I & I News

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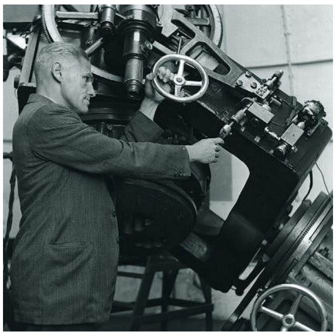

Sir Richard van der Riet Woolley, a former Astronomer Royal, used to say that no-one could call himself an astronomer who had not seen the light of dawn after a hard night's observing. He was also wary of electronics in his telescope domes, since it distanced an observer from direct contact with the cosmos. This was more than fifty years ago, when some professional telescopes were still being used visually as well as photographically. Nevertheless, with the current popularity of imaging and the preponderance of remotely operated instruments used by amateurs, Woolley's comments remain valid.

Bob Marriott, *Director*

A 30-inch reflector in Norfolk

Brian Mitchell

When I joined Norwich Astronomical Society in 1970 I was immediately led into the proposed construction of a new telescope, and for some obscure reason it was to be a 30-inch reflector. The project began with a trip – four of us in a small Datsun to Cambridge Observatory to meet Dr David Dewhirst, who had presented talks to the society before I joined. He showed us the observatory's 36-inch – an impressive piece of engineering – and he stressed the magnitude of what we intended. He later took us into the optical room, recently vacated by Dr Linfoot, their former mirror-maker, with the mirror-grinding machine made by John Hindle in the 1930s. I noticed a glass disc leaning against the wall, and measured it with my tape (I am an engineer). 'Thirty inches', I said. It proved to be a very old glass, 3 inches thick, and no-one knew what was originally intended for it.

Later, Dr Dewhirst said that we could have the glass and see what we could do with it, and if it proved to be of no use to give it at no charge to anyone who could make use of it. A few weeks later we also took possession of the grinding machine and several boxes of tools. The machine was set up in our tiny clubroom in Town Close School's playing field, and an attempt to grind it was begun.

Affairs moved on: we acquired a site for the new observatory – half an acre of ground rented from the University of East Anglia – and I drew designs for the telescope (30 inches, f/5) and the dome to house it. The telescope was to be fork-mounted, with a heavy central box with the mirror cell at the bottom and the eyepiece and flat in a rotatable drum at the top, held in place by a Serrurier truss. We were conscious that we would have to have everything made safe, as we would be accommodating, in the dark, non-professionals, visiting clubs, and even schoolchildren. The basic design of the observatory dome was for the observing floor to rotate with the telescope. There was a wide slot for the telescope to move up and down and a barrier round it, about 1 metre high. The top end of the telescope was able to rotate to allow the eyepiece to be accessible at any position of the telescope. On one side of the slot were a few steps up to the observing position, and observing could also be undertaken from the steps. The sheet-metal 20-foot dome is attached to the observing floor, with the entrance door and steps always behind the telescope as it rotates in RA and Dec.

We obtained a large shed and set up the Hindle grinding machine, and I considered the task of grinding. There were a number of cast-iron tools with the machine, but none to give the correct radius for f/'5, so I used one to produce a smaller radius followed by a flat glass blank worked around the edge of the mirror to correct to f/5. To ensure that the correct radius had been achieved, the disc was taken outside on a

sunny day, wetted, and the distance to the solar image measured – then on to fine grinding.

In the meanwhile, construction of the dome proceeded, much helped by steelwork being cut, formed, and provided free by a local engineering company, contacted by the society's secretary, Cyril Blount. To ease construction, the segments of galvanised sheet for the skin were precut to shape and riveted together by pop rivets with cover strips inside and out. The shutters for the aperture are counterbalanced, as is the entrance door. The whole construction revolves on eight cast-iron wheels set in four bogies, with side wheels to keep it all on track.

We had a good crew of helpers – all members of the society, and mostly amateurs in matters of construction. A member who was particularly useful was Dave Breeze, whose day job was in paving. As well as doing most of the brickwork, he helped with steel erection, pop riveting, and other matters. We had two members who were welders with a local trailer construction company, and I gave them drawings of the huge fork, the heavy centre box of the telescope, which were provided at no cost to the society. Someone knew of a local hospital laundry, Whitlingham Hospital, that was soon to close, so we visited it to see whether any scrap was available. The spin-dryers consisted of steel drums, 33 inches in diameter with heavy cast-iron bases, one of which provided an excellent cell for the 30-inch mirror.

After some time, the glass disc was deemed to have the correct radius and I decided to ‘give it a bit of a shine’ in order to ascertain the radius more correctly. I had a 6-inch pitch lap that I had used previously when making a 6-inch mirror, so that was used. I was surprised how quickly that small lap put a polish onto the very large glass, and as the radius proved to be correct for a 150-inch focal length I proceeded towards proper polishing with that lap.

David Fagg had connections in the printing industry and arranged for the delivery of a printer’s tilt table to my garage at home, This was a heavy steel table on wheels, the top of which could be made to tilt from horizontal to vertical. Onto this was firmly mounted the glass so that I could polish with it horizontal and tilt it to vertical for testing. The testing was carried out using Horace Dall’s null test, by which a lens is positioned in the light path of the standard Foucault test and the eventual parabolic curve has the appearance in the test of a simple sphere. I do not believe I could have produced the correct figure without this procedure. The polishing and figuring was carried out mainly by the use of the 6-inch lap, but occasionally using a much larger one to ease the curves.

Dave Cramer, working for an off-shore oil company, obtained a very large and heavy steel gas-pipe flange which was pressed into service as the base for the equatorial mount for the telescope, welded onto a sub-frame that had originally been part of the bus in which David Fagg and his family lived while their new house was being built. One of the wheel hubs from the bus was the centre pivot. The whole was on top of a massive *in situ* cast concrete plinth in the centre of the dome, aligned equatorially.

After seventeen hours of polishing and figuring over three years, on 11 June 1984 the mirror was deemed to be complete, and it was temporarily installed in the telescope for the final test to determine how it performed on stars. (Further details on the figuring of the mirror are included in my article ‘Making a 30-inch mirror’, *I&I News* New Series No. 6, 28 April 2012.)

The dome and telescope were initially pushed round by hand to examine the Andromeda galaxy, and the view was compared with the view through the nearby 10-inch Horace Dall reflector and declared to be correct. The mirror was subsequently given its aluminium coating at Herstmonceux, and the telescope and dome were provided with an electric drive and put into service. At a later stage, the telescope’s RA motion was driven and the declination set by hand, held by a friction brake.

We entertained many groups of people – scouts, schoolchildren, older people – and for a week in 1986 we showed Halley’s comet when it was above our horizon, and the Andromeda galaxy when the comet was not viewable.

From mid-1994 the telescope and dome, for a variety of reasons, moved sites – first to a former airbase at Seething, south of Norwich, and in 2000 to the sports field of Reepham High School, where all the separate parts of the telescope and dome were left by a contractor for us to re-erect. This location was arranged with the school by Ron McArthur, who lived in Reepham.

With a much smaller group now, a 1-metre dome housing a remote-controlled dome on an 8-foot tower was built first, and later Ron, working almost alone, dug out and laid foundations for the 20-foot dome and telescope and went on to build the dome support wall. A crane was then hired, and the heavy steel frame and the telescope sub-frame installed. Work proceeded slowly, and eventually it came to be just Ron and myself rebuilding the observatory. By this time the original telescope mount had been replaced with one incorporating a 6-foot-diameter steel ring, formerly intended to be part of a sugar-processing factory and much more stable. Ron went on to design and install a fully automated computerised drive system for the telescope.

A major problem with the observatory had been the damp conditions. Condensation on the inside of the dome and leaks at the joints of the dome skin had led to the mirror having to be recoated due to corrosion of the aluminium surface. Ron obtained heavy-duty sealing tape which sealed the joints completely, and I fitted sheets of aluminium around the upper parts of the dome, about 1½ inches clear of the skin, which eliminated condensation. At the last report, the school had incorporated the observatory into its curriculum and it was regularly in use.

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The Lilburn telescope in Northumberland

Len Clucas

Twenty-five years ago the objective of the Lilburn telescope, a 6.4-inch Merz lens, was seen to have suffered water damage and was replaced with a modern lens manufactured by David Sinden. The original lay on a bookcase shelf in the observatory until two years ago, when I asked permission to examine the lens and remove a small area of what looked like lime scale. The damage was, in fact, erosion of the surface in a scallop-shaped area about 1.5 x 0.5 inches at the edge of the lens where water had lodged for some time. Without a regrind and polish of this front surface the erosion could not be taken out. On cleaning the lens I saw that this patch might not affect the performance too much, so with the agreement of Adrian Parday, the observatory curator (in the photograph below), I began constructing a jacknife refractor. The purpose of this telescope is to see how the damaged lens performs, and if it is reasonable to do some casual observing. The objective is 6.4 inches in aperture and 102 inches focal length, close to f/16, the flat is ⅛-wavelength material, quartz, and the focuser is an old Skywatcher rack and pinion. I checked the viewing on stars which I could see through open workshop doors, and then on the landscape at Lilburn, where the instrument will be kept. Neither view revealed any problems. The telescope needs much more testing before a definitive verdict can be produced, which will take some time, given the weather. There are those purists who might say that the lens should be put in a museum to be admired by the madly interested public. That may happen some day, but until then, if light can be usefully transmitted through it, then it should be used. Beauty is better at the eye of the beholder than on a museum shelf.

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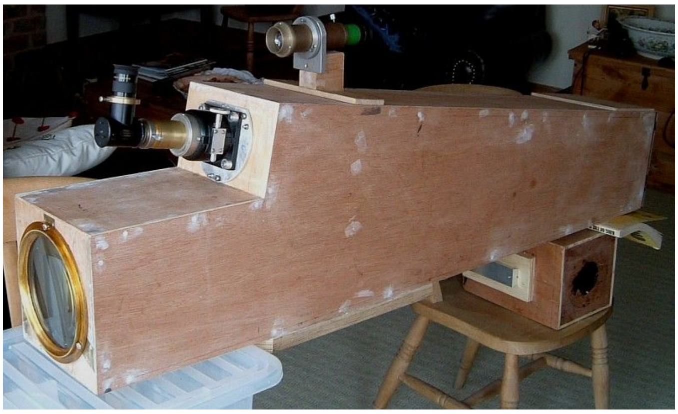

Finders for Schmidt–Cassegrains

Peter Anderson

In recent times I have used my 16-inch Newtonian less and less because of its bulk and of having to clamber around, and I now have 8-inch, 9¼-inch, 11-inch, and 14-inch Celestron SCTs. One problem with these instruments is in using the finders, since as an older person I do not bend the way I once did. Unlike longer telescopes which can be sighted along the tube, it is difficult to quickly and accurately point SCTs. The finder telescopes can be awkwardly placed for certain sky angles, requiring bodily contortions when sighting, and an easily accessible and useable method of finding objects is necessary.

The 9¼-inch is mounted equatorially and lower, and so the problem of using the finder was worse. It occurred to me that a laser pointer could be fixed on the mounting rail, to be used as a finder, rather than just using it to shoot up the polar axis for polar alignment. I discovered that the optical axis of the telescope is a little off the alignment of the mounting rail, and much more so the optical axis of the pointer, which can easily be a degree or more off the alignment of its casing. Therefore, slow rotation of the laser can also be part of the alignment. Adjustments can be made by applying or wrapping tape around either end of the pointer or the rail. It is very simple, firmly held, and easily detachable.

To operate it, hold the telescope, release the clutches, and hold down the button on the laser pointer. I use a 40-mm eyepeice (x59), and can easily point by manual means well within its field of view. To centre the object I use the keypad controls while looking through the eyepiece. The system is so simple that I imagine it is already in widespread use. My contribution (if it can be called that) is the use of the mounting rail and the very simple way of attaching the pointer. The finder eyepiece seemed invariably to be under the telescope on the far side, but now I no longer have to be a contortionist.

The 16-inch f/6 Newtonian.
(See *I&I News* New Series No. 19, 16 June 2014.)

The 8-inch, 9¼-inch, 11-inch, and 14-inch SCTs.

The finder of the altazimuth-mounted 11-inch describes a short arc in altitude, but with a direct-view arrangement it is difficult to bend down low and look up at high-altitude objects. The 90-degree finder solves this problem, but is rather too high for viewing objects near the horizon. Either its eyepiece should be rotated or rotatable up to 90º, or a second direct-view finder attached for low-altitude objects. The equatorial 14-inch, though taller, places the finder at some strange angles, so two finders help.

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A mobility mount for a tripod

Peter Anderson

I was considering how I might move my 9¼-inch Celestron around my observatory and then move it aside when not needed. My 11-inch has a commercial triangular wheeled frame support, but to purchase and import another one would have cost around AU$500, which I was not prepared to spend.

I had a second concern. The tripod of the telescope is tightened by screwing the eyepiece holder tray unit upward. Together with the weight of the telescope and mount, this places considerable pressure on the hinges at the apex of the tripod, and this particular unit does not posess a cross-bar support near the base of the legs (as my others do) to take some of this strain and make the structure more rigid.

The legs of the tripod are splayed at a quite immodest angle, and this is particularly evident if they are extended to bring the telescope to a greater height, which would also place even more pressure on the hinges. Therefore, my aim was to make a wheeled stand that would capture and hold the legs so that they would not splay further nor exert greater pressure on the hinges, and would also raise the height of the telescope.

After trying many designs I decided on the simplest. I am somewhat challenged when it comes to using tools, but I can saw a piece of wood at right angles, and can join two pieces in a ‘T’ shape after ‘worrying out’ the half thickness at the joint. Three 18-mm holes, 15 mm deep, took care of securing and capturing the bases of the legs. I glued the joint, attached various brackets and screws (with probably some overkill), and finished the job with some clear paint. Each piece of pine is 90 x 70 x 35 mm. The unit has 3-inch lockable wheels, and ultimately raises the height by 120 mm. The total cost, except a little glue and paint, was AU$62.62. It works very smoothly. Whereas the extended legs of the tripod are a trip hazard, the light timber is easily seen at night. The timber under the leg of the polar axis is extended so that for coarse polar alignment it can be placed parallel to the tile joints on my north–south observatory floor.

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Celestron air circulation vents

Peter Anderson

In *Technical Tips* No. 7 (24 October 2012) I answered an enquiry concerning condensation on the inside of the corrector plate of a Schmidt–Cassegrain telescope. Never having experienced this problem, I offered advice (hair dryers and warming) that was completely wrong. Instead, the solution seems to be in lowering the humidity of the tube by the use of dessicants, and manufactured plugs containing dessicant (below) can be inserted into the eyepiece adaptor tube. I have even read of a fellow who uses an aquarium pump in a bowl of dessicant dribbling dry air (thin tube and cork method) into the optical tube through the rear eyepiece adaptor, and monitors the humidity as it decreases. I do not wish to dwell on this in detail, but a dessicant plug will take a long time to reduce the humidity to an acceptable level.

Until recently I had never had problems with dewing on the inside of the corrector plate, though when I originally purchased an 8-inch Celestron in 1990 it was common for it to have a smeary inside, which was fixed by removing the corrector plate (first noting the registration marks), cleaning the inside, and replacing it. Since then, interior fogging has occurred only twice, and on those occasions when the instrument was stored in a closed box.

With advancing years (I am now 74) I became tired of climbing up to use my 16-inch f/6 Newtonian and switched to SCTs, especially since their prices had dropped dramatically with the Chinese-produced versions. In addition to the 8-inch, I now have a 9¼-inch, an 11-inch, and a 14-inch. With the 9¼-inch I immediately fitted a UV filter to the rear cell of the tube, effectively sealing it, and with the 11-inch I placed an f/6.3 focal reducer, which also doubles for this purpose. The result is that there has never been the slightest indication of interior fogging.

The 14-inch came with the two small vents for temperature stabilisation. I fitted the UV filter on the back cell as before, but after about six months I noticed a transient faint fog on the inside of the corrector plate. Upon investigation, when sitting in the observatory during the day with the instrument pointing upwards, this fog dispersed (since warm air rises and takes up the moisture), but when the instrument was pointed downwards the fog returned (cold air falling). Attempts to remove it with fans and hair dryers were futile, as I was simply recirculating the moisture. The reverse occurs at night. As the temperature lowers, cold air sinks from above, and the thin corrector plate (at the front end) is the first to respond. Long before the dew point is reached, the interior of the now cool corrector plate is fogging.

Telescopes cool to reach equilibrium, and larger telescopes (with thicker glass) take longer. Ventilation certainly helps, but it is difficult to determine by how much, and under what circumstances.

It became obvious that moisture enters the tube through the vents. These serve their purpose, but by themselves they are either part of the problem or part of the solution. In my case they are the problem. When the telescope is oriented over the mount, the vents are at the top and bottom at the rear. If the tube is aligned at the side of the mount they are at the sides, and an illuminating demonstration was at such an orientation with the tube horizontal, where there was a 'fog band' across half way, with the bottom half of the plate lightly fogged.

The two vents, whilst cooling the mirror, may not provide adequate circulation elsewhere, especially at the front end of the tube, resulting in the introduction of moisture. The solution is to install a circulating fan or fans, in addition to which, a heater band may well be required on the outside, just below the corrector plate.

I also use a dew shield, partly to exclude stray light. I suppose that my humidity can become higher, and the drop from daytime to night-time is not that great. Therefore, fogging rather than reaching thermal equilibrium is more of a problem. It may simply depend on local conditions.

For myself, I would rather have clear optics. As a temporary measure I have placed tape over the vents, because while they were open, all attempts at dehumidifying the tube were unsuccessful – just changing my dessicant sachets from blue to pink. Now the corrector plate remains almost totally clear, and I may reach the stage where I can reinstall my UV filter when the tube remains dry and clear, and seal the vents permanently.

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Imaging with an altazimuth mount

Peter Anderson

I live in Brisbane at latitude 27°.5 S, so I carried out tests on southern objects quite high in the sky. Although I live in a hilly wooded area I am only five miles from the city centre, though the sky to the south and west is much darker.

Because I wanted brighter images I did not try this experiment at prime focus, but instead used a focal reducer. All three test objects were past culmination, high in the south-west. A 30-second exposure showed not only the rotational drift but also the rather obvious vignetting. The latter would not be apparent at prime focus, but the loss of focus towards the edge of the field and rotational drift certainly would be apparent. As the exposures were around 1.5–2.5 minutes apart, the rotational jump between successive exposures was easily discernible. The delay between exposures occurs as the camera carries out internal dark-frame processing.

From these tests I learned the following:

1 Align the telescope on stars near the area to be photographed. This is obvious, but it does make a difference.
2 The telescope will generally track in a very satisfactory manner for 30 seconds.
3 Short-exposure (~30-second) images are quite practical.
4 Focusing is very important.
5 With the curvature of field and rotational issues, only the central portions of the field are readily usable.

ω Centauri : Canon 70D, ISO 2000, 30 sec at f/6.3

I carried out these tests to determine whether such photography was feasible – and it is! Purists have probably collapsed by now, but for my purposes a modern DSLR of around 50% quantum efficiency and no reciprocity failure can produce 'quick and dirty' images of passable quality.

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NGC 4755 : Jewel Box : Canon 70D, ISO 2000, 30 sec at f/6.3

NGC 5128 : Centaurus A : Canon 70D, ISO 2000, 30 sec at f/6.3

An orbit-sweeper

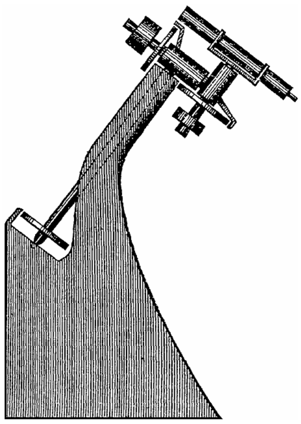
Bob Marriott

In 1861, George Biddell Airy, the Astronomer Royal, produced a design for a new type of mount to be used for convenient tracking of comets along their predicted paths. This mount could be set with two axes clamped and freedom of the third axis only, to move the telescope through any circle at any orientation. In addition to tracking comets, it could also be used to search for minor planets (of which only sixty-two were known at that time) by sweeping along the ecliptic, though Airy did not mention this possibility. Irrespective of modern tracking systems, a mount of this type might still be used for visual work with a telescope or with large binoculars: sweeping for comets, sweeping for novae along the galactic plane (assuming intimate knowledge of star patterns to fainter magnitudes), or simply for exploration of the Milky Way with one convenient directional movement. As far as I know, Airy's orbit-sweeper has never been put into practice, but the design at least presents an opportunity for a project for those who like to construct instruments. The following is the full text of Airy's 'Suggestion of a new astronomical instrument, for which the name "orbit-sweeper" is proposed', published in *Monthly Notices of the Royal Astronomical Society*, 21 (1861), 158–9.

In reflecting on the possibility of picking up De Vico's comet, by aid of the sweeping ephemeris prepared by Mr Hind, I could not but observe how ill adapted for this purpose are the instruments in ordinary use. It will be remarked that, in this and similar cases, it is not a general search in all directions about a given point that is required. For every day, places are computed which lie in a definite line drawn upon the celestial sphere; and, while it may be requisite to sweep many degrees along that line, it will be useless to direct the telescope many minutes above it or below it. The geometrical conception of the matter will at once explain this. The elements of the comet's orbit, considered as a curved line through space of three dimensions, are known with considerable accuracy; but the time of the comet's return to perihelion is not known with accuracy, and therefore the actual place of the comet upon that curved line is not known with accuracy; all that is accurately known being, that the comet will be somewhere on that line. And in fact, the definite line drawn upon the celestial sphere (of which I have spoken) is the perspective representation of a portion of the comet's orbit as viewed at a certain instant of time from the earth; and therefore the optical place of the comet must be somewhere upon that line traced on the celestial sphere, but we cannot say exactly where.

An unmounted telescope can scarcely be used to sweep along a definite track through the sky, which is defined by numerical elements of right ascension and north polar distance, but cannot easily be referred to distinguishable stars occurring in the breadth of every field of view. And the mounting which for all ordinary purposes is the most convenient, namely, that of the equatoreal, cannot be easily applied here. For sweeping in right ascension only, or (with the aid of clockwork movement, which every equatoreal ought to have) for sweeping in polar distance only, it is excellent; but for sweeping in an inclined direction, it is no better than an unmounted telescope.

I have arranged a form of mounting adapted to sweeping in all directions, a model of which (of about half-size dimensions) I ask leave to exhibit to the Society. The general form of the instrument is that of a German equatoreal. The polar axis is similar to that of a German equatoreal; but, in order to allow freedom of rotation to all parts, the fixed mass in which the polar axis turns must not be a pier widening downwards from the upper bearing of the polar axis, but must for some distance be a hollow tube or trunk. The cross-axis will be similar to that of a German equatoreal; but instead of carrying the telescope, it will carry a small trunk in which a second cross-axis turns. This second cross-axis carries the telescope. The polar axis should have a divided hour-circle, and clockwork movement (omitted in the model), the first cross-axis must have a graduated circle, and a clamp or steps by which it may be firmly fixed in a given position; the second cross-axis carrying the telescope must have a graduated circle, and must have two stops limiting its sweeping motion to any arbitrary extent. The second cross-axis must have a counterpoise for the telescope; the first cross-axis must have a counterpoise sufficient to balance both the telescope and the telescope's counterpoise. The annexed figure was drawn from the model. It will be easily seen that, by giving a proper position in rotation to the first cross-axis, the inclination of the second cross-axis to an astronomical meridian may be made any whatever, and therefore the inclination of the circle in which the telescope will sweep may be made any whatever; and it may be made to coincide with the definite line drawn on the celestial sphere in which the comet is to be sought. And, by means of its stops, the extent of that line through which its sweep is to be made may be limited as we may think fit.



To such an instrument I would propose to attach the name 'orbit-sweeper'. If I were to construct such an instrument expressly for the purpose of sweeping orbits, I would make it of wood. Such a construction would be more than sufficiently accurate for the purpose in question; its expense would be very small, it would be lighter than metal, for the same degree of stiffness; and its counterpoises, etc. would be light.

From the Director

At the Ordinary Meeting at Burlington House on 21 January I presented a 30-minute talk on the Instruments and Imaging Section. The video is available for viewing or downloading in the Members Only area of the main BAA website.

https://britastro.org/video/7186/9181

Forthcoming event

Exhibition 2017, National Museum of Scotland, Edinburgh
Saturday, 24 June, 10 am to 5 pm

http://www.britastro.org/exhibition/

A precision home-made CCD camera rotator

Ron Arbour

This device was built in my home workshop and has proved to be invaluable in my search and discovery of supernovae. Its purpose is to very precisely align the CCD detector's array of pixels east–west so that newly acquired images and their reference images always have identical orientation. Consequently, when these images are blinked (displayed alternately in quick succession) they are in perfect registration. Blinking is much more efficient than simply viewing two images in separate windows. There is less eye and neck strain, and any additional object will immediately attract attention and have less chance of being overlooked.

Most amateurs who search for supernovae employ some form of blinking – the electronic equivalent of the blink comparator as used by Clyde Tombaugh in his photographic search for Planet X (Pluto). For the process to work efficiently the images must be in perfect registration with each other, not only in x and y, but more importantly, θ. A rotational error of only 1° or even less is very fatiguing (and hypnotic) when blinking hundreds of images in sessions lasting as long as 7–9 hours in mid-winter. Currently, the images are roughly aligned by selecting the same star in both a reference and patrol image window. The cursor position is calculated to the nearest pixel, and the images are then displayed alternately in the same window.

Although far from ideal, it works, as a small amount of x or y error is tolerable, whereas a rotational error is not. For objects selected near the centre of an image the effect is negligible, but many fainter galaxies often appear near the edges of the field, and a rotational error of only 1° or even less can be most disconcerting (Figure 1). More importantly, if a faint suspect is not accurately aligned when blinking, it can easily be overlooked and a discovery lost.

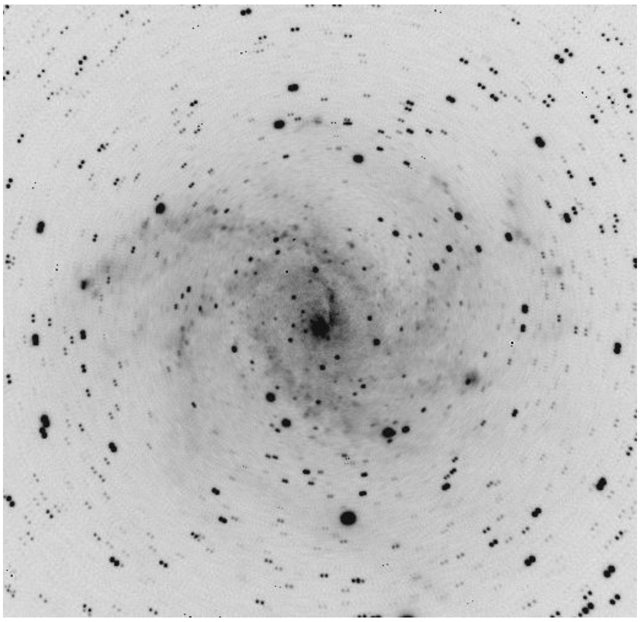


Figure 1

There is no commercially available software ideally suited for supernova searching, so amateurs often resort to writing their own: for example, GrepNova, written by Dominic Ford. While most of the separate routines can be found in applications such as CCDSoft, MaximDL, AstroArt, and so on, they are totally impracticable in the manic pursuit that is supernova searching. The software I use was written by my friend Phil Russell. He wanted to start searching for supernovae and suggested that we collaborate on a program tailored for the task. While Phil produced the programming I designed the work-flow, and in just a very few weeks we had a program that worked. Some of the routines needed to be refined, while others needed implementation, including the calculation of stellar centroids in order to perform image registration and subtraction.

Sadly, Phil died before he could discover his much-longed-for supernova or implement some of the processes we had planned. Phil's program was written in Python, while my only programming experience has been with BBC BASIC. Being in my mid-70s, I am too old to learn a new programming language, so there is little chance that the program will ever be completed. My solution to the image rotation problem was to solve it mechanically with a homemade camera rotator (Figure 2). While image rotators are available commercially, it entails more expense, cabling, and possible hair loss caused by software/hardware-related problems.

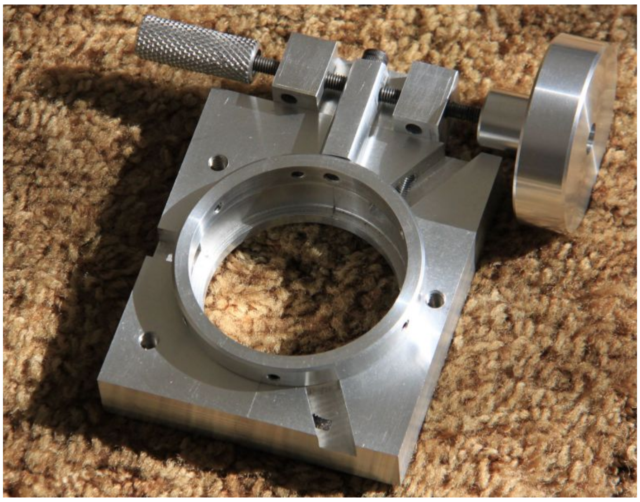


Figure 2

The principle is to align the camera very accurately east–west using the rotator device, and take a complete set of reference images. All subsequent patrol images are taken without disturbing the camera. If it has to be removed it takes only a very few minutes to align with high precision. The camera is permanently attached to the telescope to avoid damp air entering the tube, and is only removed for cleaning the CCD every couple of years or so. The camera window, CCD, and internal optics of my SCT have never misted up since adopting this stratagem, whereas they did so previously.

The device consists of several components (Figure 3), machined in my workshop on an SEIG SX3 milling machine and Myford ML7 lathe. In essence, a collar is clamped to the camera adaptor tube to which is attached the tangent arm

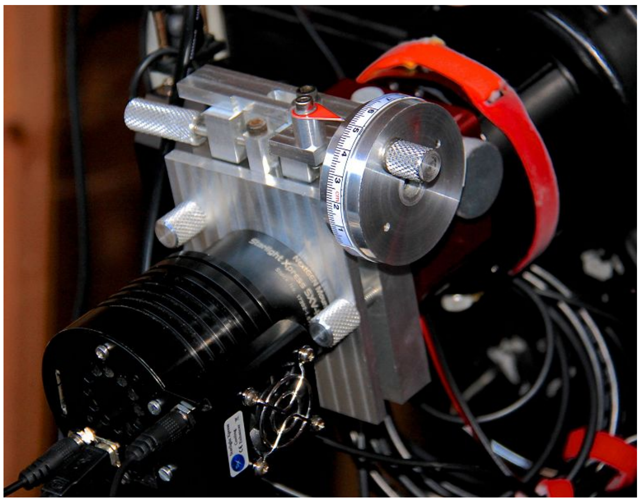
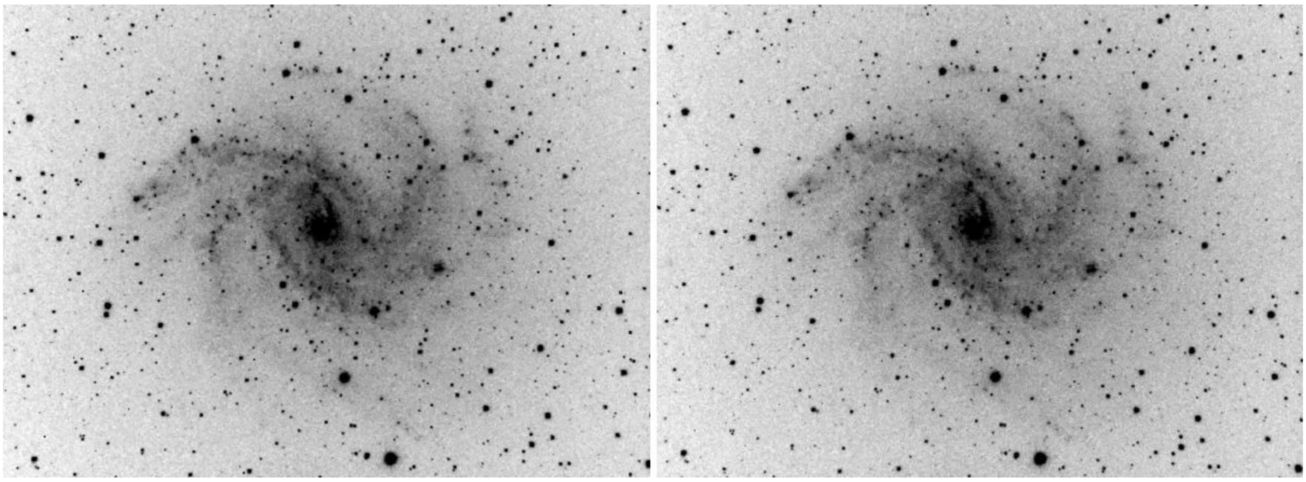


Figure 3



Two images at slightly different orientations
For an animation of blinking, see http://www.britastro.org/iandi/arbour.htm

that is either pushed or pulled by two M5 screws. The tangent arm is sandwiched between two thick plates – one fixed to the focuser, and the other free to rotate around the camera adaptor tube. Once the correct orientation has been determined, the camera adaptor ring is clamped between the two plates by means of the knurled thumbscrews.

The camera, and hence CCD rotation, is imparted between the focuser and the camera's adaptor tube by means of the tangent arm principle. A radius lever arm is fixed to the collar of the SXVR H9 camera's adaptor tube, and rotated by a pair of M5 screws with a 0.8-mm pitch. The slippable, graduated scale on the indexing drum was cut from a length of self-adhesive scales available from Axminster tools:

http://www.axminster.co.uk/ujk-technology-self-adhesive-measuring-tape-ax888486

The east–west rotational error was determined with the help of that amazing piece of software, Astrometrica. Its main purpose is to provide precision astrometry and photometry from CCD images. Astrometrica also produces a wealth of useful additional information on an image in its log file, such as the precise focal length of the telescope to within a fraction of a millimetre. It is interesting just to see the seasonal effect that temperature has on focal length. For our use here it determines the camera's position-angle error to a resolution of 0°.01. This error is then translated into divisions of the indexing drum – one full rotation being equal to 0°.726 or 7.4 pixels at the edge of the SXVR H9 detector when binned 2x2. The device is capable of much better rotational resolution than the 0°.1 given by the astrometry. The calibrated drum is divided into two hundred divisions, and three divisions causes the edge of the camera field to rotate by ~0.1 pixel – well below detectability. While the materials used in the construction probably suffer from elastic deformation, in practice the effects are undetectable.

In use, a short-exposure image is taken and its PA error is determined from Astrometrica. This value is then entered in my BASIC program, which outputs the number of divisions and the direction in which the drum has to turn to eliminate the error. To rotate the camera by hand to achieve a zero PA error by trial and error is not impossible, but in practice it is extremely time-consuming. This device makes it a pleasurable exercise.

While not using software to correct a mechanical problem might seem a retrograde step, there can be no doubt that solving a problem by making something with your own hands is much more satisfying than seeing your bank balance decline.

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The ladies participate

Bob Marriott

'Astronomy has become a deservedly fashionable hobby with young ladies.' This single sentence accompanies a poem entitled 'Star-gazing', published in *Punch* on 21 October 1893. The editor of that magazine would not have published anything twee or prosaic, and instead the verse is enigmatic.

My love is an astronomer,
Whose knowledge I rely on,
She'll talk about, as I prefer,
The satellites of Jupiter,
The nebulous Orion.

When evening shades about us fall
Each hour too quickly passes.
We take no heed of time at all,
When studying celestial
Phenomena through glasses.

The salient features we decry
Of all the starry pattern;
To see with telescopic eye
The citizens of Mars we try,
Or speculate on Saturn.

To find another planet still
If ever we're enabled,
The world discovered by her skill
As 'Angelina Tomkyns' will
Triumphantly be labelled.

The likeness of the stars elsewhere
By day we view between us,
We recognise the Greater Bear,
I grieve to say, in Tomkyns' *pere*,
And close at hand is Venus!

In fact, the editorial note
Above, which is of course meant
To lead more ladies to devote
Attention to the stars, I quote
With cordial endorsement.

Punch was a satirical publication which frequently dealt with current issues, so the name Angelina Tomkyns was probably topical at the time and well known, but was later to recede into oblivion. The verse implies that she had discovered a new object, and also refers to her father (Tomkyns' *pere*) as the 'Greater Bear'. I have found only two references to this name. The first appears in the report of a concert in which an Angelina Tomkyns participated, together with the announcement that 'Fullerton shipped seven carloads of potatoes last week', published in the Californian newspaper *South Riverside Bee* six days earlier, on 15 October – though it is improbable that this would have been versified in *Punch*. The other is an unpublished ten-volume genealogy *The Clan of Tomkyns*, held in Los Angeles Public Library. Neither of these is connected with astronomy, so perhaps someone might care to carry out further research ...

... or perhaps not.

Restoration of an AE350 f/5–20 Newtonian–Cassegrain

Alan Snook

This instrument was made by Astronomical Equipment of Luton in 1974–75. It was operated at the Hicks Observatory at the University of Sheffield from 1975 to 2008, and since then it has been dismantled and in storage. The accompanying photograph and specifications from one of AE's advertising brochures are of that same instrument. I collected all the parts from Hampshire at the beginning of February this year, though I did not begin work immediately as my workshop is not heated. It was an opportunity to think about the project and not rush the process. All the parts seemed to be present and correct apart from the Newtonian focusing mount and some brass thumbscrews on the finder telescope mounting rings.

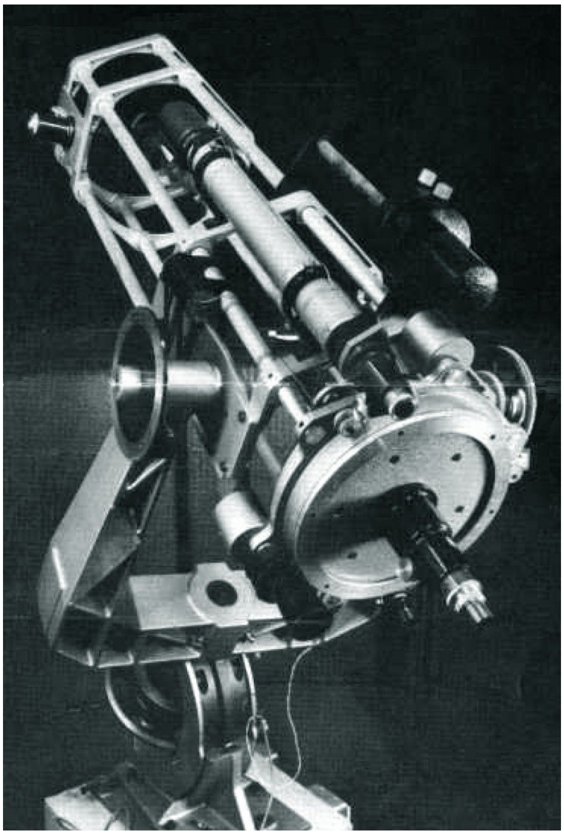
I decided that I would not rebuild the instrument to its original 1975 state, as I want it to be fit for current purposes and hold its own against anything coming off the production lines today. Also, while I am a visual observer I have been advised that my eyesight will begin to deteriorate, so I intend to equip the telescope for CCD imaging. The chilly winter nights are also becoming less attractive, so remote operation would be an advantage. The 1975 electronics and motors and the Cassegrain focusing mount will therefore be pensioned off, and I have had initial discussions about modern drive and control options with Alan Buckman at AWR Technology.

Optical Specification

Primary mirror	350-mm clear aperture f/5 ellipsoid (Dall–Kirkham system), Duran 50 or equivalent.
Secondary mirror	100-mm diameter spherical, Duran 50 or equivalent.
Cassegrain focal ratio	f/20.
Mirror coatings	Aluminised, with silicon dioxide overcoat.
Optical quality	All reflecting surfaces work to 1/10th wave or better in green light.
Finders	12 x 40-mm and 75-mm, f/13.

Mount Specification

Type	Equatorial, fork.
Tracking drive gear	360-mm diameter, 720 teeth.
Tracking/guide rate	Continuously variable, sidereal ±6%.
Tracking accuracy	±0.05% short term (typically 5–10 min), ±0.5% long term (typically 1 hour).
RA setting rate	Sidereal +60%–100%.
Dec setting rate	Variable, max. 1°/min.
Slewing	Manual.
Controls	Hand paddle with RA set and guide and Dec set controls.
Positional readout	Illuminated 250-mm diameter drum scale. RA to 4 min of time; Dec to 1°. Optional verniers to 20 sec of time in RA and 5 arcmin in Dec.
Power requirements	220 volts 50 Hz at 10 amperes.
Instrumentation capacity	15–20 kg.
Shipping weight	600 kg.



The 350-mm Cassegrain reflector is another standard AE telescope, designed for universities and polytechnics setting up or adding to their astronomy research and teaching facilities. The mounting is a rigid fork of proven design, but for customers whose research will be concentrated on the polar regions, a German mounting is available as an option. Both versions have sufficient instrumentation capacity to make them valuable also for relieving the workload on larger telescopes. The polar shaft is supported by bearings on a base of two mating castings that gives the whole instrument great rigidity. The fork is a stress-relieved aluminium casting which provides maximum support for the open-frame telescope tube. In the German version, steel fabrication, with widely spaced supports, hold the declination shaft and the telescope tube. Fully variable drive clutches on both shafts allow balance adjustments to be made without disengaging the large precision-cut worm drives. Built-in counterweights are provided to balance the telescope about both axes. Clutching of the drives permits slewing to be done manually and protects drive gears from accidental damage. Set and track rates in right ascension are achieved by control of a synchronous motor through a variable-frequency power unit; setting in declination is by means of a low-voltage reversible DC motor. The telescope tube is of open-frame construction with mild steel tubes spaced by rigid cast aluminium formers. The primary mirror support is a cast aluminium cell which, like the secondary mirror support, has adjustment for centring and collimating.

Optional Features (all at extra cost)

German mounting.
Zerodur optics to 1/20th wave.
f/4–f/14 alternate focal ratio.
Parabolic primary, hyperbolic secondary mirrors (standard Cassegrain system).
Additional Newtonian focus.
100-mm f/14 finder.
150-mm f/12.5, f/13.5, or f/15 guide telescopes.
Electric focusing on secondary.
Vernier positional readout.
Remote digital readout.
Additional electric controls for observatory functions.
Photometer.
Plate camera.

I also considered the colour of the instrument, which for AE telescopes is traditionally silver. However, some large professional telescopes are quite colourful, so I decided to be adventurous. For my 0.5-metre Halton Arp Telescope I used red marine vinyl sheet – which looks great in daylight, but the colour washes out under the illumination of a red torch. I also considered a rich green – a common colour for telescopes in the nineteenth century, but conjuring visions of pumping stations. I therefore chose gold. The ferrous set-screws, bolts, and so on will be replaced with stainless steel or brass, and with the pairing of stainless steel and gold paint the result will be impressive.

Although the telescope is badged as a '350', referring to the aperture in millimetres, the construction seems to be all Imperial, not metric. Dimensions are in inches, and the threads are BSW for the larger components and seem to be BA for the smaller parts. Stainless metric fixings are reasonably priced, but I have discovered that Imperial BSW stainless is rare and pricey.

The base plate: 21 x 14 x $^{19}/_{32}$ inches; weight 20kg

The detritus was cleared out of the threaded holes using a traditional dodge. One of the old ferrous bolts to be discarded was cut with a lengthways slot with the grinder – the slot being at about the 2 o'clock position from the start of the thread. The bolt was then wound in half a turn and then back out, and this was repeated until the detritus was cleared. For fixing the plate to the plinth there are five slotted holes, allowing 5º of azimuth adjustment. The fixing holes are laid out symmetrically but machined in one direction only, clockwise. Therefore, if the studding in the plinth were to be laid out symmetrically, instead of having an adjustment of 2½º either side of the meridian there would be 5º to the east and zero to the west.

When my window cleaners saw the finished base plate they thought that I had sent it off to be coated professionally, so I took that as a compliment. I use Rustoleum CombiColour, but this paint seems really fussy about the type of brush used. After practising with many coats – some with thinner, some not – on the underside of the base plate where it does not show, I only produce a decent finish when I use an artist's high-quality soft mop brush.

The base casting: weight 40kg

The base casting and the banana casting, which sits on top of it holding the polar axis bearings, are held together with a pair of ¾-inch BSW clamp bolts, but separation proved awkward. The top bolt was removed easily, but the bottom bolt refused to budge, even after days of soaking in Plusgas

and blasts from a blowtorch. I was on the verge of resorting to cutting it off when it finally let go as I was jumping up and down on an extension tube over a tommy bar, holding a socket, with my son Rob standing on the casting to hold it down. We also stripped off the Hammerite coating.

Fine adjustment of the polar axis in altitude is accomplished by means of two set-screws through the base plate. Wear on the set-screws showed that they were a contact fit, or even an interference fit, with the banana casting. Two new holes were drilled and tapped M10 to provide a sensible amount of clearance.

The polar axis bearings: weight 8 kg

The 3-inch-diameter polar axis is held in two plain bearings set in plummer blocks. The top plummer block also houses a thrust race which takes the weight of the polar axis, massive fork, and optical tube assembly. Surprisingly, there is no provision for greasing the bearings *in situ*. The thrust race had been damaged, and it seems that during the instrument's time at Sheffield someone decided to fit a polar-axis clamp by drilling and tapping the top plummer block to take a set-screw. Unfortunately, in the chosen position the set-screw bears down on the thrust-race ball cage, not the shaft. It must have been wound in really tight, because it had chewed into and distorted the cage, which is solid material. There is only this one damage point on the cage, which suggests 'fit and forget'. The appearance of the wear pattern on the thrust race indicated that the set-screw had jammed it solid and prised apart the cage and one of the seats, probably fractionally lifting the whole fork and optical tube assembly and affecting the telescope's ability to track smoothly. I am hoping this has not affected the RA gearing. Happily, the exact same branded thrust race (Imperial size) is still available new. Unhappily, the price is about five times that of a metric race of comparable size, and not acceptable. I have found a metric thrust race, an SKF 51116 costing under £40, which can be fitted without too much difficulty.

The next photograph shows the two polar-axis cast-iron plummer blocks ready for repair, rebushing, and painting. The bottom bearing is at left, and the top bearing is at right. I have drifted out the old bearing bushes.

It can be seen that the bottom block has suffered, as there are two sizeable chunks chipped off the left-hand flange. Cast iron is strong but brittle. This damage must have resulted from the polar axis being dropped onto it several times. This is a warning for the future that due to the great weight I will need to devise and record safe procedures for assembling and dismantling the mount.

Fortunately, the chip damage is mostly cosmetic. There is still a 4 x 2-cm cross-section of metal intact in the casting, so the repair can also be mostly cosmetic. Aside from the chips, it can be seen that the bottom block is narrower, although they left the bearing factory identical. This is because the flange on the right side of the block was machined off. Otherwise, at latitudes above 35º it would be an interference fit with the curve on the base casting. The bearing shell was also cut down to match. Note that the hole in the bearing bush (which is there to line up with a greasing point, not provided) is offset toward the top edge of the bush.

Patching the bottom plummer block

In the next photograph the white object is a 3D-printed plastic former which will act as a mould for the Loctite Chemical Metal as it cures, minimising the amount of finishing needed. This repair method is seen as preferable to building up hot metal. The heat involved in adding the large quantity of missing metal risks distortion of the casting.

The clamp bolts

Two clamp bolts hold the crescent of the banana casting to the matching crescent of the base casting. This provides rough setting of the polar axis to the angle of latitude. The original clamp bolts are ferrous ¾-inch BSW welded to ½-inch steel plate. When assembled the steel plates do not show, but the bolts and nuts do. I have made replacements using M20 x 55-mm stainless steel hex-head set-screws through 9.5-mm hard aluminium plate, relieved to give clearance for the 13-mm deep hex heads. This photograph shows the original and new clamp bolts.

Reassembly of the parts

This last photograph shows how the base plate, base casting, banana casting, clamp bolts, and plummer blocks fit together. This assembly weighs 90 kg and stands more than 50 cm high. The plummer blocks are sporting their new yellow split bearing bushes. The bushes are a push fit after spending a while in the freezer, and are held with a splash of Loctite 603 retaining compound. Also, both blocks were drilled 4 mm, tapped 2BA, and grease nipples fitted. The new greasing points are visible at the right of each block.

To be continued ...

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A cautionary tale

Steve Holmes

In the April 2016 edition of the *Journal* a paper by Giovanni di Giovanni entitled 'Obtaining solar eclipse and planetary transit contact times using DSLR imaging' (126(2), 79–82) describes a method whereby accurate timings for eclipse and transit contacts could be derived from measurements taken from high-resolution DSLR images of the event (plus a fair bit of numerical analysis). I was very interested in this paper, as I had used a very much simpler but conceptually similar method to calculate the time of fourth contact at the total solar eclipse of 20 March 2015, which I viewed (or rather did not view, due to the cloud cover) from Tórshavn in the Faeroe Islands. However, when I read the paper closely I became concerned that it was lacking several elements which one would expect to appear in a scientific paper. I thus composed a Letter to the Editor noting these concerns, but the Editor declined to publish it. My enquiries as to the reasons for this met with a blank refusal to engage in discussion, and so I felt I had to try other avenues.

A report of my experience in the Forum on the BAA website elicited a few responses, but nothing of substance. It did, however, bring the matter to the attention of Bob Marriott. He agreed that my concerns warranted further investigation and, because the measurement of contact times might reasonably be said to fall within the remit of 'instruments and imaging', offered to contact the author on my behalf. This led to a useful e-mail discussion with di Giovanni, which revealed that the intent of the paper was not exactly as described when it was published in the *Journal*.

Problems with the paper

I must first note that di Giovanni is to be congratulated on his powers of geometrical manipulation, which enabled him to derive complex formulae for the way the overlap of the solar and lunar or planetary discs varies depending on the relative positions of the two bodies (and thus the time since the start of the eclipse or transit), and on his dedication to the task of curve-fitting measurements of the overlap derived from observation images in order to determine, from the resultant graph, the times of contacts. I felt, however, that I must take issue with his description of the technique as a 'simple method', requiring as it does the obtaining of a very large number of images during the course of an eclipse or transit (running into the hundreds, in fact), followed by a decidedly non-trivial and labour-intensive reduction of the data thereafter.

Given the complexity of di Giovanni's technique, the first question to be asked is whether this complexity can be justified. In other words, while 'professional' methods will no doubt use more elaborate procedures, to what extent is the 'geometric' method superior to the more traditional and straightforward 'amateur' methods, such as taking many closely-spaced images (or a video) around the presumed time of contact and then estimating by eye when the contact occurs? It is of course true that the 'by eye' method suffers from human error in judging when the disc is cut and when it is not, but surely the published method has the same problem when determining the measured degree of overlap. An image which is sufficiently sharp to enable values to be accurately measured would surely be clear enough to merely show whether the limb was 'intact' or not. Even if the precise instant of the contact was not captured, a much simpler method of calculation using just the images taken close to the contact would enable an equally accurate estimate to be made – as I did with the 2015 eclipse.

Then, of course, there is the question of the accuracy of the curve-fitting. The original paper states that the final step in the procedure requires the iterative process to be repeated 'many times ... until we obtain a good fit'. However, there are, to my eye, many data points below the fitted curve as published in the paper, but none above it. Is the given curve really a 'good fit', therefore? How sensitive is the final result to the goodness of the fit, and to the criteria adopted to determine goodness? Is it in fact possible to obtain several 'best fits', depending on which parameter(s) have been varied during the iteration and by how much? (a common problem with iterative procedures). How sensitive is the result to measurement errors, particularly those taken close in time to contacts? How sensitive is it to the number of data points, and to their disposition relative to the times of contact? How sensitive is it to incorrect orientation of the measured images? I am sure other questions could also be asked, but the above seem to highlight obvious omissions from the normally-expected scientific treatment of experimental data, particularly in the area of error estimation.

The author's reply

Having put the above concerns to di Giovanni, the reply I received was courteous, helpful, and rather surprising! In answer to my point about complexity he wrote: 'This method is not superior to traditional methods. It is just a teaching exercise. It is suitable for high-school students who have to learn the equation of the circle'; and later: 'I repeat ... it is for instructional purposes only, nothing more!' Or in other words, the method is not in fact one which is being recommended as effective for amateurs to use, as the *Journal* paper implies, but is merely an academic exercise created for, one assumes, one of di Giovanni's astronomy tutorial classes (he is a professional astronomer and lecturer at Colle Leone Observatory in central Italy). Given this revelation, it becomes clear why the paper is lacking in such things as consideration of errors – this aspect was not part of the exercise. He also agreed that the curve-fit may not be exactly accurate, but said that this could be due in part to the equations he derived not being a perfect representation of the actual situation – but again, as this was only a teaching exercise the discrepancy does not particularly matter. He finally closed the discussion by saying that, in any case, he has now 'abandoned this type of activity'; that is, once the exercise had fulfilled its original purpose, he moved on to other things.

Issues arising

Having received this additional information from the author, I feel there are questions to be asked about the way the method was presented in the *Journal*. Although the paper does briefly state in its Introduction that the method is 'mainly for educational purposes', it also says that the method was 'developed', implying an ongoing process which has finally come up with this new technique, and then in the Conclusion suggests that others might also like to apply the method to their own observations. One would never guess that, in the author's own words, it was all merely 'a teaching exercise'!

It is, of course, impossible to know how the material was originally presented to the Papers Secretary and then the referees, but if they realised it was just an exercise then the paper should have reflected this more strongly, and if they did not then surely they should have raised the same issues about complexity and error estimation that I did. Maybe the blurring occurred somewhere in the editing process. The author does state that the Papers Secretary 'revised' the paper (though I did not think this was part of his officially-defined duties), so perhaps the real purpose of the study was, quite literally, 'lost in translation' (di Giovanni's English is good, but not perfect, and so would have needed some 'polishing'). Whatever the reasons, the final somewhat misleading outcome was a little unfortunate. Note, however, that I ascribe no fault to the author. It is clear from his communications with me that he never intended the paper to be anything more than a description of a teaching exercise; its promotion to 'new method' came later.

I must also ask why my Letter to the Editor (which was a version of the information given in paragraphs 3 to 5 above) was deemed 'unsuitable for publication', as it was clearly relevant to the content of the paper in question and, I would have thought, of interest to the membership at large. Unfortunately, the criteria for acceptance state that the Editor may reject material which 'she does not find significant or interesting'. But this should not be a consideration. It is the interest of the membership which matters, not that of the Editor.

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Other pursuits. (Photograph by Giovanni di Giovanni.)

Observatorio de Roma, Campo Imperatore, central Italy. (Photograph by Giovanni di Giovanni.)

BAA instrument no. 1

Bob Marriott

Instrument no. 1 is a speculum-metal grating measuring 36 x 36 mm, with a ruled area 29 x 21 mm, and with a presentation inscription on three sides of the face: 'Ruled on Rowland's Engine. Johns Hopkins University, Baltimore, Md. U.S.A. 1890. Plate prepared at the Astronomical and Physical Instruments Works of J. A. Brashear, Allegheny, Pa., U.S.A., and presented by him to the British Astronomical Association. 14,438 lines to one in. 568 lines to mm. A.E. Decemb. 10, 1890'. (For details see my article 'John Brashear and the BAA' in the June 2015 issue of the *Journal*, and the Section website: http://www.britastro.org/iandi/.) From 1890 to 1951 this grating was loaned and used successively by John Evershed, Walter Maunder, C. P. Butler, W. B. Wright, and L. Vizard. In 1952 it was loaned to a Member who by 1959 had disappeared, and it was later written off as lost. In 2004 I received a letter from that Member, informing me that he wanted to return it, and I recovered it on 24 September that year. Instrument no. 1 is not only an early example of a new technology; it is a tangible record of international recognition of the Association immediately it was founded. Historically, it is the Association's most important and valuable instrument. I recently prepared a box for it, with an account of its history and provenance, and it is now deposited permanently in the Association's archives at Burlington House.

Reminiscences of Roy Panther

Bob Marriott

The recent April issue of the *Journal* includes Guy Hurst's obituary of Roy Panther, who died at the age of 90 last October. It is a worthy tribute, and here I present a few personal memories.

Roy was the first astronomer I met. That was in 1967, when I was in my mid-teens and he was aged 40. He lived in the village of Moulton on the north side of Northampton, a few miles from where I lived. At that time the village was surrounded by fields, but with the expansion of the town and the fast-encroaching housing estates, business units, and lighting, in the mid-1970s he moved to Walgrave, a few miles to the north. This was a dark site, but his neighbour consistently left his curtains open at night, with the room lights turned on and shining into Roy's garden. Eventually, Roy took the opportunity to dispense with this nuisance when his neighbour became curious and asked him about his telescopes. Roy told him that he could see through bedroom windows in Scaldwell, across open fields almost three miles away. From then on, his neighbour's curtains were always closed at night. At a later time Roy acquired an additional house near Northampton town centre. Here were lodged two young ladies who received gentlemen guests – but this was not a secret, as he spoke of it freely.

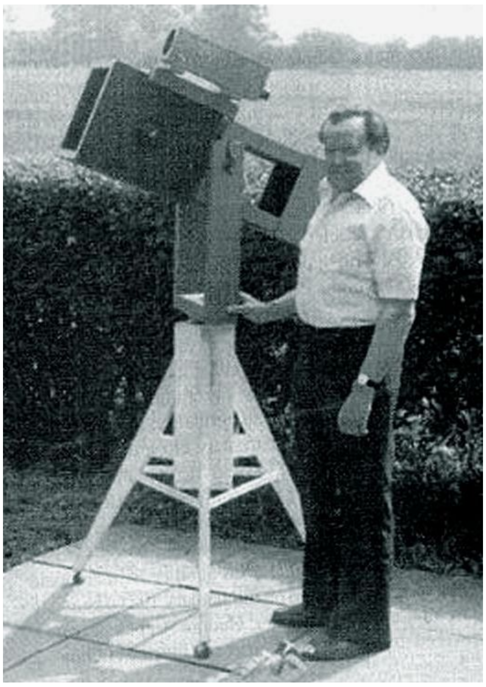
In his youth Roy observed variable stars, and I remember his saying that during the war years, when he was in the town centre he was able to make naked-eye magnitude estimates during the blackout. He joined the Association in 1946 (as of last October he was the sixth most longstanding Member), and soon began to collaborate with George Alcock in meteor work. George was fourteen years older than Roy. He had been observing meteors since the early 1930s, and throughout those years there were several prominent Members in East Anglia who contributed to the work of the Meteor Section. Of these, George lived the closest, near Peterborough, and it may well have been these factors which influenced Roy and led him to his chosen work. In 1947, when Roy was aged only 21, the Director of the Meteor Section, J. P. M. Prentice, who lived in Stowmarket, Suffolk, entrusted him to carry out the reduction of observations submitted to the Meteor Section, which, he said, occupied him for 'three hours each evening for three evenings a week for three years'. Eventually, however, he informed Prentice that he would no longer continue with this work.

Freed from his analytical work, Roy began to devote most of his observational work to sweeping for comets, as did George at about the same time. More than thirty years later, after several near misses, on Christmas Day 1980 he made his first and only discovery: comet 1980u. Almost immediately he was nominated to receive an award: the Merlin Medal and Gift, which 'shall be made in recognition of a notable contribution to the advancement of astronomy'. The nomination was approved, and the presentation took place at the Ordinary Meeting of 30 May 1981. This was only four months after his discovery, and it is obvious that it was not only in recognition of a single achievement but also for many years of dedicated effort. At that time the President, Cdr Derek Howse, was abroad, and the award was presented by the Vice-President, Leslie White, who spoke of Roy's 'great contribution to cometary work':

> By the time of his discovery he had carried out more than 600 hours of comet seeking often under difficult conditions, so it was certainly time that his patience should be rewarded. It should not be thought that Mr Panther had only worked upon comets as, although now concentrating upon that subject, he had also made many valuable observations on behalf of the Meteor Section. Mr Panther said that he was deeply conscious of the honour which the Association was according him. For many years he had been in friendly rivalry with Mr Alcock, but always without achieving any success. Perhaps his luck had now changed, and he could only hope that they would both continue to discover new objects.

The report in the *Journal* included the first published photograph of a BAA award presentation. A few months later, in the Annual Report of the Comet Section, the Director, Michael Hendrie, wrote:

> It is a pleasure to record the award of the Merlin Medal to Roy W. Panther for more than thirty years' comet observing and the discovery of comet Panther 1980u.



Leslie White presents Roy with the Merlin Medal and Gift

Notably, comet Panther passed between the North Celestial Pole and Polaris; but it cannot be known who will be next to see it, as it has an orbital period of about 10,000 years.

The Merlin Medal and Gift is awarded primarily for observational work, and neither the citation nor Leslie White's presentation speech mention that many of Roy's observations were carried out with home-made telescopes, for which he made three mirrors – an 8-inch, a 10-inch, and a 14-inch, each of them without machinery. He also, though to a lesser extent, observed planets, asteroids, and, not infrequently, aurorae.

I first encountered George Alcock's name in 1967 when I read of his discovery of Nova Delphini in July of that year, and it was through Roy that I came to know him. They worked with a common purpose, and their close association was made particularly evident on one

Bert Lineham with his 4-inch f/15 Swift refractor, *c.*1957

occasion when George telephoned me frantically: 'Where's Roy? I've been calling him all day and he's not answering!' Apparently, their telephonic communications were very frequent. Later that evening I called Roy to tell him that his presence was being sought. 'Well, I go out sometimes', he explained, 'I can't phone him every day.'

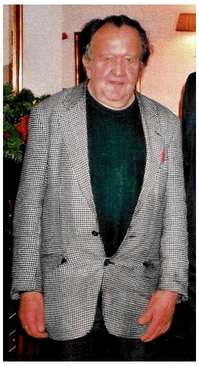
Around 1985, during one of my visits to Roy's home, he showed me the gnomonic projection charts which had been supplied by Prentice almost forty years earlier, to be used for plotting meteor paths (gnomonic projection displays all great circles as straight lines). Each of these large charts was mounted on a wooden roller, and each bore the signature of Grace Cook, who had joined the Association in 1911 and was Acting Director of the Meteor Section 1914–18 and Director 1921–23. Roy also showed me a star catalogue which had just been sent to him by George, who had received it from Prentice many years earlier. Inserted in this catalogue was a letter which Roy had sent to Prentice in 1950. 'The ****** never answered it', he said, 'and now I've got it back!'

When I was about 7 years of age I began to read avidly about astronomy, and with a small book I learned and identified the constellations and many naked-eye objects in the dark skies over Northampton. Later, my parents bought me a small refractor by Charles Frank, so I was then able to observe telescopically many objects with which I was already familiar; but my parents did not know anyone with connections in astronomy. Several years later, a friend at a youth club said that he knew someone who had a telescope. Subsequently, in January 1967 I met Roy Panther, Harry Brierley, and Bert Lineham. Harry and Bert had joined the Association in the early 1950s, and all three of them were veteran observers. Roy and Harry made mirrors and constructed telescopes, Bert was an engineer by profession and was inventive in the design and modification of mounts, and Harry and Bert, besides being visual observers, used their own hand-operated astrographs to produce high-quality colour slides in 35-mm and 2 x 2-inch formats, and negative black-and-white slides using fine-grain film such as Ilford Pan F, all of which they developed themselves. In addition, through them I came into contact with some well-known names in astronomy and optics. Roy was a friend of George Alcock, and Harry knew David Dewhirst at Cambridge Observatory and often quoted his own correspondence with W. H. Steavenson, who at that time lived in a house in the observatory grounds. Harry and Bert were friends of Cliff Shuttlewood, who lived in Leicester and had worked with Jim Hysom, who in turn had begun his career at Cox, Hargreaves, and Thomson and was a friend of Horace Dall. In 1962 John Thomson and Jim Hysom cofounded Optical Surfaces, and in 1967 Jim and his brother Robert founded Astronomical Equipment in Luton. In 1968 I joined the Association, the Webb Society, and *The Astronomer*.

Harry Brierley with his home-built 6-inch f/9 Newtonian reflector, *c.*1957. He later made an 8½-inch and an 11¾-inch.

Roy, Harry, and Bert possessed the knowledge, skills, and experience essential to practical amateur astronomy, and I am grateful for having known them. But the years seem to have passed swiftly. Roy was aged 90, Harry would now have been 98, and Bert would have been 105.

Roy was very reclusive (though notably in 1980 he was visited by the comet specialist Charles S. Morris, from Prospect Hill Observatory, Harvard). As far as I know, he had no family – at least, he never spoke of anyone – he did not drive, he had few modern devices, he kept his telephone number private to the point of secrecy, I never saw him take a drink except tea, and his requirements were minimalistic: some pieces of furniture, several telescopes, and a few books. Observational astronomy was his mainstay, and he seldom spoke of anything else. Throughout his final years he became ever more reclusive, and we rarely met except perhaps occasionally in town, though by coincidence rather than by arrangement. No-one knew that he had died until some time afterwards, and it must be assumed that his telescopes, books, and charts were cast away or destroyed.



In May 2013, Roy was persuaded to attend the meeting of the Comet Section in Northampton, and when his presence was announced he was greeted with a standing ovation. This took place during the morning, and at the beginning of lunch-time he told me that he was going home. It was time for him to return to his hermitage. So, I walked with him for a while, and we talked of old times and of departed friends. That was the last time I saw him.