can cover any area of astronomy, from beginners' initial experiences, to more advanced and specialized aspects. Remember, this is your forum for letting other members know who you are and what are your interests.

Distribution of Current Notes

Current Notes is available in two formats: paper copy and a digital version. The digital version will be e-mailed to members whose e-mail address is registered with the secretary. Paper copies are also mailed free of charge to members without an e-mail address. The website version will be uploaded to the Member's Section on the Society's website (www.manastro.co.uk) following the issue of the next edition.

Guidelines for Submissions

In the absence of an editor for Current Notes please submit a copy of any contribution on floppy disk or as e-mail attachment to maspresident@btinternet.com in either MS Word format, PDF or as plain text file. If possible, please also submit a hard (printed) copy. Hand-written or typed contributions are also welcome, although to limit the editorial workload, these should ideally be kept short in length. Finally, any data submissions (e.g. statistics, observations, measurements) should be submitted either in a suitable digitized format (e.g. Excel spreadsheet, completed graphs) or with clear instructions as to how the data should be presented in Current Notes. If in doubt, please contact the editor.

Manchester Astronomical Society
Godlee Observatory
University of Manchester
Sackville Building, Sackville Street
Manchester
M1 3BU