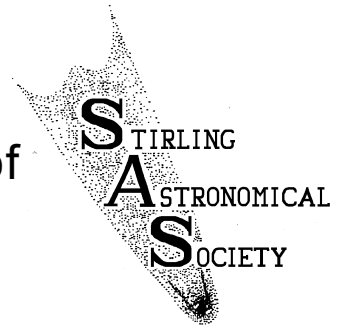


Newsletter of



Vol. 18 No. 1 January 2003

This Issue of *Mercury* contains a Centre Pull-Out of the
STIRLING CITY TELESCOPE COLLIMATION

This stepwise guide, prepared by Chris Davis, describes the principles and techniques specifically for collimating the Stirling City Telescope in the Highland Hotel Observatory Dome, before commencing an observation session with the telescope.

Our thanks to Chris Davis

GIORDANO BRUNO - THE FIRST ASTROBIOLOGIST?



Astrobiology can loosely be defined as the study of (or the search for) life on other planets - now taken so seriously that NASA has an Astrobiology Institute doing just that. The works of the mediaeval scholar Giordano Bruno must be regarded as one of the very early attempts to examine this science, and thus makes him one of the first astrobiologists. For example, in his work of 1584, "*On the Infinite Universe and Worlds*", Giordano Bruno stated:

"Innumerable suns exist; innumerable earths revolve around these suns in a manner similar to the way the seven planets revolve around our sun. Living beings inhabit these worlds."

We will look at just how this prediction has stood the test of time later, but will now look at the man himself. Giordano Bruno is regarded by a number of modern Renaissance scholars as a trail-blazer, or even as a founder, of modern science and philosophy. He is said by many to have had more influence in his own time than a number of his more famous contemporaries, including Copernicus. Giordano Bruno was celebrated for his phenomenal memory, which allowed him to memorise vast amounts of text in several languages. This remarkable skill attracted the attention of wealthy patrons, and with their encouragement he travelled to Rome to demonstrate his abilities to the Pope. He was, however, also unorthodox and outspoken by

nature, and these qualities led him whilst in Naples to attract the attention of the Inquisition. Bruno left Naples in 1576 to escape this persecution, but when the same happened in Rome, he set out on his travels. Bruno began what was to be a fifteen year journey of teaching and writing across Europe, sponsored by various patrons.

Amongst Bruno's many accomplishments was the development of an abstract model of the solar system, as well as a mnemonic wheel, known as the Memory Wheel, which was circular and comprised seven concentric layers like the orbits of the seven known planets of the time. He also promoted a revolutionary view of a universe that extended everywhere and in all directions - surely a prototype of what later would become, with complex mathematics, Einstein's theory of special relativity? Bruno put it thus:

"There is no absolute up or down, as Aristotle taught; no absolute position in space; but the position of a body is relative to that of other bodies. Everywhere there is incessant relative change in position throughout the universe, and the observer is always at the centre of things."

In the light of this, many people regard Giordano Bruno as the first European to publish a doctrine that allowed not only for the possibility of the Earth as a planet orbiting a sun, but also for many similar planets, with conditions suitable for life, orbiting other suns. Such a position was not popular at that time and the Powers-That-Were soon caught up with him. In 1591, in Venice, Bruno was arrested by the Inquisition and tried. He spent eight long years in prison before eventually being declared a heretic. On the 17 February 1600, on the Campo dei Fiori in Rome, Bruno was burned at the stake.

But let us now look at Bruno's position, 400 years after his execution. In the last few years, more than twenty giant planets have been found orbiting nearby suns. For example, there are the planetary systems thought to be around the stars 51 Pegasus, 70 Virgo, and 47 Ursa Major, each of which are normal main sequence stars like our Sun. Some of the planets are within the "habitable zones" of their stars, that is, within a range of orbital distances where water could exist and, presumably, life could flourish. Conventional wisdom has it that gas giants like Jupiter are unlikely abodes for life, but their moons may be a different story. In our own solar system, the larger the gas giant is, the more mass there will be in its system of moons. If this holds true for extra-solar systems, then some of the newly discovered planets, many times more massive than Jupiter, could have moons as large as Mars. Do these moons exist? Are they Earth-like? How do Bruno's predictions of four centuries ago hold out?

Let us take his statement: *"Innumerable suns exist"* There are several hundred billion stars in the Milky Way galaxy alone, as we now know. Many recent images reveal the stars, nebulae, and dark clouds along the plane of our Milky Way galaxy as seen from various vantage points. So far, Bruno is proved correct. Bruno also said: *"Innumerable earths revolve around these suns in a manner similar to the way the seven planets revolve around our sun."* The recent discovery of three planets around Upsilon Andromedae makes this assertion seem more likely than ever. This is given substance by the dry observation by some wag from NASA that: "Nowadays, discovering planets is a tiring business but relatively safe as jobs go." (*NASA Science News, May 21, 1999*). Another point to Bruno!

"Living beings inhabit these worlds." The proliferation of life in the Universe remains a tantalising mystery. However, NASA's Astrobiology Institute has posed a challenge, a project called the Book of Life, to try to answer the question. Dr Baruch Blumberg, head of NASA's Astrobiology Institute, has said: "The mission is to look for life without any specifications. Nothing in the mission would preclude looking for rather strange and unusual life forms that we can't even imagine right now." (*May 28, 1999*). Dan Goldin of NASA has added: "We're looking

for any form of biological life. Single-cell (organisms) would be a grand slam."

Will Bruno be vindicated once again? Only time will tell.

Sandie Cayless

THE WHIRLIGIG OF TIME*

"Time travels in diverse paces with diverse persons. I'll tell you who Time ambles withal, who Time trots withal, who Time gallops withal and who he stands still withal." (Rosalind in As You Like It, III ii 325)

Little could Shakespeare realise how prophetic this now appears, written about 300 years before Albert Einstein's work on relativity. In our everyday experience, time "like an ever rolling stream" appears to flow steadily on at a constant rate from past, through the present, and into the future. Obvious though it seems to us, this commonsense view is seriously at odds with modern physics. Einstein famously expressed this point when he wrote to a friend, "The past, present and future are only illusions, even if stubborn ones". His conclusion follows directly from his special theory of relativity, which denies any absolute, universal significance to the present moment. Instead, simultaneity is relative; two events that occur at the same moment if observed from one frame of reference may occur at a different moment if viewed from another.

An apparently simple question such as "What is happening on Mars right now" has no universal answer - it depends on the observer. Consider the following scenario. Two people, one Earthbound and the other an astronaut travelling in a spaceship between Earth and Mars at 80% of the speed of light, attempt to answer the question as to what another astronaut on Mars is doing right now. The Martian has agreed to raise a flag when his/her clock is at 12.00 noon, and to transmit a signal indicating this event at the same time. For the Earthling, Earth appears stationary, Mars is a nearly constant 20 light-minutes away, and the travelling astronaut is moving at 80% of the speed of light between them. The situation also looks very similar for the Martian.

For the Earthling, the following events take place:

Before noon

By exchanging signals, the Earthling and the Martian verify the distance between them and synchronise their clocks.

12.00 noon (Earth and Mars)

The travelling astronaut passes Earth on a course to Mars. The Earthling assumes that the Martian is raising the flag and starts to wait 20 minutes for the verifying signal to arrive from Mars.

12.11

Knowing the travelling astronaut's speed, the Earthling calculates that the astronaut will encounter the signal from Mars at this time.

12.20

The signal from Mars duly arrives at Earth and the Earthling confirms his earlier assumption that noon on Mars is the same as noon on Earth.

12.25

The travelling astronaut passes Mars.

But what is the travelling astronaut's experience? He has no sensation of travelling at 80% of the speed of light and in his frame of reference his spaceship appears to be stationary, Earth to be

moving away from him at 80% of the speed of light, and Mars towards him at the same speed. His measurements show that the two planets are 12 light-minutes apart, and not 20 light-minutes. This discrepancy, known as length contraction, is a well known and tested result of Einstein's theory. A related effect is time dilation, which causes clocks on the spaceship and the planets to run at different rates. The Earthling and the Martian think the astronaut's clock is slow; while the astronaut thinks their clocks are fast.

For the astronaut, the following events take place according to the astronaut's clock:

Before noon

By exchanging signals with the Earthling and the Martian, the astronaut measures the distance between the Earth and Mars as 12 light-minutes.

12.00 noon

As Earth appears to go past him, the astronaut assumes that the Martian is now raising the flag, and he starts to wait 12 minutes for verification from Mars.

12.07

The astronaut is surprised to receive the signal from Mars, contrary to his assumption. He thinks the Martian must have raised the flag at 11.55, five minutes early (astronaut time), for him to receive the signal at 12.07.

12.15

Mars passes the astronaut. The Martian and the astronaut find that their clocks do not agree, but they cannot decide which one is correct.

There is thus no agreement on the present moment, defined as when the Martian raised the flag, because of the clock differences, and so there is no universal present moment. More than this, time dilation means that two observers moving relative to each other experience different durations between the same two events. Suppose Tweedledum travels at very high speed, approaching that of light, to a nearby star and then returns in the same manner. For Tweedledum the time away has been one year. However, for his twin Tweedledee who has stayed behind at home, Tweedledum has been away ten years. Thus one twin is now nine years older than the other, although both were born on the same day!

Time dilation only becomes so noticeable when motion occurs close to the speed of light, but it happens at all speeds. Flying by jet to Australia and back makes you a few nanoseconds younger than the people remaining at home. Atomic clocks are sensitive enough to detect this, and they have confirmed it. Large time dilations can be observed in particle physics. Some sub-atomic particles such as muons have a built-in clock because they decay with a definite half-life. When travelling at nearly the speed of light in a large particle accelerator, they appear to decay much more slowly than normal. Some cosmic rays move so close to the speed of light that, from their point of view, they cross the Galaxy in minutes, even though from the Earth they appear to take tens of thousands of years. If time dilation did not occur they would decay long before reaching us.

Einstein, in his general theory of relativity, showed that gravity as well as speed affects time. The effect of a gravitational field is to slow time down. The more intense the field, the more time is slowed down. Clocks on satellites orbiting the Earth run faster than clocks on the ground because gravity is less up there. This can be measured and actually has to be taken into account in the satellite Global Positioning System, otherwise significant errors, as much as kilometres, could occur in pinpointing positions.

At the surface of a neutron star gravity is so strong that time is slowed to about 30% of Earth time. If it were possible to view the Earth from there, events here would seem to be happening

at the speed of a fast-forward video. The ultimate gravitational field is at the "surface" (event horizon) of a black hole. Here, time actually slows to a stop and stands still relative to Earth. If you fell into a black hole from close by it, in the brief interval (to you) before you disappeared, all eternity would pass by in the rest of the Universe. The inside of a black hole is thus beyond the end of time as far as the rest of the Universe is concerned. If it were possible for an astronaut in a spaceship to zoom in close to a black hole and return unscathed (not ever very likely!) he would have leaped far forward in Earth time.

So time travel *is* possible. As we have seen, travel forward in time can be achieved either by using high speed motion or by using an intense gravitational field. But there is no way ever to go back in time again!

Time is therefore not at all what it seems to be from ordinary experience. The question "What time is it?" has no universal meaning, and the more profound question "What actually is time?" will engage the attention of philosophers as well as physicists for many years to come.

Derek Allen

* Shakespeare again! (Feste in *Twelfth Night* V i 389)

NATIONAL SPACE CENTRE, LEICESTER

No astronomer driving down the M1 near Leicester should miss the chance of visiting this new attraction. Supported by Millennium Lottery Funding, I think this is one of the more successful ventures of its type, and this is because it concentrates on one field of science like *Our Dynamic Earth* (whereas *The Glasgow Science Centre* tries to cover everything).

Arriving in the car park, you are confronted by a five-storey high, transparent building made of "bubble wrap"! This houses the Rocket Tower, in which a Thor Rocket and a Blue Streak Rocket stand. The rockets were installed first, and the plastic building erected around them. All the problems associated with using rockets to escape Earth's gravity are explored, with hands-on experiments available. No-one can fail to be impressed with the efforts made to counteract cosmic radiation and the destruction caused by minute particles of cosmic dust hitting the sides of spacecraft at several thousand miles per hour. The more conventional building attached to the tower contain exhibits which demonstrate how an astronaut can survive in space, the use of Earth orbiting satellites, current happenings in Space and a major display on the Planets and the Universe. A shortwave radio operator monitors the International Space Station and other satellites, and there are sometimes opportunities to speak to astronauts live.

The £8 entrance ticket includes admission to a 20 minute programme in the planetarium dome. This was an animated 3D film about the *Search for Extra-terrestrial Life* when I visited. About three to four hours are needed to wander round, and further visits will be needed to fully appreciate the entire exhibition. Refreshment Areas, a Bookshop and High Tech Toilets are also on site. (The Toilet hand wash system works on the basis of putting your hands in a box, where in turn, soap is dispensed, water added, and hot air supplied to dry them. It sounds great, but when a Pack of 20 Cub Scouts arrive at the Toilet, some were getting hot air while others were waiting on the water! Sometimes the old ways work best - several sinks would be better).

More information is available on www.spacecentre.co.uk

Bert Mackenzie

TO THE EDITORS, *Mercury*

For a lay person like myself, the recent virtuoso performance given by David Bacon in his lecture to SAS* begs a number of questions. The search for "evidence" of the existence of "dark matter" seems to me a strange pursuit. The hypothesis is that the Universe is pervaded, at almost vanishingly low density, by something that has been given the name "dark matter". It seems that we are concerned with only two properties - infinite transparency to the visible electromagnetic spectrum, and the capacity for gravitational attraction of normal matter and, presumably, of itself. There seem to be good mathematical arguments for the existence of this "stuff". David Bacon wished to demonstrate effects from which to conclude that the "stuff" is actually there!

Which brings me to a question. Consider a simple optical system consisting of a point source of light, a convex lens, and a screen on which falls an image of the point source. If the image is formed by rays close to the axis of the system, the image will approximate to a point. Rays at greater angles to the axis will be deviated more, and give rise to a more "messy" image (e.g. third order aberrations upset the scheme of things). If instead of a convex lens we have a mass deviating light by gravity, will not the light making a larger angle with the source/mass axis be deviated *less* than light nearer the axis? How therefore can a gravitational image be formed at all?

There may be a well known answer to this question. If so, some space in *Mercury* might be devoted to it, as I cannot believe the answer is self-evident. The answer may have some bearing on the search for gravitational waves by interferometry, which depends on interactions between images .

Mike Culpin

* *Seeing the Invisible Cosmic Web*, 11 October 2002

Editors' Note

Mike's question may be answered by a recent *Mercury* article, *Gravitational Lensing*, Vol 17, No 2, April 2002, p3, which states:

In many ways gravitational lenses act like ordinary glass lenses. A major difference, however, is that a glass lens has a well-defined focal point, whereas a gravitational lens produces a focal line or surface. The convex shape of a glass lens ensures that the deflection angle is directly proportional to the distance from the optical axis, i.e. from the line connecting the lens and the observer, so that all incoming parallel rays meet at the same point behind the lens - at its focal point. A typical gravitational lens, however, causes light rays to undergo smaller deflections the farther they are from the optical axis, and not larger ones as for a glass lens. Parallel rays deflected by gravity thus meet at different locations behind the lens, depending on how far from the optical axis they are at the lens. Another difference between gravitational and glass lenses is that the former, unlike the latter, are achromatic. For glass lenses the degree of deflection depends on the wavelength of the light. This is not the case with gravitational lensing - all wavelengths are affected equally, even down to X-rays, which cannot be focused by glass optics.

Other recent *Mercury* articles relevant to this whole interesting subject are:

Detection of Gravitational Waves by Interferometry, Vol 17 No 2, April 2002, p1

No Dark Matter in the Universe After All?, Vol 17 No 4, October 2002, p4

COLLIMATING THE STIRLING CITY TELESCOPE

The home-grown "spot method" of collimating Newtonian telescopes in general, was described in a Mercury article (Vol 15 No 1 Jan 2000). This is a stepwise guide with method and principles for anyone faced with having to specifically collimate the Stirling City telescope in the Highland Hotel observatory dome. The job is made very much easier if you can enlist an assistant to turn the primary mirror cell adjusters when necessary, and if you can have a 7/16" AF spanner to hand for slackening the secondary mirror housing. The principle of the technique is based on getting the exact centre of the primary mirror in the exact centre of the eye-piece view. This aim is greatly assisted by the black spot which has been strategically fixed at the centre of the primary mirror. (The spot does not affect the telescope's performance at all because the centre of the primary mirror cannot see the bit of the Universe behind the secondary mirror anyway.)

The procedure is two-stage:

A : Aim the primary mirror directly at the secondary mirror.

B : Aim the secondary mirror directly up the eye-piece tube.

A / PRIMARY MIRROR ADJUSTMENT.

- STEP A1: Take the covers off the mirrors and remove the eye-piece.
- A2: Set the telescope tube nearly horizontal so you can look into the tube and see the primary mirror at the far end.
- A3: Pin or prop a large white card on the observatory wall where the telescope is aiming. This makes the primary mirror's centre spot and three edge clips easy to see.
- A4: Imagine a mirror diameter line from one of the mirror edge clips passing through the centre spot.

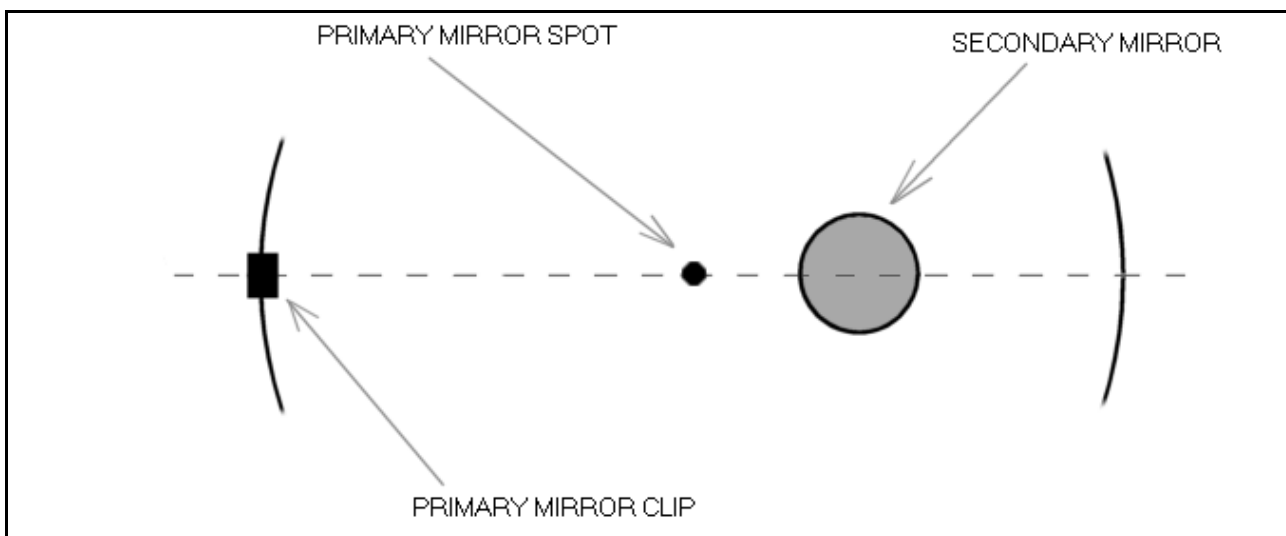


Diagram 1

Move your head so the secondary mirror housing is on the opposite side of the spot to the mirror clip, as in diagram 1

- A5: Refine your position so the black spot and the secondary seem to touch as in diagram 2.

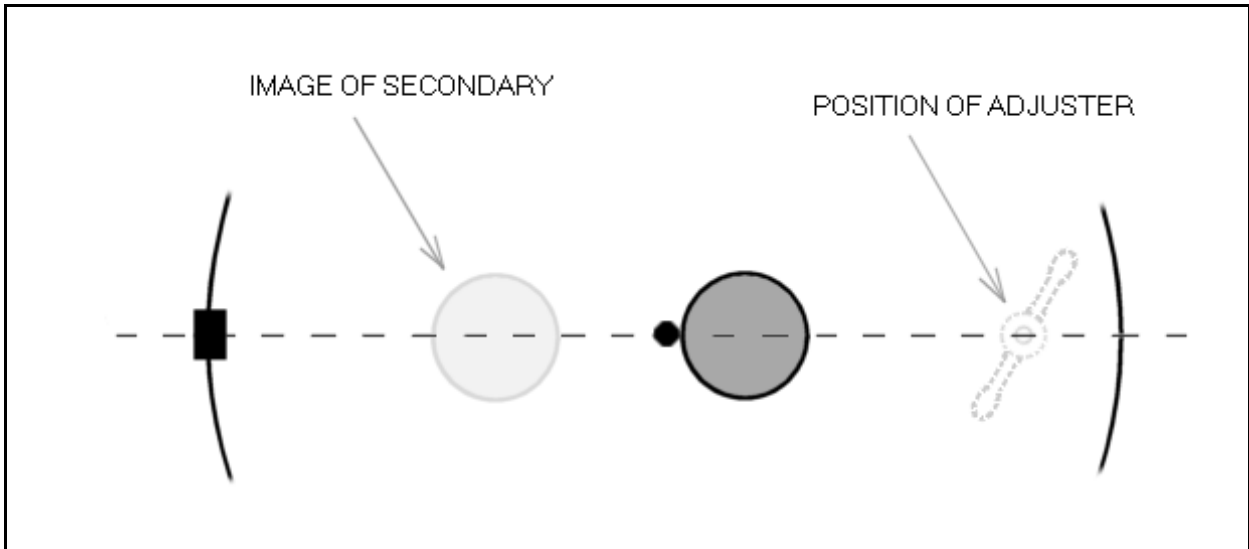


Diagram 2

- A6: Station your assistant at the back of the telescope where the primary mirror adjuster wingnuts are. You can tell the assistant which wingnut to turn because from your point of view it is opposite the mirror clip (see diagram 3), so you can say whether it is in the top half or bottom half of the mirror. Just remember to reverse "left" and "right"; for example if the adjuster is on your right, it will be on your assistant's left because he/she is looking at the back of the mirror.
- A7: Note where the image of the secondary is relative to the black spot. There are three possibilities :

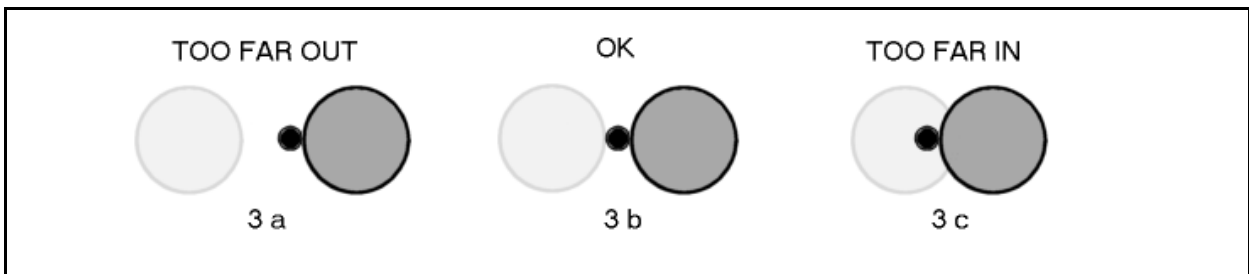


Diagram 3

- 3a IMAGE TOO FAR OUT
Get assistant to turn wingnut clockwise until create the symmetrical view 3b with the spot apparently sandwiched between the secondary and its image.
- 3b IMAGE TOO FAR IN
Get assistant to turn wingnut anticlockwise until achieve the symmetrical view, diagram 3b.
- A8: Repeat the procedures from Step 4 for the other two mirror clips and adjusters. Then go round the clips again until an exactly symmetrical view (diag 3b) is obtained from all angles without any further adjustment being required.

PROOF OF THE SYMMETRY TECHNIQUE

With the view exactly symmetrical all round, imagine the secondary is transparent and that you move to superimpose it over its image, as in diagrams 4a to 4c.

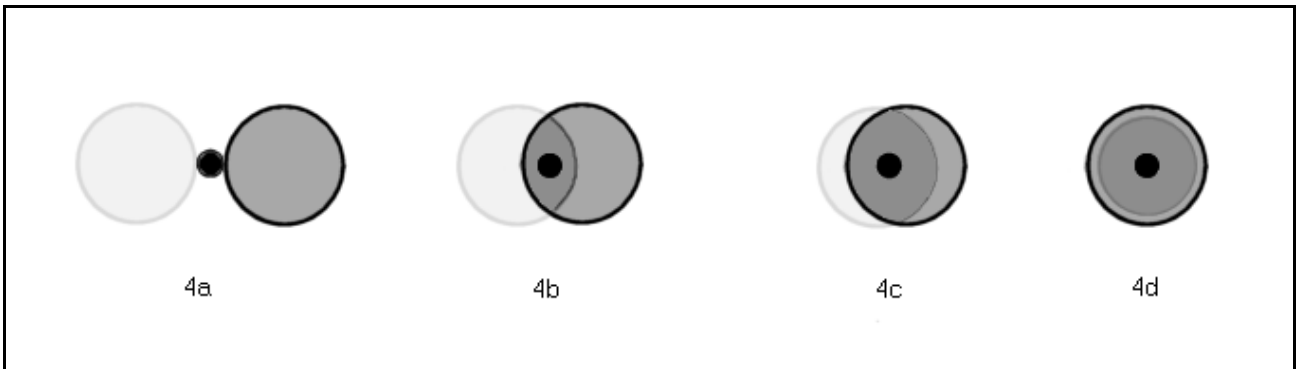


Diagram 4

The primary mirror centre spot would appear at the centre of both the secondary and its image. The only way this can happen is if the secondary is directly in line with the optical axis of the primary mirror, which is exactly what is required for perfect collimation.

B / SECONDARY MIRROR ADJUSTMENT.

With the primary mirror now aimed directly at the secondary mirror, the secondary can be adjusted to deflect the primary mirror's focus up the centre of the eye-piece tube.

- STEP B1: Look down the eye-piece tube at the secondary. Ian Smith made the new spider to hold the secondary mirror housing exactly at the centre of the telescope tube and exactly opposite the eye-piece hole, so no side to side or up and down adjustment should be necessary, and a circular looking secondary flat mirror should be visible.
- B2: The secondary mirror is actually elliptical but if its angle to the eye-piece is at a correct 45 degrees it should appear circular. Check if the reflection shows the whole of the primary mirror. If some of the primary mirror is missing off the top or the bottom of the view then go to STEP B3. If it is OK top and bottom but some of the primary mirror is missing off the left or right of the view go to STEP B5.
- B3: Slacken the steel, smaller nut (7/16" AF) that holds the secondary mirror housing in the centre of the three armed "spider"; but only just enough to allow the housing to be rotated.
- B4: Look down the eye-piece tube and gently rotate the housing to get both the top and the bottom of the primary mirror into view. Retighten the nut while holding the mirror housing to prevent it rotating out of position again. Avoid getting fingers on the mirror surface.
- B5: If there is primary mirror missing to the left or right attend to the secondary mirror's tilt adjuster screws.

There are two concentric screws which can seem to behave rather unpredictably.

The following should reveal what is really going on.

First slacken the thin inner locking screw. This frees up the fatter, outer adjuster screw for tilting the secondary housing left or right (diagram 5b). This hopefully will get the primary mirror fully into view, in which case just do up the inner locking screw, and if the view has not changed you are home and dry.

Being able to move the secondary housing either way with the outer adjuster depends on the springiness of the pivot screw. But as shown in diagram 5a the outer adjuster ceases to have any effect once the pivot screw has sprung back straight. So if you need more adjustment you have to do up the "locking screw" to pull on the housing (diagram 5c)

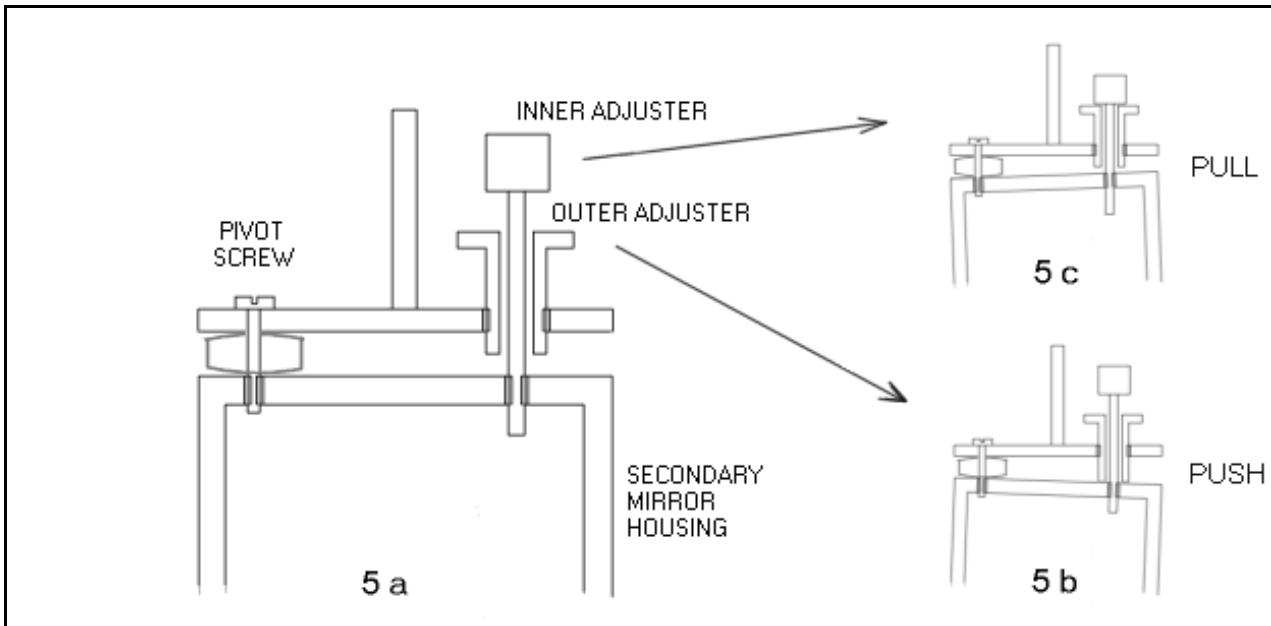


Diagram 5 : Showing the push pull nature of the secondary adjuster mechanism.

Theoretically the two screws could be only just unlocked and then turned as one to get the full range of adjustment before nipping up the lock again. But that is not as easy as it sounds.

- B6: If the secondary required significant adjustment one should go back and retrue the primary mirror adjustment; STEPS A4 to A8.
- B7: Now it should be possible to fine adjust the secondary mirror using STEPS B3 to B5 again until the circular images of the mirrors and eye-piece tubes are all concentric in the secondary, with the black spot at the centre of everything.

Collimation will now be literally "spot on" to give a perfect view of the stars.

Chris Davis

DIRECTOR OF OBSERVATIONS' REPORT, SESSION 2001-2002

Observational Highlights of the Year

Early months gave clear evenings, later months very disappointing.

Moon, Mercury, Venus, Mars, Jupiter and its moons, and Saturn and its moons, have all featured in records of memorable evening observations. April and May saw an impressive "Dance of the Planets".

Solar activity still high, although sunspot maximum has passed.

Deep-sky objects seen on occasional clear dark nights.

Educational Aspects

Astronomy Activity Afternoons for classes at Braehead, St Mary's (Raploch) and Dunblane Primary Schools.

Astronomy Activity Evenings with 1st Alloa Boys Brigade, Kippen Nature Club, and P7W class from St Ninians Primary School who have their own Astronomy Club.

Similar Activity Evenings at Callander, St Ninians and Stirling Highland Hotel for prize-winners in "Reading Planet" challenge, organised by the Library Service.

Participation in "Evening Encounter" at Plean Country Park, organised by Countryside Rangers.

Series of ten Evening Lectures given in both the Autumn and Winter terms, through the hospitality of Stirling Highland Hotel.

Visits to the Observatory

Total number of visitors since November 2001: 580, compared with 438 the previous 12 months.

Open Doors Days (2) and an Open Doors Evening, organised by Stirling Council Environmental Services, attracted 184 visitors.

The Log Book records numerous visiting groups: Hotel guests particularly, Members of Alumni Programmes, Former Pupils and Staff of the High School of Stirling (on the 40th Anniversary of the School move to the new site), Round Tables from Bridge of Allan and Callander, and Alloa "41" Club.

Nationalities: All corners of Scotland, England (29 locations), and Ireland (2); Germany, Japan, Mexico, Netherlands, Singapore, Switzerland, USA, and "the far side of the Moon"!

Astronomical Societies of Stirling (regularly!), Falkirk, Glasgow, Edinburgh.

Bob Forest, custodian of the Brinton Telescope (our "twin) at the University of Hertfordshire.

Work on the Telescope (now 113 years old, and better than ever)

Emergency work on the hatch after a gale on 28 January.

Installation of an improved focussing mount, and of counterweights (still in progress).

Minimisation of interference from light pollution.

General maintenance.

Projected tasks for the Coming Session

Decision awaited regarding application for "Awards for All" Lottery grant, to facilitate the installation of CCD camera and display.

Re-aluminising of primary and secondary mirrors.

Motorising of the equatorial drive.

The Society's thanks are once again due to the Management of Stirling Highland Hotel, and to Stirling Council Educational Services.

Ken Mackay

SPACE TRAVEL CAN SERIOUSLY DAMAGE YOUR HEALTH

When astronauts return to earth after a spell of weightlessness, NASA plucks them out of the Space Shuttle and shields them so no-one else can see what state they are in. Many have been taken away in wheelchairs. Astronauts' health can be wrecked, at least temporarily, by long periods in space. Muscles shrivel, bones weaken, hearts strain and lungs struggle. While this is a problem with astronauts in orbit around the Earth, it presents a major obstacle to space travel further afield. NASA is planning to send six astronauts on a three-year mission to Mars in 2020 which will take them a year each way to travel and a year on Mars itself. There are of course many technical problems to overcome first, but the biggest problem is not the rocket or the space capsule needed, but the health of the astronauts in the weightlessness of the capsule for this length of time.

Humans are not designed for weightless conditions. Our bones and muscles evolved under the influence of Earth's gravity, and are kept in shape by continuously working against the force of gravity. Even with a regime of vigorous exercise, astronauts on the Mir space station lost 1-2% of their bone mass each month they were up there. With bones getting weaker all the time, the risk of breaking a limb on a mission to Mars has been calculated to be as high as 30%. How could this be coped with? It could certainly seriously prejudice the success of such a mission. Muscles waste away from lack of use and some, such as calve muscles, can lose up to 20% of their mass after prolonged weightlessness. Tendons and ligaments weaken and tear easily, and lung function suffers.

The effect on the heart is also very serious. Under normal gravity, blood tends to sink towards the feet, and there is a pressure gradient from the brain down to the feet. Under weightlessness there is no such pressure gradient and the body responds by making less blood. With less blood circulating, the heart does not pump as hard so its muscles are worked less and eventually start to atrophy, with potentially disastrous consequences.

What can be done about all this? New types of exercise regimes may help, but this cannot be the whole answer. A search is on for possible drugs to fight bone loss. These could involve the hormones and enzymes which the body normally uses in building healthy bones. Means of improving the blood supply are also needed. One device being developed is a cylinder worn around the bottom half of the body. The inside is kept under vacuum at low pressure and contains an exercise treadmill. It provides a substitute for body weight by applying negative pressure over the lower body. The machine should restore the blood pressure gradient, strengthen the heart and cut down on bone loss.

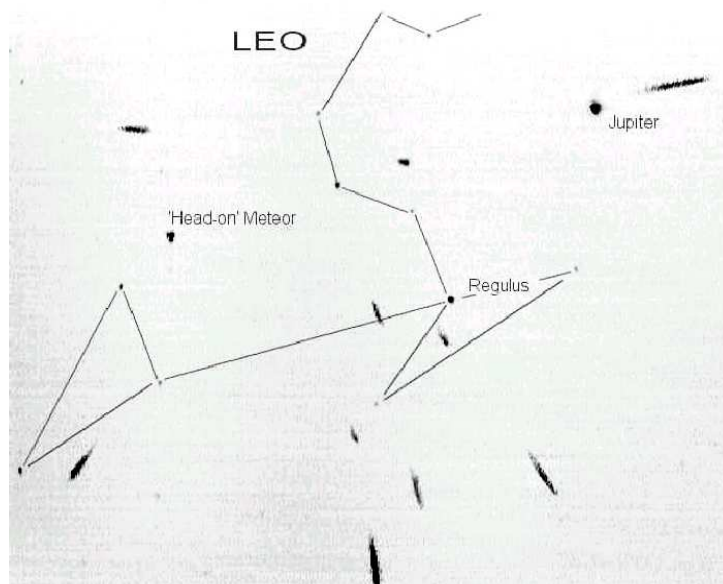
Returning from space to Earth for an astronaut's body which has got used to weightlessness is likewise a big problem yet to be solved satisfactorily. Bone recovery is the most serious aspect. After a six month space flight it can take up to three years to repair the damage, but bones may never be completely the same again.

A spin-off of the research on maintaining astronauts' health is likely to be a better understanding of many problems of old age and what can be done. Osteoporosis is similar to bone wasting under weightlessness, and the same applies to some heart conditions. So what's good for astronauts should be good for us as well!

Derek Allen

THE LEONID METEORS

Douglas Cooper was out with his video camera 17-18 November recording the Leonid meteor shower that night. His results were then processed by Chris Davis to grab frames where something was actually happening, and he then merged these into a single composite image. This negative shows several meteors which occurred over a period of time that night, as you can see. They are both to be congratulated on this excellent piece of work !



HISTORICAL NOTE

I came across a press cutting from October 1977, which may be of interest. It mentioned the successful launch of the two Voyager spacecraft just prior to the 20th anniversary of the launch of Sputnik 1. Both Voyagers were believed to be functioning well after some early problem with Voyager 2, which had been sent off first but would be overtaken by Voyager 1. They would both reach Jupiter in 1979 and Saturn in 1980 and 1981. At this time, the possibility of a further extension to the Voyager 2 mission by using Saturn's gravity to put it on course for Uranus and Neptune (arrival September 1989) was perceived as a dream of the mission controllers. The article finished with the words:- "Whether Voyager 2 will function successfully for the 12 years such a flight will take, must be questionable after its rather shaky beginning." Given that spaceflight had began only 20 years previously, this idea of a mission taking more than 12 years must rate as one of the best efforts of the Space Age, and our knowledge of the Solar System increased by leaps and bounds for every planet the Voyagers flew past.

Bert Mackenzie

STIRLING ASTRONOMICAL SOCIETY MEETINGS, 2003

10 January	Lecture Dr Marek Kukula	(Title to be confirmed)
31 January	Members' evening	
21 February	Lecture Dr Ian Percival	(Title to be confirmed)
28 February	Members' evening	
14 March	Lecture Dr Ian Bond	
	<i>Microensing searches for extra solar Planets</i>	
28 March	Members' evening	
11 April	Lecture	(Speaker and title to be confirmed)
25 April	Members' evening	
9 May	Lecture Dr Ross McLure	(Title to be confirmed)
30 May	Last members' evening	

All lectures (except on 21 February) are on the second Friday of the month at The Smith, Dumbarton Road, Stirling, from 7.30 to 9.30 pm.

All members' evenings are on the last Friday of the month at the Mayfield Centre, St. Ninians, Stirling, from 7.30 to 9.30 pm.

HMacP

AGM of the SCOTTISH ASTRONOMERS' GROUP - 2002

Against the backdrop of Scottish Astrofest the annual general meeting of SAG was held on the afternoon of Saturday 16th November at Wigtown Primary School, as guests of the Wigtownshire Astronomical Society. President Mark Pollock, who welcomed all those attending, chaired the meeting. First on the agenda was a report by Secretary Douglas Cooper, who highlighted that this had been a year of change for SAG, with changes in the committee and the introduction of an additional meeting to the annual calendar. The success of the meetings at Falkirk and Edinburgh, together with the wonderful autumn weekend at Dundee, made 2002 a year to remember, with grateful thanks to all who had organised and contributed.

Vice President Russell Cockman then presented the Treasurer's report on behalf of Brian Kelly, who had sent his apologies for not being able to attend. The report confirmed that the group's finances were healthy. Helen Macdonald, Secretary of the Wigtownshire group and key organiser of Astrofest, gave a summary of her society's activities, pointing out their advantage of having dark skies for observing. Helen also outlined exciting plans for a centre for Astronomy in the area. Next, Diane Cherry outlined the activities of the Association of Falkirk Astronomers, in particular the success of the weekend at Glen Lyon in October, where the weather this time had allowed lots of outdoor activities, even some observing, visual and radio! (For more on the latter, come to this year's May meeting of SAG at Ayr, where Bill Ward will explain all.)

The election of office bearers for 2003 ensued, with the existing committee being re-elected unopposed. A final vote of thanks was given for all who had contributed over the past year, with a special thanks to Walter Scott and to his wife Susan for the significant effort put into the continued production of SAG MAG as a quality publication.

Douglas Cooper

Stirling Astronomical Society

OFFICERS AND COMMITTEE FOR 2003

<i>President</i>	Dr Harry Stout
<i>Chairman</i>	Douglas Cooper
<i>Secretary</i>	Hamish MacPhee
<i>Treasurer</i>	Dr Iain Smith
<i>Director of Observations</i>	Dr Ken Mackay
<i>Membership Secretary</i>	Albert MacKenzie
<i>Librarian</i>	Maurice Dixon
<i>Committee Members</i>	Terry Aitchison Dr Alan Cayless John Clynes

EDITORIAL

Our thanks to the contributors to this issue. Please think about items or articles for next time.

Please send your contribution to (or first discuss it with) one of the Editors :

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Copy can be in clear handwriting, typescript, e-mail, or on floppy disk, preferably in rich text (.rtf) format, in that ascending order of preference for the work involved in editing. Contributions should usually be not more than about 750 words in length, or 1000 at the most. Please have material ready by the end of February for the next issue of *Mercury* due out the beginning of April 2003.

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THE NIGHT SKY : January, February, March 2003

SUN	January		February		March	
	12	26	9	23	9	23
(approx) Rises	08.39	08.21	07.54	07.22	06.47	06.11
(approx) Sets	16.09	16.35	17.05	17.36	18.05	18.34

MOON	January				February			
	NM	FQ	FM	LQ	NM	FQ	FM	LQ
Phase	NM	FQ	FM	LQ	NM	FQ	FM	LQ
Date	2	10	18	25	1	9	16	23
Rises	08.41	11.36	15.41	00.35	08.42	10.12	16.08	01.24
Sets	14.47	00.00	08.59	10.53	16.12	01.10	07.54	09.31

March				
Phase	NM	FQ	FM	LQ
Date	3	11	18	25
Rises	07.33	09.15	18.14	03.22
Sets	17.55	02.40	06.43	09.17

PLANETS

Magnitude

MERCURY	<i>January</i>	Unsuitable for observation	
	<i>February</i>	Unsuitable for observation	
	<i>March</i>	Unsuitable for observation	
VENUS	<i>January</i>	Visible for several hours before sunrise, SE sky	-4.4
	<i>February</i>	Visible before dawn. SE sky	-4.4
	<i>March</i>	Morning object. Viewing time diminishing through month. Low SE sky	-4.2
MARS	<i>January</i>	Early morning object. Moving east from Libra into Scorpius SE quadrant	+1.4
	<i>February</i>	Morning object. Moving from Scorpius into Sagittarius, SE sky	+1.5
	<i>March</i>	Before dawn. In Sagittarius near Antares low SE sky	+1.6
JUPITER	<i>January</i>	Visible low E sky by 20.00	-2.5
	<i>February</i>	Visible throughout hours of darkness. Low E sky in Cancer	-2.6
	<i>March</i>	Visible from early evening SE sky in Cancer near Praesepe	-2.4
SATURN	<i>January</i>	Evening object in Taurus with rings wide open. SW quadrant	-0.4
	<i>February</i>	Evening object. Retrograde until 22 then normal motion. SW quadrant	-0.1
	<i>March</i>	Evening object, W sky. Not visible after midnight by end of month.	0.0

CONSTELLATIONS (near meridian at 22.00)

1st January Draco (below pole), Ursa Minor (below pole), Camelopardus, Perseus, Auriga, Taurus, Orion, Eridanus, Lepdus

1st February Draco (below pole), Camelopardus, Auriga, Gemini, Orion, Canis Minor, Canis Major

1st March Cepheus (below pole), Lynx, Cancer, Canis Minor, Hydra

CONJUNCTIONS (with the moon unless otherwise stated and based on observing at 51°N)

January

<i>Date</i>	<i>Time</i>	
2	18.00	Mercury at stationary point
4	01.00	Mercury 5° N
4	03.00	Earth at perihelion (91.3 million miles),
11	02.00	Venus at greatest elongation,
11	20.00	Mercury in inferior conjunction
15	19.00	Saturn 3°S
19	17.00	Jupiter 4°S
23	01.00	Mercury at stationary point
27	15.00	Mars 0.4° N
28	18.00	Venus 4°N
30	11.00	Mercury 5° N
31	00.00	Neptune in conjunction

February

<i>Date</i>	<i>Time</i>	
2	09.00	Jupiter at opposition
12	02.00	Saturn 3° S
15	20.00	Jupiter 4° S
17	22.00	Uranus in conjunction
22	08.00	Saturn at stationary point
25	04.00	Mars 2° N
27	13.00	Venus 5° N

March

<i>Date</i>	<i>Time</i>	
1	17.00	Mercury 3°N
11	11.00	Saturn 3°S
15	02.00	Jupiter 4° S
25	18.00	Mars 3°N
29	14.00	Venus 4° N

METEORS

There are no major showers during this period, however it is possible that the Virginids in late march might produce some slow long-pathed meteors.

ZODIACAL LIGHT

February The evening cone may be observed stretching from the western horizon along the ecliptic from 18th onward after the end of twilight. Only visible if conditions are good in the absence of moonlight and artificial light.

March The evening cone might be observed from beginning of month to the 4th, then again after the 19th.

Compiled by Hamish MacPhee